

**West Virginia Wetland Rapid  
Assessment Method (WVWRAM)  
Appendices 5.5 – 5.7:  
ArcGIS Procedures and Python 2.7**

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Water Quality Standards and Assessment Section  
Division of Water and Wastewater Management  
WV Department of Environmental Protection

## Contents

5.5 ArcGIS Methods for Creating Input Layers.....	126
5.5.1 AlgalLakes .....	126
5.5.2 AlgalStreams .....	126
5.5.3 AMLAMD: Acid Mine Lands and Acid Mine Drainage.....	127
5.5.4 BRankHUC .....	127
5.5.5 BRankInput: Site Biodiversity Rank Input Layer .....	128
5.5.6 DisturbedLand: Disturbed Land Cover Layer.....	134
5.5.7 DNR_Fishing .....	137
5.5.8 eBirdHotspots.....	137
5.5.9 FirstSecondOrderFlowlines.....	138
5.5.10 FloodplainARAFEMA: Composite Floodplain Layer .....	139
5.5.11 Floodway: FEMA Floodway.....	145
5.5.12 Hpu: Hydrologic Protection Units.....	145
5.5.13 HUCWetlandSizeUniq: Wetland Size/Uniqueness by 12-digit HUC Layer .....	145
5.5.14 ILF_banks: In-Lieu Fee Mitigation Sites and Mitigation Banks Layer .....	154
5.5.15 IEIUMa2010v32: Index of Ecological Integrity U Mass Layer .....	155
5.5.16 ImpairedStreams.....	157
5.5.17 InfrastructureWetlands: Wetlands with Public Use Infrastructure Layer .....	158
5.5.18 Karst Composite Layer.....	160
5.5.19 NHD_WVStreams.....	161
5.5.20 NHDFlowline .....	161
5.5.21 NPDES .....	162
5.5.22 NPL_point and NPL_Bndry: National Priority List .....	163
5.5.23 NSPA: Wetland is in a Natural Streams Preservation Act Watershed Layer .....	163
5.5.24 NWIExports.gdb: NWI Exports Layer.....	165
5.5.25 PalustrinePlots .....	168
5.5.26 PasturesNotHayfields: Grazed NLCD Grasslands .....	169
5.5.27 Peatlands_20160228.....	169
5.5.28 PropertyBoundaries_WVDNR_20171011 .....	170

5.5.29 Public_surface_water_intakes .....	170
5.5.30 PublicLandBoundaries .....	171
5.5.31 Railway.....	171
5.5.32 RestoredWetlands.....	171
5.5.33 RunoffLand: Lands that Produce Runoff Layer.....	173
5.5.34 SDE_NHD_waterbodies_24k_rivers & 50_mi_drainage .....	176
5.5.35 Septic: Septic System Failure Risk Layer .....	177
5.5.36 SepticFailureRiskStatsgo: Septic Failure Risk from NRCS Statsgo Layer .....	181
5.5.37 SeweredAreas: Sewered Areas Layer .....	182
5.5.38 Slope.....	183
5.5.39 Ssurgo_wv.....	184
5.5.40 Ssurgo exports: Calcareous Soils and Karst Layer .....	184
5.5.41 SwimmingAreas: Swimming Areas Layer.....	185
5.5.42 TimberHarvest: Recent Timber Harvests Statewide Layer.....	187
5.5.43 TMDL: Wetland is in a Watershed with a TMDL Plan Layer.....	194
5.5.44 TotalLossRP100: Losses from 100-yr flood .....	195
5.5.45 Trails.....	196
5.5.46 Trout_Streams .....	196
5.5.47 Urbanized_areas .....	197
5.5.48 Watershed Plan: Watershed Plan Layer .....	197
5.5.49 Watersheds_12digit.....	198
5.5.50 Wellpads.....	199
5.5.51 WetlandBirds: Wetland Breeding Bird Occupancy Layer .....	199
5.5.52 Wb-rivers: Wide rivers.....	203
5.5.53 WV_Protected_Lands .....	204
5.5.54 WV_Transportation.....	204
5.6 ArcGIS Methods for Calculating Metrics .....	205
5.6.1 AllResults: Results of All GIS Metrics .....	205
5.6.2 AquaAbund: Aquatic Area Abundance.....	208
5.6.3 Brank: Site Biodiversity Rank of Wetland.....	213

5.6.4 BRankHUC: Watershed Biodiversity Rank .....	224
5.6.5 BufferContig: Contiguous 300m Buffer for Wildlife .....	228
5.6.6 BufferLand: Buffer and Landscape Integrity .....	232
5.6.7 BufferPerim: Wetland Perimeter with Natural Buffer .....	234
5.6.8 Chem Time: Time and space for Chemical Reactions to Occur .....	239
5.6.9 Clay: Clay near Surface.....	241
5.6.10 Clay Organic: Clay and Organic Soils .....	244
5.6.11 Connect FL: Connectivity to Historic Floodplain.....	246
5.6.12 ConsFocus: WVDNR Conservation Focus Areas with Wetland Focus .....	248
5.6.13 Creating Wetland Units from NWI Polygons .....	251
5.6.14 CSFunction: Carbon Sequestration .....	252
5.6.15 Depressions: Surface Depressions .....	254
5.6.16 Discharges: Discharges to wetland within 100 m of boundary.....	256
5.6.17 DrainageArea: Drainage Area of Wetland .....	260
5.6.17 Disturb50m: Land use disturbance within 50 meters of wetland boundary.....	262
5.6.18 DisturbWshd: Land use disturbance within contributing watershed .....	266
5.6.19 EconRisk: Economically Valuable Flood Risk Area Downstream of Wetland.....	268
5.6.20 FAFunction: Flood Attenuation .....	272
5.6.21 FAOpportun: Flood Attenuation Opportunity.....	274
5.6.22 FAPotential: Flood Attenuation Potential .....	276
5.6.23 FASociety: Flood Attenuation Value to Society .....	278
5.6.24 Fisheries: Wetland discharges to economically important fisheries .....	280
5.6.25 FloodArea: Proportion of wetland area in floodplain, including the intermediate variable FloodRatio, and Floodplain (Y/N) .....	283
5.6.26 FloodIn: Floodwaters Delivered to Wetland.....	286
5.6.27 Floodway: Wetland is in a FEMA Floodway.....	288
5.6.28 Function: Total Wetland Function .....	290
5.6.29 Headwater: Headwater Location.....	292
5.6.30 HFuncNoBR: Habitat and Ecological Integrity Function without Site Biodiversity Rank .....	294

5.6.31 HFunction: Habitat and Ecological Integrity Function .....	296
5.6.32 HInvest: Societal Investment in Habitat and Ecological Integrity .....	299
5.6.33 Histosol: Deep Organic Soils .....	305
5.6.34 HOpportunity: Habitat and Ecological Integrity Landscape Opportunity .....	310
5.6.35 HPotential: Habitat and Ecological Integrity Potential .....	312
5.6.36 HSociety: Value to Society of Habitat and Ecological Integrity .....	314
5.6.37 HUC12WQ: Water quality issues in HUC12 watershed .....	316
5.6.38 HUse: Public Use of Habitat and Ecological Integrity .....	319
5.6.39 HydIntact: Intactness of hydrologic regime .....	321
5.6.40 HydroH: Hydrologic regime for habitat.....	323
5.6.41 HydSW: Available Surface Water .....	325
5.6.42 ImpairedIn: Impaired waters impacting wetland .....	327
5.6.43 ImpairedOut: Wetland Discharges to Impaired Waters .....	331
5.6.44 IrrEdge: Irregularity of the Upland/Wetland Edge .....	334
5.6.45 Karst: limestone/dolomite bedrock or calcareous soil .....	338
5.6.46 LandEco: Landscape-level Ecological Connectivity .....	340
5.6.47 LandHydro: Landscape-level Hydrologic Connectivity .....	343
5.6.48 LandInteg: Landscape Integrity Index .....	345
5.6.49 LandPos: Landscape Position.....	357
5.6.50 LowSlope: Low Slope.....	363
5.6.51 MarlPEM: Emergent Wetland on Marl Deposits.....	365
5.6.52 Microtopo: Microtopographic Complexity .....	368
5.6.53 Organic: Organic Matter near Surface .....	370
5.6.54 OwnerAccess: Land Ownership and Accessibility .....	374
5.6.55 PublicUse: Public Use and Research .....	379
5.6.57 RoadRail: Road and Railroads .....	386
5.6.58 Runoff: Runoff and Storage Potential.....	388
5.6.59 Runoff50m: Lands producing runoff within 50 meters of wetland boundary .....	391
5.6.60 RunoffWshd: Runoff within contributing watershed.....	393
5.6.61 SeasonPond: Seasonal Ponding.....	395

5.6.62 Slope: Median Percent Slope .....	398
5.6.63 SlopeWshd: Mean Percent Slope of the Contributing Watershed .....	402
5.6.64 SoilH: Hydrologic regime for soil.....	405
5.6.65 SoilIntact: Lack of Soil Disturbance or Compaction .....	407
5.6.66 SoilOrgCalc: Special soil types, i.e., organic or calcareous soil .....	408
5.6.67 SoilRunoff: Soil Runoff and Infiltration Potential.....	410
5.6.68 StreamEdge: Complexity of wetland/stream interface.....	412
5.6.69 StrucPatch: Structural Patch Richness .....	416
5.6.70 SWoutflow, SWOutflow2: Surface Water Outflows .....	419
5.6.71 TMDL: Wetland is in a watershed with a TMDL plan .....	421
5.6.73 VegAll: All Vegetation Types.....	422
5.6.74 VegByLP: Vegetation fringing open water.....	424
5.6.75 VegFA: Vegetation .....	431
5.6.76 VegFQ: Vegetation Floristic Quality .....	434
5.6.77 VegH: Vegetation Structure and Quality .....	440
5.6.78 VegHorInt: Horizontal Interspersion .....	442
5.6.79 VegPerUng, VegPerUng4, VegPerUng1: Persistent ungrazed vegetation .....	444
5.6.80 VegVerStr: Vegetation Vertical Structure .....	450
5.6.81 VegWoody: Woody Vegetation .....	454
5.6.82 VegWQ: Vegetation.....	459
5.6.83 WaterSupply: Wetland discharges to water supply intake area .....	461
5.6.84 Wetland Units: Assigning Site Codes to updated statewide Wetland Units .....	466
5.6.85 WetldBird: Wetland Breeding Bird Areas .....	468
5.6.86 WFlowPath: Water Flow Path.....	472
5.6.87 WQFunction: Water Quality .....	481
5.6.88 WQOpportun: Water Quality Opportunity .....	483
5.6.89 WQPlan : Watershed or Water Quality Plan Exists.....	485
5.6.90 WQPotential: Water Quality Potential.....	488
5.6.91 WQSociety: Water Quality Value to Society.....	491
5.6.92 WQUse: Water quality used by public.....	494

5.6.93 WshdPos: Watershed Position, headwaters, major river floodplains, and karst .....	497
5.6.94 WshdUniq: Watershed Wetland Size and Uniqueness .....	500
5.7 Python 2.7 Code .....	503
5.7.1 Flood Attenuation Function .....	503
5.7.2 Flood Attenuation Opportunity .....	506
5.7.3 Flood Attenuation Opportunity Aspects .....	508
5.7.4 ConnectFL: Flood Attenuation Opportunity .....	511
5.7.5 FloodIn: Flood Attenuation Opportunity .....	513
5.7.6 FloodArea: Flood Attenuation Opportunity .....	517
5.7.7 Runoff50: Flood Attenuation Opportunity .....	520
5.7.8 RunoffWshd: Flood Attenuation Opportunity .....	523
5.7.9 SlopeWshd: Flood Attenuation Opportunity .....	526
5.7.10 StreamEdge: Flood Attenuation Opportunity .....	533
5.7.11 Flood Attenuation Potential .....	538
5.7.12 Flood Attenuation Potential Aspects .....	540
5.7.13 Runoff: Flood Attenuation Potential .....	544
5.7.14 VegFA: Flood Attenuation Potential .....	548
5.7.15 VegAll: Flood Attenuation Potential .....	554
5.7.16 VegPerUng: Flood Attenuation Potential .....	557
5.7.17 VegWoody: Flood Attenuation Potential .....	562
5.7.18 Flood Attenuation Society .....	567
5.7.19 Flood Attenuation Society Aspects .....	568
5.7.20 EconRisk: Flood Attenuation Society .....	570
5.7.21 Floodway: Flood Attenuation Society .....	573
5.7.22 Globalvars .....	575
5.7.23 Habitat and Ecological Integrity .....	587
5.7.24 BRank: Habitat and Ecological Integrity Function .....	593
5.7.25 HFuncNoBR: Habitat and Ecological Integrity Function .....	603
5.7.26 HFunction: Habitat and Ecological Integrity Function .....	605
5.7.27 HOpportun: Habitat and Ecological Integrity .....	609

5.7.28 HOpportun: Habitat and Ecological Integrity Aspects .....	611
5.7.29 BufferLand: Habitat and Ecological Integrity Opportunity .....	613
5.7.30 LandEco: Habitat and Ecological Integrity Opportunity .....	616
5.7.31 LandHydro: Habitat and Ecological Integrity Opportunity .....	620
5.7.32 AquaAbund: Habitat and Ecological Integrity Opportunity .....	622
5.7.33 BRankHUC: Habitat and Ecological Integrity Opportunity .....	629
5.7.34 BufferContig: Habitat and Ecological Integrity Opportunity .....	633
5.7.35 BufferPerim: Habitat and Ecological Integrity Opportunity .....	639
5.7.36 ConsFocus: Habitat and Ecological Integrity Opportunity .....	645
5.7.37 Karst: Habitat and Ecological Integrity Opportunity .....	648
5.7.38 LandInteg: Habitat and Ecological Integrity Opportunity .....	652
5.7.39 WetldBird: Habitat and Ecological Integrity Opportunity .....	667
5.7.40 WshdPos: Habitat and Ecological Integrity Opportunity .....	672
5.7.41 WshdUniq: Habitat and Ecological Integrity Opportunity .....	677
5.7.42 Habitat and Ecological Integrity Potential .....	680
5.7.43 HPotential: Habitat and Ecological Integrity Potential Aspects .....	682
5.7.44 HydroH: Habitat and Ecological Integrity Potential .....	685
5.7.45 SoilH: Habitat and Ecological Integrity Potential .....	687
5.7.46 VegH: Habitat and Ecological Integrity Potential .....	690
5.7.47 Histosol: Habitat and Ecological Integrity Potential .....	693
5.7.48 HydIntact: Habitat and Ecological Integrity Potential .....	698
5.7.49 HydSW: Habitat and Ecological Integrity Potential .....	701
5.7.50 Karst: Habitat and Ecological Integrity Potential .....	704
5.7.51 MarlPEM: Habitat and Ecological Integrity Potential .....	708
5.7.52 SoilIntact: Habitat and Ecological Integrity Potential .....	713
5.7.53 SoilOrgCalc: Habitat and Ecological Integrity Potential .....	715
5.7.54 StrucPatch: Habitat and Ecological Integrity Potential .....	717
5.7.55 VegFQ: Habitat and Ecological Integrity Potential .....	721
5.7.56 VegHorInt: Habitat and Ecological Integrity Potential .....	729
5.7.57 VegVerStr: Habitat and Ecological Integrity Potential .....	731



5.7.58 Habitat and Ecological Integrity Society .....	734
5.7.59 Habitat and Ecological Integrity Society Aspects.....	735
5.7.60 Hinvest: Habitat and Ecological Integrity Society .....	737
5.7.61 HUse: Habitat and Ecological Integrity Society .....	742
5.7.62 OwnerAccess: Habitat and Ecological Integrity Society .....	744
5.7.63 PublicUse: Habitat and Ecological Integrity Society .....	749
5.7.64 Actions: Utilities .....	754
5.7.65 ActiveRiverArea: Utilities.....	757
5.7.66 AllResults: Utilities .....	761
5.7.67 CalcFunction: Utilities .....	770
5.7.68 CreateBasicGeom: Utilities.....	776
5.7.69 CreateWetlandUnits: Utilities .....	779
5.7.70 DrainageArea: Utilities .....	782
5.7.71 FloodArea: Utilities.....	786
5.7.72 Floodplain: Utilities.....	791
5.7.73 InitRequest: Utilities .....	794
5.7.74 Water Quality .....	799
5.7.75 Water Quality Function.....	803
5.7.76 Water Quality Opportunity.....	808
5.7.77 Water Quality Opportunity Aspects.....	810
5.7.78 Discharges: Water Quality Opportunity.....	818
5.7.79 Distrub50: Water Quality Opportunity .....	823
5.7.80 DistubWshd: Water Quality Opportunity .....	828
5.7.81 ImpairedIn: Water Quality Opportunity.....	832
5.7.82 RoadRail: Water Quality Opportunity .....	838
5.7.83 Water Quality Potential.....	840
5.7.84 Water Quality Potential Aspects .....	843
5.7.85 ChemTime: Water Quality Potential.....	850
5.7.86 ClayOrganic: Water Quality Potential .....	856
5.7.87 Depressions: Water Quality Potential .....	862

5.7.89 Headwater: Water Quality Potential .....	868
5.7.90 SWoutflow: Water Quality Potential .....	871
5.7.91 VegWQ: Water Quality Potential .....	875
5.7.92 Clay: Water Quality Potential .....	881
5.7.93 IrrEdge: Water Quality Potential.....	884
5.7.94 LandPos: Water Quality Potential.....	890
5.7.95 Lowslope: Water Quality Potential .....	896
5.7.96 Microtopo: Water Quality Potential.....	899
5.7.97 Organic: Water Quality Potential.....	903
5.7.98 SeasonPond: Water Quality Potential .....	907
5.7.99 Slope: Water Quality Potential.....	912
5.7.100 VegByLP: Water Quality Potential.....	915
5.7.101 VegPerUng: Water Quality Potential.....	926
5.7.102 VegWoody: Water Quality Potential .....	934
5.7.103 WFlowPath: Water Quality Potential.....	942
5.7.104 Water Quality Society .....	953
5.7.105 Water Quality Society Aspects .....	955
5.7.106 Huc12WQ: Water Quality Society.....	961
5.7.107 ImpairedOut: Water Quality Society.....	965
5.7.108 WQPlan: Water Quality Society .....	969
5.7.109 WQuse: Water Quality Society .....	972
5.7.110 Fisheries: Water Quality Society.....	977
5.7.111 WaterSupply: Water Quality Society.....	980
5.7.112 Wetland Functional Assessment Tool Launch Script .....	990

## 5.5 ArcGIS Methods for Creating Input Layers

The following sections described the source data and methods to create the GIS input layers used in the West Virginia Wetland Rapid Assessment Method. Layers should be updated based on the schedule in section 5.4 of the WVWRAM Reference Manual. The typical steps to update a layer are:

- read the description in this section for layer-specific information,
- locate/acquire the source data and place it in the SourceAsReceived folder,
- clean up, filter, or compile the source data as needed,
- create the updated layer,
- give the new layer the name that is used in the GlobalVars file, or if that is not possible/practical then update the GlobalVars file to show the new name,
- in the SourceFunctionalAssessment folder, append the version date to the old layer and replace it with the new layer,
- package the new layer for WV GISTC, either as a zipped shapefile or in a geodatabase,
- send the packaged layer to WV GISTC, along with any changes to GlobalVars and any changes to metrics.

### 5.5.1 AlgalLakes

Version date: November 2018

Previous version(s): March 2016

Location: M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WaterQualityDatasets.gdb

Purpose: Input to HUC12WQ (Water Quality Function and Value to Society), ImpairedIn & ImpairedOut (Water Quality Function)

Description: Algae-impacted Public Fishing Lakes. Public fishing lakes that are chronically impaired or impacted by algal blooms. This is a geometry-only layer.

Source Data: This layer is a subset of the WVDNR Public Fishing Lakes, as identified by Brandon Keplinger, James Summers and John Wirts in March 2016. Updated by Jack Hopkins in November 2018. In 2018, there were 29 records in this dataset.

### 5.5.2 AlgalStreams

Version date: March 2016

Location: M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WaterQualityDatasets.gdb

Purpose: Input to HUC12WQ (Water Quality Function and Value to Society), ImpairedIn & ImpairedOut (Water Quality Function)

Description: This layer spatially depicts streams that are chronically impaired or impacted (i.e., affected by algae but not seriously enough for inclusion on the impaired list) by algal blooms in West Virginia.

Source Data: These data are a small subset of the National Hydrography Dataset, including streams that are considered chronically impaired or impacted, based on best professional judgement of field evaluators James Summers and Jamie Peterson at WVDEP. The dataset was created by Elizabeth Byers on February 9, 2016 in preparation for use in statewide wetland functional assessment. The NHD data source used was WVDEP M:/basemap/NHDH\_WV.

### 5.5.3 AMLAMD: Acid Mine Lands and Acid Mine Drainage

Version date: 14 March 2023

Purpose: Water Quality Function: Input to Discharges / Water quality / WQ Opportunity

Location: WETLAND\SourceFunctionalAssessment\AMLAMD

Description: This layer is a compilation of acid mine seep locations as field-verified by WVDEP's Watershed Assessment Branch (James Summers from 2013-2023). James Summers provided multiple shapefiles that were copied into a single shapefile, with attributes then stripped to save computing space. This is a presence/absence input to WVWRAM.

### 5.5.4 BRankHUC

Version date: 2/26/2024

Previous version(s): 10/6/2017

Input to: BRankHUC metric

Input from BRankHUC needed: polygon geometry (wall-to-wall) and BRank attribute

Location:

M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceAsReceived\BRank\BRankHUC

Source: In 2024, this layer was prepared by Meryl Friedrich at WVDNR in cooperation with Elizabeth Byers. In the future, WVDNR's GIS office will prepare the layer for use in the WVWRAM GIS Tool. The next scheduled update will be in 2034 when the next State Wildlife Action Plan is written; however, it is worth checking around 2029 just in case there are interim updates. This layer can be updated by WVDNR using the BRank R code written by Meryl Friedrich whenever BRankInput is updated. BRankHUC uses all of the species, not just the wetland species, to rank watersheds in terms of their overall biodiversity.

Description: HUC12 watersheds attributed with BBranks. Both the geometry and the attribute "BBrank" are used to calculate the metric BBrankHUC. All species, not just wetland species, are used to calculate the Branks of the HUC12 watersheds.

### 5.5.5 BRankInput: Site Biodiversity Rank Input Layer

Version date: 2/29/2024

In 2024, this layer was prepared by Meryl Friedrich, GIS analyst at WVDNR, in cooperation with Elizabeth Byers. In the future, updates should be requested from WVDNR's GIS team. The next scheduled update will be in 2034 when the next State Wildlife Action Plan is written; however, it is worth checking around 2029 just in case there are interim updates. When requesting this layer from WVDNR, specify that it should only contain wetland species, i.e. species that are either dependent on wetlands or that use wetlands for any part of their life cycle, such that wetland conservation would significantly benefit the species. The method below has been coded into R by WVDNR.

Previous version(s): 5 November 2017

Strategy: 3/16/2017 EAB

GIS method: 11/5/2017 Elizabeth Byers

Python code: N/A

Location: WETLAND\SourceFunctionalAssessment\HabitatData.gdb\BRankInput

Purpose: Habitat Function: Input to Site Biodiversity Rank Adjustment (Brank)

Description:

This layer is derived from sensitive WVDNR data on rare, threatened, or endangered species, high quality natural communities, and species in greatest need of conservation statewide. The layer includes spatial occurrence data attributed with unique taxa identifiers, Conservation Status Rank at the state (SRank) and global (GRank) level, and Occurrence Quality Ranks (OQRank).

The strategy to create this layer is to:

- Combine the SGCN data with the Biotics EO's, being sure to retain the Elcode, TaxonName, Grank, Sranks, OQRank, and TaxGroup.
- QC the Elcode and Ranks for correct updated values.
- Round the ranks using the rounding rules for Site Biodiversity Rank.
- Delete records that have large spatial uncertainty, that are historic (last observation date before 1980), that are extirpated, and records with any other problems in their data quality.
- Add fields for Disjunct occurrences and for species/community differentiation.
- Export and add random ID tied to Elcode. Delete all fields with taxonomic information except whether a record is a species or a community occurrence.

Source Data:

Note that the first three datasets below are sensitive and maintained by WVDNR. Processing of these data must be done by authorized WVDNR staff or their designees. Data may not be shared without explicit permission from WVDNR.

- Elements Occurrence Data
  - SGCN\_EOS2016
  - EO\_SHAPE\_Statewide\_2017\_10\_10
- Element Ranking Data
  - Communities: PlotData\_20171004.mdb (Table: WV Associations 2014)
  - Plants: TrackedPlantsHandout\_10Mar2017.doc
  - Animals: WVNHP\_RTE\_Animals with ranks\_2016Nov.pdf (public data from WVDNR website)

Method:

## **STEP 1: COMPILE DATA**

### **Fields of Interest**

#### **SGCN fields    EO\_SHAPE fields**

Elcode	ELCODE
TaxonName	SNAME
Srank	S_RANK
Grank	G_RANK
OQrank	BASIC_EO_R
TaxGroup	NAME_CAT_1
	LAST_OBS_D (last observation date)
	EST_REP_AC (estimated representational accuracy)
	“EO rank comment” (not sure what this is called in Biotics)

plus spatial fields Shape, OBJECTID, Shape\_Length, Shape\_Area

**Export SGCN\_EOS2016 and EO\_SHAPE\_Statewide\_2017\_10\_10 to create working copies  
SGCN and EO\_SHAPE**

**In SGCN, delete the old Biotics records prior to importing the new ones**

"Dataset" = 'EO\_SHAPE\_2017\_01\_04'

**Add fields to SGCN in preparation for import**

LAST\_OBS\_D (text, length = 50)

EST\_REP\_AC (text, length= 30)

**In EO\_SHAPE, add the fields of interest with the SGCN names shown above and field  
calculate to populate them.**

Elcode (text, 254) = ELCODE

TaxonName (text, 254) = SNAME

Srank (text, 254) = S\_RANK

Grank (text, 254) = G\_RANK

OQrank (text, 254) = BASIC\_EO\_R (when field calculating, populate this with letter codes, not strings)

TaxGroup (text, 254) = NAME\_CAT\_1

## Load data from EO\_SHAPE into SGCN

### STEP 2: ADD RANKS AND QC DATA

#### **Notes on interpreting ranks for the purpose of assigning biodiversity significance ratings to sites:**

- Elements with range ranks spanning two levels (e.g., G2G3) should be treated as if they had the higher (e.g., G2) rank;
- Elements with range ranks spanning three levels (e.g., G3G5) should be treated as the middle rank (e.g., G4);
- Elements with ranks such as G3? should be treated as if there were no question marks;
- Elements with a GU or G? rank should be treated as if they were G4;
- Elements with “Q”s attached to their global ranks (i.e., questionable taxa) should be treated at the next lower G rank (e.g., treat a G3Q as if it was a G4); however, this is open to the discretion of the senior Natural Heritage scientist and is dependent upon the rationale for the “Q” qualifier. For example, if there is taxonomic uncertainty as to whether a G5T1Q subspecies should be elevated to species status, the Q “penalty” should not be applied.
- Subspecies (elements with T-ranks): The rationale behind this process is accounting for the relative size of a subspecies’ distribution to its overall species distribution.
  - If the T-rank is 3 or 4 units away from its G-rank (e.g., G5T1, G5T2, G4T1), treat the functional Grank as one unit lower than the T-rank (e.g., G5T1 = G2; G5T2 = G3).
  - If the T-rank is <3 units away from its G-rank (e.g., G4T3, G5T3), treat the functional G-rank as the T-rank (e.g., G4T2 = G2, G5T4 = G4).
- Element Occurrences with range ranks (e.g., AB) should be treated as if they were ranked at the lower of the two levels (e.g., B);
- Element Occurrences that are not yet ranked should be treated as if they were C-ranked.

#### **Table Cleanup**

- Populate empty fields as needed
  - blank OQrank = C
  - add missing Elcodes
- I made one change: Biotics record “Undefined Wetlands” (6) at Willis Ridge were renamed to “Summit Sinkhole” and given Elcode = CEWVSumSin and Ranks = S1 G5.
- Update all ranks against updated RTE lists from DNR. There are three RTE lists: animals, plants, communities.

- Combine the three lists into one Excel table, load to ArcGIS and Join on Elcode; export.
  - If the ranking lists do not have the Elcode, you can join on TaxonName to add most of the Elcodes to the ranking table, then populate the non-matches in the ranking table by hand. The final ranking table can be joined to the SGCN layer.
- Round the SRanks and GRanks using the rounding rules, i.e., final SRanks are S1, S2, S3, S4, S5
- Round the OQranks using the rounding rules, i.e., A, B, C, D
- Some SGCN are not currently tracked by WVNHP. Assign these S4 & S5 species a rank of S3 for purposes of analysis. Do not change their GRank. Select "Elcode" NOT LIKE 'CE%' AND( "Srank" = 'S4' OR "Srank" = 'S5' )
- Check for hidden characters in Elcodes, which will disrupt calculations. There are lots in the snail records – invisible until you try to work with the data. Create a new field Elcode10 (text, 10 characters allowed) and Field Calculate = [Elcode]. The fields with hidden characters will be truncated and marked with an asterisk. Note that some of the longer non-standard Elcode fields will be starred also – these should be changed to 10-character Elcodes.
- Check for unique relationships: Every Elcode should have exactly one TaxonName, and the inverse should also be true. Also, every Elcode should have only one SRank. There are lots of problems in the birds (common names mixed in – I did not fix all of these) and snails (mishmash of new and old Elcodes and SRanks). Here’s a quick way to find the problems (do this for Elcode | TaxonName, TaxonName| Elcode, and Elcode | SRank):

First compute a field that concatenates **Elcode** and **TaxonName**. A delimiter, "|", is optionally added.

Elcode	TaxonName	Concatenate
PGPIN01020	Abies balsamea	PGPIN01020 Abies balsamea

R-Click the **Concatenate** field and Select “Summarize”, retaining the first occurrence of Elcode:

Concatenate	Elcode	Count
PGPIN01020 Abies balsamea	PGPIN01020	15

On this new table, R-click **Elcode** and select “Summarize”. In the table that is generated, sort the “Count” field in descending order. All of the Elcodes should have a count of “1”. If any have a count higher than “1”, then there are two taxon names for that Elcode.

Elcode	Count
PGPIN01020	1

*Based on method at: <https://gis.stackexchange.com/questions/71452/how-to-count-occurrences-of-one-field-grouped-by-values-of-another>*

**Save this cleaned file, then export to another file for deleting records.**

### **STEP 3: DELETE OLD OR UNCERTAIN RECORDS**



## **Multipart to Singlepart: explode multipart features so that you don't mistakenly delete a small accurate source feature that is linked to a large low-res source feature.**

### **Delete historic records and records with approximate locations**

- Delete historic, failed to find, extirpated, or "unrankable" occurrences: "OQrank" IN ( 'F', 'F?', 'H', 'H?', 'X', 'X?', 'U')
- Delete records with LAST\_OBS\_D before 1980
- Delete records with last observation date prior to a known year that have low, very low or null representational accuracy: ("LAST\_OBS\_D" LIKE '%pre%' OR "LAST\_OBS\_D" LIKE '%PRE%' OR "LAST\_OBS\_D" LIKE '%Pre%') AND "EST\_REP\_AC" NOT IN ('Very High', 'High', 'Medium') (78 records)
- Delete records that have large spatial uncertainty, i.e., circular features with a radius of more than a kilometer, or non-circular features with a similar area (> 3,150,000 m<sup>2</sup>)
  - Select "Shape\_Area" > 40000000 and delete these 54 highly uncertain locational records.
  - Select "Shape\_Area" > 3150000 (780 records). Delete these unless they are a wetland species that overlies a single wetland or a nearly contiguous wetland complex (I did not see any obvious ones).

## **STEP 4: ADD FIELDS NEEDED TO CALCULATE SITE BIODIVERSITY RANK**

### **Add fields needed to calculate Site Biodiversity Rank**

- SpecComm (text, length = 2): S = species, C = natural community
- Flag (text, length = 20). Ideally this field will come from the "EO rank comment" in Biotics. I consulted with WVNHP to populate it. It is currently not complete but good enough to use, with many of the plant and community disjuncts identified. In the process, we identified a few other elements with Granks in need of revision: flatrock riverscour = G1, summit sinkhole = G3, Meadow River oak-ash swamp = G1.
  - OnlyRange: only known occurrence of an element rangewide
  - BestState: best available occurrence in state (for G1, G2, S1 elements)
  - Best5Range: among 5 best occurrences rangewide (for G3 elements)
  - Best5Ecoregion: among 5 best community occurrences in an ecoregion (for G4-G5 communities)
  - Disjunct: disjunct occurrence
  - OnlyState (or EOCount = 1): only known occurrence in state
- EO\_Count (short integer): count of Elcode10 (summarize field and join output table on Elcode10)
- Wetland (short integer): to calculate B-ranks for wetland sites, add this modifier.
  - 0 = Exclude from analysis: element would not occur in a wetland, i.e., taxon would not include wetlands in any part of its habitat, foraging area, or life cycle; vegetation community would not be a wetland nor typically contain wetland inclusions below minimum mapping size.
  - 1 = Include in analysis: element could occur in a wetland.
  - *Note that screening has been done for plants, communities, fish, snails, cave invertebrates, and mussels as of 11/03/2017. Other invertebrates and vertebrates have not yet been screened. Wide ranging species including mammals and birds probably do not need to be screened.*

## **STEP 5: ENCRYPT SENSITIVE FIELDS**

**Encrypt the data so that no taxa are identifiable**

**Export all records to another file, e.g., SGCN\_trimmed\_randomID**

**Generate random number ID**

Summarize Elcode10 to determine the number of unique Elcodes. Export this table to Excel and generate unique random numbers: =RANDBETWEEN (1,9999). Fill about 4000 rows with random numbers, then filter for unique values. Paste the values next to the Elcodes. Re-load the table back to ArcGIS and Join on Elcode10.

**Attribute table has the following fields, which will be used to create Site Biodiversity**

**Ranks:**

RandID: Randomly assigned unique element identification number

Strank: State Conservation Status Rank (S1-S5)

Grank: Global Conservation Status Rank (G1-G5)

OQrank: Occurrence Quality Rank (A-D)

SpecComm: S = species, C = natural community

Flag: Disjunct = disjunct, BestRange = among 5 best occurrences rangewide, OnlyRange = only known occurrence rangewide

EO\_Count: count of the number of times each Elcode10 occurs in the dataset.

**The rest of the fields can be deleted, creating an encrypted version of the data.**

**Export the resulting feature class and name it “BRankInputAll”.**

**Select only the wetland elements (Wetland = 1) and re-export data with filename “BRankInput”.**

## 5.5.6 DisturbedLand: Disturbed Land Cover Layer

Version date: 4 March 2024

Pervious version(s): 8 March 2017

Strategy: completed 4/6/2016 EAB

GIS method: 4/8/2016 EAB; verified 4/18/2016 EAB; revised 3/8/2017 to remove Godzilla polygons; revised 2/15/2024 EAB for layer update; revised 3/4/2024 SJM to remove Godzilla polygons

Python coding: not needed

Final verification: 4/18/2016 EAB; 3/8/2017 EAB; 3/4/2024

Update schedule: every 5 years

Purpose:

Water Quality Function / Opportunity aspect / LandUse50m & LandUseWshd factors

Description:

Rationale: Farming, grazing, golf courses, residential areas, commercial land uses, urban areas, and developed areas in general, are major sources of pollutants (Sheldon et al. 2005). Tilled fields are a source of nutrients, pesticides, and sediment. Pastures are a source of nutrients and pathogenic bacteria, and clearcut areas are a source of sediment (Sheldon et al. 2005).

Summary of strategy: Vectorize NLCD and export disturbed land cover classes. Union with recent timber harvests, urbanized areas, and grazed pastures. For this layer, NLCD disturbed land cover classes are defined as

- 21 Developed, open space
- 22 Developed, low intensity
- 23 Developed, medium intensity
- 24 Developed, high intensity
- 31 Barren land, non-natural
- 81 Pasture/hay
- 82 Cultivated crops

Source Data:

- M:\basemap\landcover\_grids\ Raster: landcover\_2021\_NLCD.img
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WaterQualityDatasets.gdb
  - Feature Class: PasturesNotHayfields (updated 2023)
  - Feature Class: TimberHarvest (updated 2024)
- M:\LayerFiles\arcsde\_backup.gdb
  - Feature Dataset: tiger2010      Feature Class: urbanized\_areas (no updates available in 2024)

Output:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WaterQualityDatasets.gdb

- Feature Class: DisturbedLand

Method:

### **## Vectorize NLCD pixels**

Conversion tools / From Raster / Raster to Polygon

Field: Value

Input: landcover\_2021\_NLCD.img

Output Feature Class: NLCDpolys

*Note that I had to turn off Geoprocessing/Background processing for this to work. It takes some time to run. Results contained 7102272 records in 2024)*

### **## Select disturbed land cover types from NLCD.**

Select by attributes.

Method: Create a new selection.

SELECT \* FROM NLCDpolys WHERE: "grid\_code" IN (21, 22, 23, 24, 31, 81, 82)  
(4000689 out of 7102272 selected in 2024; 2072074 out of 3540450 selected in 2017)

### **## Export disturbed land cover types.**

R-click NLCDpolys / Data / Export Data

Export: Selected features

Output feature class: DisturbedNLCD\_export  
(4000689 records)

### **## Clip the layer to the state boundary**

ArcToolbox / Analysis Tools / Extract / Clip

Input feature: DisturbedNLCD\_export

Output: DisturbedNLCD\_clip

*(Note that this took 14 minutes of processing time in 2024)*  
(1547795 records)

### **## Dissolve layer to reduce file size and avoid Godzilla polygons.**

ArcToolbox / Data Management Tools / Generalization / Dissolve

Input feature: DisturbedNLCD\_clip

Do not create multipart features

Output: DisturbedNLCD  
(316229 records)

### **## Union disturbed land use selections.**

*## Note that with ArcEditor license, Union can only accept two layers at a time. The unions take  
## some time to process. Dissolve each intermediate layer prior to Union-ing.*

ArcToolbox/Analysis Tools/Overlay/Union

Input Features: urbanized\_areas, PasturesNotHayfields, TimberHarvest, DisturbedNLCD

Output Feature Class: DisturbedLand in WaterQualityDatasets.gdb

Join Attributes: ONLY\_FID

Check box “Gaps Allowed” (default)

Output: DisturbedLand\_union

**## Dissolve DisturbedLand to reduce file size and processing time.**

ArcToolbox / Data Management Tools / Generalization / Dissolve

Input feature: DisturbedLand\_union

Do not create multipart features

Output: DisturbedLand\_dissolve

(274560 records)

**## Clip the layer to the state boundary**

ArcToolbox / Analysis Tools / Extract / Clip

Input feature: DisturbedLand\_dissolve

Output: DisturbedLand\_clip

(274500 records)

**## Check the layer for Godzilla polygons with more than 100,000 vertices**

Add Field VertexCount, as a Long Integer

Field Calculate VertexCount: !shape!.pointcount

Be sure to select the Python code (not VB Script) at the top of the Field Calculator popup

Cut or Dice Godzilla polygons to decrease number of vertices (there were about 6 in 2024)

## Check geometry to be sure there aren't any errors

(274531 records)

### 5.5.7 DNR\_Fishing

Version: October 2017

Input to: Water Quality Function / Fisheries, HUC12WQ, ImpairedIn, ImpairedOut, and Habitat Function / Public Use

Location on DEP server: WETLAND\SourceAsReceived\DNR\_Fishing\

- HighQualityStreamFisheriesWVDNR20150820.shp (geometry only)
- TrStStreams.shp (attributes used in Fisheries metric calculations)
- PublicFishingLakesWVDNR20150820.shp (attributes used in HUC12WQ and ImpairedIn)
- PublicFishingAccessSites\_2017\_10.shp (geometry only)

Description: WVDNR layers (request from WVDNR GIS team) showing high quality stream fisheries, trout streams, public fishing lakes, and public fishing access points.

### 5.5.8 eBirdHotspots

Version date: 3/5/2024

Previous version(s): 10/11/2017

Input to: Public Use Metric (point geometry only, no attributes needed)

Location on DEP server:

WETLAND\SourceFunctionalAssessment\HabitatData.gdb\eBirdHotspots

Description: Birding hotspots as identified by eBird, filtered to include only those hotspots that have a significant number of species recorded. In 2024, we set the threshold at 35 species or more based on the best professional judgement of Sara Miller with Kylie Joins and Elizabeth Byers. In 2024, we also noted that all of the hotspots identified in the 2009 *Birding Guide to West Virginia*, by Greg Eddy are included in the ebird hotspots, so we don't need to add these separately.

Source: After creating/logging in to an eBird account, eBird hotspots for West Virginia were downloaded in 2024 as a csv file by:

Clicking on the Science tab on the eBird homepage (<https://ebird.org/home>), proceeding on to the eBird Data and Tools link, and clicking on Download Raw Data Here. Once there, select the API and Request Access (<https://ebird.org/data/request>). Submitting the request will automatically generate a key (Example: cpbsopfrbmjg). Add the key to the end of the following URL to get the HotSpots data download: [https://api.ebird.org/v2/ref/hotspot/US-WV?fmt=csv&key=\[INSERTKEYHERE\]](https://api.ebird.org/v2/ref/hotspot/US-WV?fmt=csv&key=[INSERTKEYHERE]). Following this link paired with the key will automatically download the data.

The 2024 link may be used to access the data in the future (<https://api.ebird.org/v2/ref/hotspot/US-WV?fmt=csv&key=cpbsopfrbmjg>). A download using this link can be compared to the 2024 data to ensure that the data has been updated.

The csv file should be filtered so that only those “hotspots” with a significant number of species (35 in 2024) are included. Then the csv file needs to be converted to a shapefile. Export to SourceFunctionalAssessment\HabitatData.gdb and create a zipped shapefile to send to WV GISTC.

Notes from 2017. Birding Hotspot (Brooks Bird Club, WVDNR, Audubon, and citizen birding organization hotspot lists for WV). Initial list combines eBird download of birding hotspots and main wetland sites from Eddy 2009. eBird hotspots were downloaded from: <https://confluence.cornell.edu/display/CLOISAPI/eBird-1.1-HotSpotsByRegion>

These hotspots were supplemented by wetlands that intersect main birding wetlands areas from Eddy 2009:

- National Wildlife Refuges: Canaan Valley, Ohio River Islands
- Wildlife Management Areas: Fairfax Pond / Rehe, Meadow River, Pleasant Creek
- State Parks: Canaan Valley, Blackwater Falls, Cathedral
- Exemplary Wetlands: Altona, Cranberry Glades, Dolly Sods: Alder Run, Bear Rocks, Spruce Knob Lake, Winfield, McClintic, Greenbottom, Cranesville
- Other: Stauffer’s Marsh

### 5.5.9 FirstSecondOrderFlowlines

Version: 2017

Location on DEP server:

WETLAND\SourceFunctionalAssessment\WaterQualityDatasets.gdb\FirstSecondOrderFlowlines

Input to: LandPos

Description: This layer was created by Nathan Gunn on Mike Shank’s team based on the NHD Flowlines in 2017. It shows the first and second order streams. In the future, we will likely need help from TAGIS to update this layer. We do not have Nathan’s code.

### 5.5.10 FloodplainARAFEMA: Composite Floodplain Layer

Version date: 2/23/2024

Previous version(s): 3/8/2017

Strategy: Completed 4/13/2016 EAB

GIS method: 4/20/2016 EAB; updated 2/23/2024 EAB

Python code: not needed but layer needs to be created. Started 6/13/2016 MCA; Completed 11/28/2016 JCC

Final review by EAB: 11/28/2016; godzillas fixed and reviewed again 3/8/2017 EAB


Input to Flood Attenuation / Opportunity / Floodplain Ratio


Description: This layer is a composite of the FEMA 100-year floodplain, FEMA 500-year floodplain, FEMA high risk advisory zone, and the TNC Active River Area base zone data. The TNC data identifies potential floodplain areas higher up in the watershed.


Strategy: Compile the FEMA 100-yr, 500-yr, and high risk advisory layers into a single layer. Convert the ARA raster to a polygon feature class, then extract the base zone polygons and union the base zones with the FEMA layers.

Source Data:

Get the latest FEMA flood layers from WV GISTC. Kurt Donaldson provided them in 2024. They are on the M drive in SourceAsReceived/Floodplain.

 [FEMA\\_NFHL\\_100yr\\_Floodplain\\_20231207\\_wmA84.gdb](#)

 [FEMA\\_NFHL\\_500yr\\_Floodplain\\_20231207\\_wmA84.gdb](#)

 [highRiskAdvisoryFloodZone\\_20231128\\_GDB.gdb](#)

Get the latest ARA layer from the Conservation Gateway (TNC)at:

<https://www.conservationgateway.org/ConservationByGeography/NorthAmerica/UnitedStates/dc/reportsdata/freshwater/floodplains/Pages/default.aspx>

In January 2024, the latest layer is:

Appalachian Landscape Conservation Cooperative ARA map (10 meter pixels). This is a 547 Meg file that requires the 7zip program to extract.

[http://easterndivision.s3.amazonaws.com/Freshwater/App\\_LCC\\_10m\\_ARA\\_simplified.7z](http://easterndivision.s3.amazonaws.com/Freshwater/App_LCC_10m_ARA_simplified.7z)

The ARA layer was finalized in 2014 after we had used a draft version for WVWRAM, so we needed to update it 2024. It may not be updated again, so this version of the ARA may become a static input. The downloaded data is at:

M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceAsReceived\ActiveRiverArea\AppData\_LCC\_10m\_ARA\_simplified\_downloaded2024



Method:

### **## Combine the three FEMA polygon layers**

One by one, dissolve each of the three FEMA layers (100-yr floodplain, 500-yr floodplain, and high risk advisory)

Union two of the layers, then dissolve the result.

Union the dissolved result with the third layer, then dissolve the result.

Output file can be named FEMAdissolve.

### **## Convert ARA raster to polygon (skip if there are no updates to ARA)**

Conversion Tools / From Raster / Raster to Polygon

Input file: ara10m\_simp

Do not create multi-part polygons

Set maximum number of vertices to 50000

Select "Simplify polygons" if available.

Output file: ARApolys

*Note that this takes a long time to run and needs a lot of memory. In 2024, it failed on EAB's desktop due to insufficient memory after running for 82 minutes. Options are to close down other unneeded applications to free up system memory. You can also increase the virtual memory allocation of your system. Another option is to split the input dataset into smaller sections and merge the results. Also try using a larger cell size.*

### **## Extract base zone polygons from ARA (skip if there are no updates to ARA)**

Request from TAGIS to change Raster Layer (TIFF) to Polygons

We asked Mike Shank in 2024, and his engineer (Jackie Crawford) made the change for us.

Save this layer in SourceAsReceived and make a copy in WorkingFiles.

Clip the polygon layer to the state boundary

Analysis Tools / Extract / Clip

Input file: ARABasePolys

Clip by: state or county boundaries

Output file: ARABasePolClip

ARABasePolClip Attribute Table

Select Data by Attribute

Value 2 OR Value 3

Export Selection

Output file: ARABasePolClip\_selection

Data Management Tools / Generalization / Dissolve

Input file: ARABasePolClip\_selection

Uncheck "create multi-part polygons"

Output file: ARABaseZone2024 (this file is stored in SourceFunctionalAssessment\FloodplainData.gdb for future use if needed)

## **## Combine the FEMA and ARA layers**

Analysis Tools / Overlay / Union  
Input features: ARA\_BaseZone2024  
FEMADissolve  
Output feature class: ARAFEMAUnion  
Join Attributes: ONLY\_FID  
Check box “Gaps allowed” (default)

Data Management Tools / Generalization / Dissolve  
Input file: ARAFEMAUnion  
Uncheck “create multi-part polygons”  
Output file: ARAFEMADissolve

## **## Check for Godzilla polygons and fix if present**

Open attributes of ARAFEMADissolve  
Add field: VertexCt, long integer  
Field Calculate VertexCt = !shape!.pointcount (be sure python is selected, not VB)  
Sort descending on VertexCt to find the polygons with the most vertices.  
If there are any polygons with more than 100000 vertices, split or cut them.  
This is an iterative process. After cutting a few polygons, select just the largest polygons and run  
“Field Calculate” again, until all of the Godzilla polygons are gone.

Open attributes of ARAFEMADissolve  
Add field: VertexCt, long integer  
Field Calculate VertexCt = !shape!.pointcount (be sure python is selected, not VB)  
Sort descending on VertexCt to find the polygons with the most vertices.  
If there are any polygons with more than 100,000 vertices, cut or Dice them.

This is an iterative process. Select the first record with >100,000 vertices. Under Geoprocessing, search for Dice. The input will be ARAFEMADissolve, and the output name should include the FID for that selection (ARAFEMA\_dice\_FID34366). Set the Vertex Limit to 50,000. Run: time may vary depending on the size of the polygon being diced from several minutes to less than a minute. Repeat until all Godzillas have been diced and each one is in a new layer.

Using the FIDs as reference, go back to the ARAFEMA\_Dissolve layer. Make a copy and delete the records that were diced. Now, Union the diced records with this layer. Under Attributes to Join, select only feature IDs.

## **## Export file**

Clear all selections  
R-click the Unioned layer and export data  
Output file: FloodplainARAFEMA

Export feature class to SourceFunctionalAssessment \ FloodplainData.gdb (you may need to first rename the existing FloodplainARAFEMA file with its version date)  
Export shapefile and zip it for transfer to WVGISTC, where the WVWRAM GIS Tool is hosted.  
Update the WVWRAM Reference Manual, table 5.4.

### **## Create composite ARA / FEMA floodplain layer**

ArcToolbox / Data Management Tools / Projections and Transformations / Raster / Project Raster

Input Raster: ara\_wv\_514

Output raster: ara\_wv\_514\_WGS1984\_AS

Output coordinate system: WGS\_1984\_Mercator\_Auxiliary\_Sphere (Same as wvFldZone\_20130410\_wgs84wmA

ArcToolbox / Conversion Tools / From Raster / Raster to Polygon

Input raster: ara\_wv\_514\_WGS1984\_AS (base zone pixels only)

Output polygon features: ARA\_BaseStreamDissolve

Feature Class: ARA\_BaseStreamDissolve ) \*

*## Note: The same projection is need for this to work.*

ArcToolbox / Analysis Tools / Overlay / Union

Input features: ARA\_BaseStreamDissolve

wvFldZone\_20130410\_wgs84wmA

Output feature class: FloodplainARAFEMA1 (in Floodplain/FloodplainData.gdb)

Join Attributes: ONLY\_FID

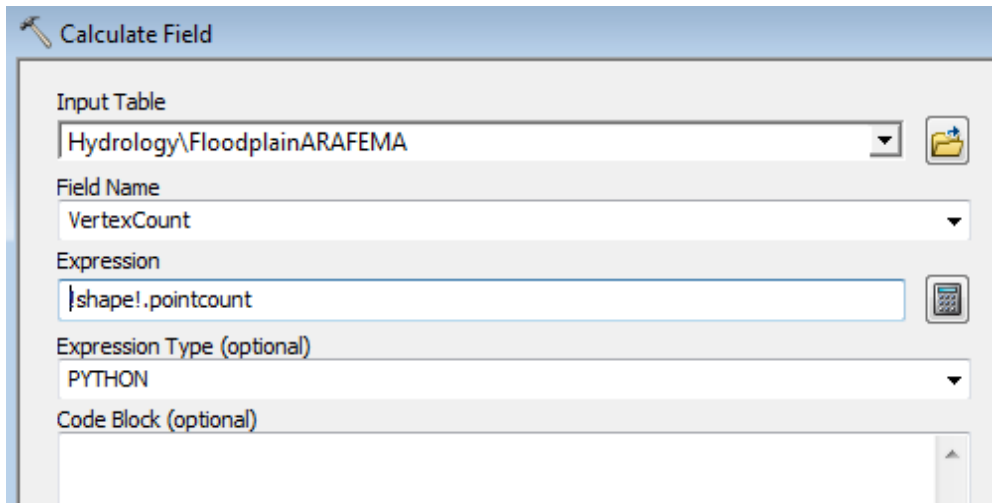
Check box "Gaps allowed" (default)

ArcToolbox / Data Management Tools / Generalization / Dissolve

Input feature: FloodplainARAFEMA1

Output feature: FloodplainARAFEMA

This procedure creates "Godzilla" polygons with excessive numbers of vertices. Calculate the number of vertices:



The result shows that the 7 polygons have over 1 million vertices each.

	OBJECTID *	Shape *	Shape_Length	Shape_Area	VertexCount
▶	1	Polygon	53996324.896162	3040573755.522367	1034084
	2	Polygon	101107564.309451	5855371181.578798	1933262
	3	Polygon	62267314.5704	3468097047.91795	1886231
	4	Polygon	30714255.396928	1388000988.94105	1050397
	5	Polygon	114432544.912949	8820651120.886469	2259243
	6	Polygon	59925642.260688	3737146642.180347	1443725
	7	Polygon	73312174.266924	5532878563.257989	1415591

We want to reduce the number of vertices, and it is okay to greatly increase the number of polygons. Use the Advanced Editing menu. Select the first polygon and Explode Multipart Feature. Repeat for all the polygons with excessive numbers of vertices. A reasonable target is no more than 200,000 vertices, or to run on machines with less computing power, aim for 50,000 max.

There are now 38,273 polygons.

Re-calculate the Vertex Count and sort descending to see how large the remaining polygons are.

There are still 8 godzilla polygons.

Select the largest polygon and display it. In this case, much of the polygon is outside the state boundary.

Clip to the state boundary.

Re-calculate the Vertex Count. Clipping to the state boundary reduced the number of vertices and polygons, but we still have 13 polygons that are large.

OBJECTID *	Shape *	VertexCount	Shape_Length	Shape_Area
8948	Polygon	573901	19270481.705695	989379087.7021
8940	Polygon	467993	12535554.187262	433159996.1671
8945	Polygon	348716	6875947.453924	307247750.1287
8944	Polygon	336470	7473546.604928	334037041.8003
8913	Polygon	282900	5191616.606475	297577899.8208
8930	Polygon	276153	6136721.073907	225465784.2883
8929	Polygon	256662	4928284.028657	146594338.5023
8939	Polygon	246231	5963703.548092	366715972.1137
8919	Polygon	228153	6961973.809428	262696562.9930
8911	Polygon	221481	5168390.652119	167526751.5629
8910	Polygon	213398	4228302.81113	156445035.2970
8927	Polygon	208399	5386408.614975	210113513.0173
8928	Polygon	170198	3400359.208558	148308467.4043
8926	Polygon	135293	1579435.590921	62698823.94625
8942	Polygon	134210	5126978.804533	217803415.6553
8912	Polygon	115970	2307092.411527	181863952.7191
8943	Polygon	104122	3943513.934997	215158508.6281
357	Polygon	89342	2719157.106055	69784217.29904
370	Polygon	88183	1837249.859314	59212403.13553

Explode Multi-part Features again for polygons with more than 100,000 vertices.

Re-calculate the Vertex Count. 9 polygons still have counts > 200,000.

Select the largest polygon and zoom to it. Find good places to cut it (subwatersheds along major rivers require only a single cut) and cut it into smaller chunks. Repeat for all the other large polygons.

Re-calculate the Vertex Count to verify that no “Godzillas” are left.

### 5.5.11 Floodway: FEMA Floodway

Version date: 21 February 2024

Previous versions: 2016

Purpose: Input to Flood Attenuation / Value to Society

Update Schedule: every 5 years

Source data:

- SourceFunctionalAssessment \ FloodplainData.gdb \ FEMA\_NFHL\_Floodway\_20231207\_wmA84.gdb

This layer is from the WV GISTC, which maintains the dataset for FEMA floodplains and hazards. We stripped the attributes to reduce file size, since this layer only needs the geometry for WVWRAM metrics.

### 5.5.12 Hpu: Hydrologic Protection Units

Version date: 2/26/2024

Previous version(s): 2017

Input needed from hpu: point geometry plus attributes STATUS\_FLA and INSPECTA\_1

Input to: Discharges metric

Location: M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WaterQualityDatasets.gdb

Description: Hydrological Protection Units represent mining impacts, This is a database maintained and regularly updated by DEP outside WQSAS. The WVWRAM GIS Tool selects those records that have outlets with open status, i.e., where attributes are "STATUS\_FLA" = 'O' AND "INSPECTA\_1" = 'OUTLT'

Source data: M:\mr\hpu.shp

Strategy: Copy hpu.shp to a working folder. Select records where "STATUS\_FLA" = 'O' AND "INSPECTA\_1" = 'OUTLT'. Export to a new shapefile. You can delete the extraneous fields so that the filesize stays small. Check against the last version of hpu to be sure it looks reasonable. Then rename the old version of hpu to hpu\_2017 or whatever the previous version date was. Export the new version to a feature class: WaterQualityDatasets.gdb/hpu. Export again to a shapefile and zip for transfer to WVGISTC. Update the WVWRAM Reference Manual table 5.4 and the WVWRAM Reference Manual Appendix hpu description in section 5.5.x.

### 5.5.13 HUCWetlandSizeUniq: Wetland Size/Uniqueness by 12-digit HUC Layer

Version date: 5 October 2017

Strategy: 3/16/2017 EAB  
GIS method: 10/5/2017 EAB  
Python code: not needed  
Final review by EAB: 10/5/2017

Purpose:

Input to Habitat / Landscape Opportunity (LandEco: Landscape Ecological Connectivity)

Update schedule:

This layer should be re-created when there are significant updates to the National Wetlands Inventory for West Virginia.

GIS Method (no field method):

Make heat map of 12-digit HUC watershed layer with the following fields, highlighting HUCs in the top 5% of the state.

Type diversity: number of unique NWI codes in the watershed (e.g., PEMA, PEMC, PEMCx) including types that have no vegetation component (e.g., PUBH, R3US2). Do not include spoil wetlands (%s%)

Density: number of vegetated NWI polygons; many of these polygons may be contiguous with each other, forming a single wetland.

Proportional Area: proportion of the watershed's total area occupied by vegetated wetlands as mapped by NWI.

Area of largest vegetated Wetland Unit in the HUC12.

Source Data:

- M:\LayerFiles\arcsde\_backup.gdb
  - Feature Dataset: basemap\_physical\_non\_replica
    - Feature Class: watersheds\_12digit
  - Feature Dataset: basemap\_cultural\_non\_replica
    - Feature Class: SDE\_wvbound
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\EnhancedNWI\_20150511.gdb
  - Feature Dataset: CONUS\_WVWetlandsProj
    - Feature Class: EnhWVWetland
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandFunctionResults\WetlandResults\_EAB.gdb
  - Feature Class: WU\_VegAll

Method:

**## STEP 1: Prepare the HUC watershed layer**

**## Clip 12-digit HUC to state boundary**

ArcToolbox / Analysis / Extract / Clip

Input features: watersheds\_12digit

Clip features: SDE\_wvbound

Output Feature Class:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceFunctionalAssessment\Hydrology.gdb
  - Feature Class: HUC\_12digit1

**## Reduce number of attributes to decrease processing time**

*## Note that HUC\_12 is a unique identifier for the watershed but NU\_12\_NAME is not unique*

ArcToolbox / Data Management / Fields / Delete Field  
 Input Table: HUC\_12digit1  
 Drop field: Select all except HUC\_12 and HU\_12\_NAME

**## STEP 2: Determine the largest vegetated wetland in each 12-digit HUC (MaxVegArea)**

**## Spatial Join HUC watershed with vegetation-attributed Wetland Units**

ArcToolbox / Analysis / Overlay / Spatial Join  
 Target Features: HUC\_12digit1  
 Join Features: WU\_VegAll  
 Output feature class: Hydrology.gdb / HUC\_12digit2  
 Join operation: JOIN\_ONE\_TO\_ONE  
 Check “Keep all target features”  
 Field Map of Join Features: retain the following  
 HUC\_12  
 HUC\_12\_NAME  
 SHAPE\_Length  
 SHAPE\_Area  
 VegArea (R-click, select MERGE RULE / Maximum)  
 Match option: INTERSECT

**## Add field to store the largest vegetated wetland area and set NULL intersections to zero**

Open attribute table of HUC\_12digit2  
 Add field “MaxVegArea” and Field Calculate MaxVegArea = VegArea  
 SELECT \* FROM HUC\_12digit2 WHERE: MaxVegArea IS NULL  
 Field Calculate MaxVegArea = 0

**## Find the wetlands that intersect more than one 12-digit HUC.**



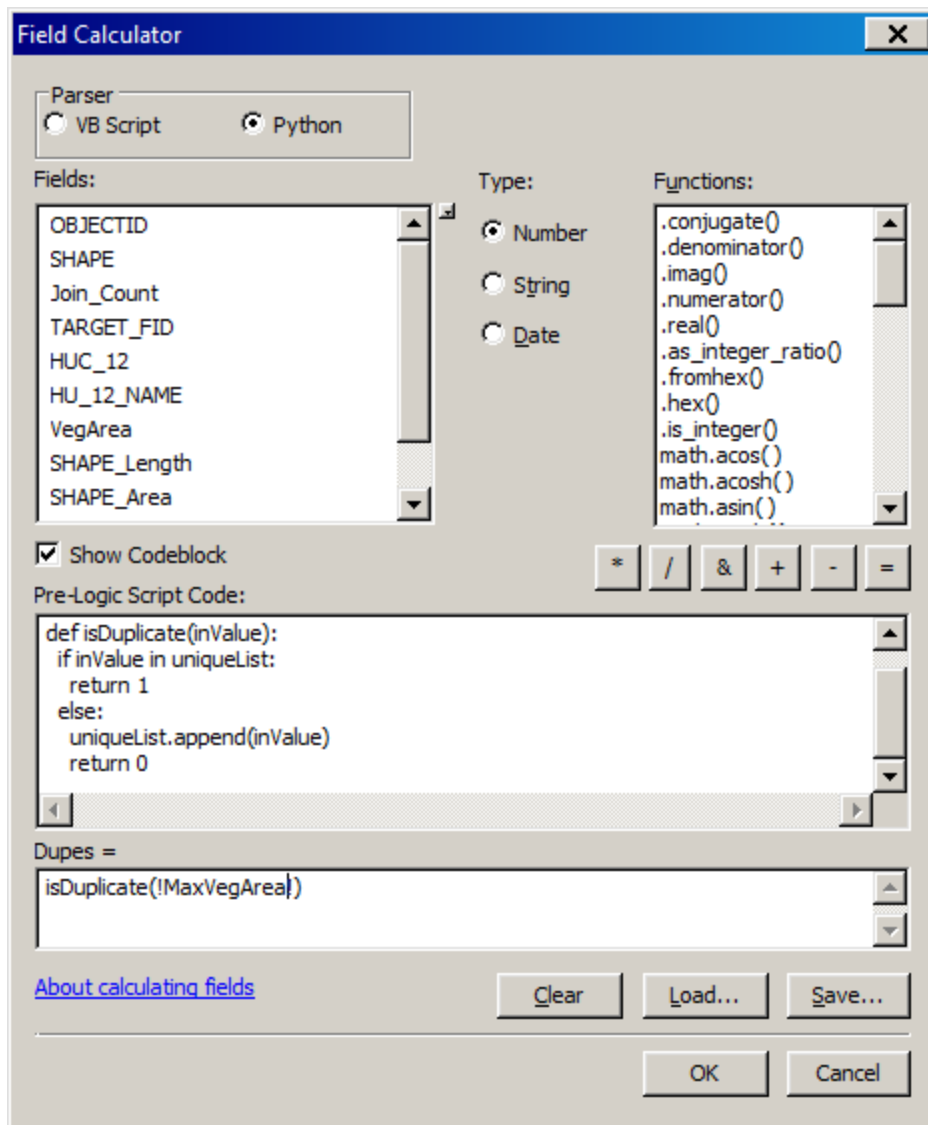
*Instructions below from <https://gis.stackexchange.com/questions/183472/identify-duplicate-attributes>*

Instructions provided demonstrate how to use the Field Calculator to identify duplicate field values. Single occurrences and the first occurrence of multiple values are flagged with 0. Duplicates are flagged with 1.

Create a new field. Set the type as short or long integer and accept the other defaults. Right-click the newly created field and select Field Calculator. Select the Python parser. Ensure that the 'Show Codeblock' option is checked. Paste the following code into the Pre-Logic Script Code box:

```
uniqueList = []  
  
def isDuplicate(inValue):  
    if inValue in uniqueList:  
        return 1  
    else:  
        uniqueList.append(inValue)  
    return 0
```

Type 'isDuplicate(!Field!)' in the lower expression box and replace the word 'Field' with the name of the field that contains the duplicated values. Click OK. All duplicate records are designated with a value of 1 and non-duplicate records are designated with a value of 0 in the new field.



**## Fourteen wetlands cross HUC boundaries. Examine these manually to put the correct area in each watershed. Some are just touching a boundary and don't need replacement. Below are the manual revisions to MaxVegArea:**

Buffalo Creek-Ohio River (050901011007): 0

Horseshoe Run: 102938

Brush Run-Greenbrier River: 65827

Bull Run-Cheat River: 7903

Devilhole Creek-North Fork Hughes River: 6180

Middle Grave Creek: 328183

Grave Creek: 140738

Lee Creek: 9387 (largest vegetated wetland has been converted to golf course pond)

Little Creek-Monongahela River: 3553

Little Otter Creek-Elk River: 1462

Mill Creek-Meadow River: 442947

Little Clear Creek: 578758

Guyan Creek: 54196  
Rich Creek-Gauley River: 46555  
Laurel Creek-Gauley River: 13356  
Scary Creek-Kanawha River: 122268  
Buffalo Creek-Kanawha River: 253100  
Shields Run-North Branch Potomac River: 196589

### **## STEP 3: Number of unique NWI codes in the watershed (DiversNWI)**

#### **## Intersect Enhanced NWI and HUC watershed**

ArcToolbox / Analysis / Overlay / Intersect  
Input Features: EnhWVWetland  
                  HUC\_12digit1  
Output feature class: NWIExports.gdb / NWI\_HUC12digit\_join  
Join attributes: ALL  
Output type: INPUT

#### **## Delete the spoil wetlands**

R-click NWI\_HUC12\_join and select Edit Features / Start Editing  
Open attribute table of NWI\_HUC12\_join  
SELECT \* FROM NWI\_HUC12\_join WHERE: "ATTRIBUTE" LIKE '%s%'  
Delete selected features  
Editor / Save Edits  
Editor / Stop Editing

#### **## Add field and concatenate NWI attribute with HUC\_12**

Open attribute table of NWI\_HUC12\_join  
Add field Concatenate (text, length = 50)  
Field Calculate Concatenate = [HUC\_12] & " | " & [ATTRIBUTE]

#### **## Summarize by HUC watershed**

Open attribute table of NWI\_HUC12\_join  
R-click the header for the field "Concatenate" and select "Summarize"  
Select a field to summarize: Concatenate  
Choose one or more summary statistics to be included in the output table: HUC\_12 (first)  
Specify output table: NWI\_HUC12\_summary1

#### **## Summarize again for the count of unique attributes by HUC watershed**

Open attribute table of NWI\_HUC12\_summary1  
R-click the header for the field "First\_HUC\_12" and select "Summarize"  
Select a field to summarize: First\_HUC\_12

Choose one or more summary statistics to be included in the output table: Concatenate (first)  
Specify output table: NWI\_HUC12\_summary2

### **## Join results back to HUC watershed**

R-click HUC\_12digit2 and select Joins and Relates / Joins  
Join attributes from a table  
Choose the field: HUC\_12  
Choose the table: NWI\_HUC12\_summary2  
Choose the field in the table: First\_HUC12  
Join options: Keep all records

### **## Export joined layer**

R-click HUC\_12digit2 and select Export Data / All features  
Output feature class: Hydrology.gdb / HUC\_12digit3

### **## Add field to store number of unique NWI codes in the watershed (DiversNWI)**

Open attribute table of HUC\_12digit3  
Add field DiverseNWI (short integer) and Field Calculate DiversNWI = [Cnt\_First\_HUC\_12]

### **## Set null intersections to zero**

Open attribute table of HUC\_12digit3  
SELECT \* FROM HUC\_12digit3 WHERE: "DiverseNWI" IS NULL  
Field Calculate DiverseNWI = 0

### **## STEP 4: Number of vegetated NWI polygons in the watershed (DensVegNWI)**

#### **## Select the forest, shrubland, emergent, moss, and aquatic bed vegetation.**

*## (Note that the VegAll layer created in WU\_VegByLP and used in WU\_VegAll includes only the Palustrine polygons. The layer below includes an additional 3 vegetated lake polygons and 7 vegetated riverine polygons)*

Clear all selections

```
SELECT * FROM EnhWVWetland WHERE:  
"ATTRIBUTE" LIKE 'PEM%' OR "ATTRIBUTE" LIKE 'PFO%' OR "ATTRIBUTE" LIKE  
'PSS%' OR "ATTRIBUTE" LIKE 'PAB%' OR "ATTRIBUTE" LIKE 'PML%' OR  
"ATTRIBUTE" LIKE 'L%AB%' OR "ATTRIBUTE" LIKE 'L%EM%' OR "ATTRIBUTE" LIKE  
'R%AB%' OR "ATTRIBUTE" LIKE 'R%EM%'
```

### **## Create layer of all vegetation from selection**

R-click EnhWVWetland / Data / Export Data  
Export: Selected features

Output feature class: \NWIEExports.gdb \ NWI\_VegPalLacRiv

### **## Determine the number of vegetated NWI polygons in each HUC**

ArcToolbox / Analysis / Overlay / Spatial Join  
Target Features: HUC\_12digit3  
Join Features: NWI\_VegPalLacRiv  
Output feature class: Hydrology.gdb / HUC\_12digit4  
Join operation: JOIN\_ONE\_TO\_ONE  
Check “Keep all target features”  
Field Map of Join Features: retain the following  
HUC\_12  
HUC\_12\_NAME  
SHAPE\_Length  
SHAPE\_Area  
MaxVegArea  
DiversNWI  
Attribute (R-click, select MERGE RULE / Count)  
Match option: INTERSECT

### **## Add field to store the number of vegetated NWI polygons and set NULL intersections to zero**

Open attribute table of HUC\_12digit4  
Add field “DensVegNWI” (short integer) and Field Calculate DensVegNWI = [ATTRIBUTE]  
SELECT \* FROM HUC\_12digit4 WHERE: DensVegNWI IS NULL  
Field Calculate DensVegNWI = 0

*## Check the zero values of MaxVegArea and compare to zeros for DensVegNWI. If they are not the same (three were different on 10/5/2017) then check the HUCs manually and correct them.*

### **## STEP 5: Proportion of the watershed's total area occupied by vegetated wetlands (RatioVeg)**

#### **## Spatial join vegetated NWI wetlands to HUC**

ArcToolbox / Analysis / Overlay / Spatial Join  
Target Features: HUC\_12digit4  
Join Features: WU\_VegPalLacRiv  
Output feature class: Hydrology.gdb / HUC\_12digit  
Join operation: JOIN\_ONE\_TO\_ONE  
Check “Keep all target features”  
Field Map of Join Features: retain the following  
HUC\_12  
HUC\_12\_NAME  
SHAPE\_Length

SHAPE\_Area  
MaxVegArea  
DiversNWI  
DensVegNWI  
SHAPE\_Area\_1 (R-click, select MERGE RULE / Sum)  
Match option: INTERSECT

**## Add field to store the proportion of vegetated wetlands and set NULL intersections to zero**

Open attribute table of HUC\_12digit  
Add field "RatioVeg" (float) and Field Calculate RatioVeg = [SHAPE\_Area\_1] /  
[SHAPE\_Area]  
SELECT \* FROM HUC\_12digit WHERE: RatioVeg IS NULL  
Field Calculate RatioVeg = 0

### 5.5.14 ILF\_banks: In-Lieu Fee Mitigation Sites and Mitigation Banks Layer

Version date: 24 January 2018

Strategy: 10/19/2017 EAB

GIS method: 10/19/2017 EAB

Python code: not needed

Final review by EAB: 10/19/2017

Purpose:

Input to Habitat / Value to Society / HInvest

Update schedule:

This layer should be updated at least every 5 years, or more often if time permits.

Description:

Rationale: Wetlands that have been restored, enhanced or created represent investments of time and money, and are of high value to society. In-lieu fee sites and mitigation banks are the most common type of project in West Virginia, although voluntary restoration also occurs.

Method:

- Check web for updates to RIBITS: <https://ribits.usace.army.mil/>.
- Check with WVDEP DWWM/WIB for updates to in-lieu fee sites, mitigation banks, or other mitigation sites. WVDNR Coordination Unit may also have information.
- Note that this is a point file; as polygons become available, sites should be moved to the "RestoredWetland" layer.
- Note that most project wetlands have not been mapped in the National Wetlands Inventory as of 2017.

Merge points from all sources and write to ILF\_banks point file.

Output:

M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandsGeodatasets.gdb  
Feature Class: ILF\_banks

### 5.5.15 IEIUMa2010v32: Index of Ecological Integrity U Mass Layer

Version date: 28 November 2018

Strategy: 11/15/2018 EAB

GIS method: 11/28/2018 JSH

Python coding: not needed

Final review by EAB: 11/28/2018

Purpose:

Index of Ecological Integrity is an input to the Landscape Integrity metric (LandInteg).

Update schedule for layer:

Layer should be updated (re-created from UMass source data) when U Mass releases major updates. The next update is expected in 2019. We should receive notification from UMass when it is released.

Description:

U Mass developed this layer as part of their Conservation and Prioritization System (CAPS) for the northeastern states. The layer shows scores for an Index of Ecological Integrity (high scores = higher integrity), normalized for the state of West Virginia. Version 3.2 (2010). 30m pixels.

Scott Jackson (sjackson@umass.edu,11/19/2018) writes: *The DSL data sources are from around 2010. Some are a little older; some are newer. The landcover is based on 2011 NLCD and TNC's Ecological Systems Map. I believe that there will be an updated version coming out once the new NLCD data are released.*

Elizabeth Byers (WVDEP) asks: *Pipelines and powerlines are mapped as "shrubland & grassland" and are ranked higher than the adjacent wetlands or forests that they fragment. I wonder if this is an unintended artifact of your analysis?*

Scott Jackson replies: *We have no way to score ecological integrity in absolute terms (e.g. x units of integrity). So, we created a relative scoring system that compares shrub swamps to shrub swamps, salt marshes to salt marshes. Powerlines and pipelines are generally categorized as shrublands. Because much of the northeast lacks shrublands of any size, powerline/pipeline shrublands often score pretty high. It is not meant to suggest that a powerline shrubland has more integrity than an adjacent forested wetland, it means that the powerline shrubland is better than many other shrublands in that state (assuming that you used the IEI that was scaled to state boundaries).*

Source Data:

Project webpage: <http://www.umasscaps.org/>

Data download page: [http://www.umasscaps.org/data\\_maps/dsl.html#WV](http://www.umasscaps.org/data_maps/dsl.html#WV)

Source file: DSL\_IEI\_state\_2010\_v3.2\_WV.tif



Method:

Download data and process as described below, from Jack Hopkins' notes on file processing (November 2018):

### **# Converting pixel values from (0.1 - 1) to (1 - 100)**

Use the Spatial Analyst tool "Raster Calculator"

Double click input layer from the available layers and variables box

Multiply the layer by 100 using the expression \*100      example expression..  
("IEIUMa2010v32" \* 100)

Click Ok to save as a new output raster file

### **# Creating fixed integer values instead of floating values**

Use the Spatial Analyst tool "Int"

Load the previously created raster as the input raster

Click Ok to save as a new output raster file

### **# Creating an attribute table**

Use the Data Management tool "Build Raster Attribute Table"

Load the previously created raster as the input raster

Click Ok to create an attribute table with an object Id field, pixel value field, and count field

### **# Assigning the No Data pixels a value of zero**

Use the Spatial Analyst tool Reclassify

Load the previously created raster as the input raster

In the reclassification table window type in the desired new values

Click Ok to save as a new output raster file

### **# Clipping the Image to the WV state boundary**

Make sure that both the input raster and the WV State Boundary layer are in the table of contents

Open the Attribute table for the WV State Boundary and select the attribute so that it is highlighted

Open the Image Analysis function located in the Windows tab at the top toolbar in Arc Map

You'll see a list of all available layers in the top most box

Make sure to add a check mark next to the raster layer (if this isn't already) as well as click on the name of the layer causing it to highlight itself

Click the now available “Clip tool” in the processing window

This creates a new raster that has not been saved but should now have been clipped to the wv state boundary. This new clip should also be located in the table of contents

Right click this new layer, hover over the word data, and then click export data

**# You might have to create the attribute table again for the new raster layer**

Use the Data Management tool “Build Raster Attribute Table”

Load the previously created raster as the input raster

Click Ok to create an attribute table with an object Id field, pixel value field, and count field

Output Data:

M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceFunctionalAssessment\HabitatData.gdb\IEIUMa2010v32

### 5.5.16 ImpairedStreams

Version date: 2016

Input to: HUC12WQ, ImpairedIn, ImpairedOut (line geometry only, no attributes used)

Location:

M:\wr\WTRSHD\_BRANCH\303D\_TMDL\_IMPAIRED\WV2016\_ImpairedStreams\_24KNHD.shp

2024 Notes from KSS: Leave as is until updates are finalized. A newer version is in draft form but not yet ready for use. Every impairment is a separate file. Brittany is working on it. When a new 303d list is shared it will use new codes in a new shape file.

### 5.5.17 InfrastructureWetlands: Wetlands with Public Use Infrastructure Layer

Version date: 12 October 2017

Strategy: 3/16/2017 EAB

GIS method: 10/12/2017 EAB

Python code: not needed

Final review by EAB: 10/12/2017

Purpose:

Input to Habitat / Value to Society / PublicUse

Update schedule:

This layer should be updated at least every 5 years, or whenever staff become aware of new boardwalks or educational/research programs at wetlands.

Description:

Rationale: Wetlands with boardwalks, nature trails, on-going educational programs, or sustained scientific research programs are of high value to society.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\EnhancedNWI\_20150511.gdb
  - Feature Dataset: CONUS\_WVWetlandsProj
    - Feature Class: EnhWVWetland

Method:

Create named wetland polygons where there are known boardwalks, nature trails, educational programs, or sustained scientific research programs. Educational and research programs should continue for more than 2 years. Priority is given to adding wetland polygons that are not already included in a named wetland database (e.g. ExemplaryWetlands).

Often wetland polygons can be copied or traced from the National Wetlands Inventory (NWI). However, if they are not mapped in the NWI or another source, they must be heads-up digitized. The boundaries can be approximate, e.g. +/- 100m, and do not need to be attributed to NWI codes. In wetland functional assessment, this layer will be intersected with Wetland Units, and therefore the boundaries do not need to be exact.

Data Fields:

**Name** [text 50 characters]

Give the wetland a name based on, in this order: (1) name on USGS topographic map, (2) name on signage at the wetland or local maps including the wetland, (3) name used informally by users of the wetland, or (4) name based on nearest stream or other natural landmark.

**Boardwalk** [short integer]

- 0 No boardwalk present
- 1 Boardwalk present

**NatureTrail** [short integer]

- 0 Wetland not accessible via maintained trail
- 1 Wetland is accessible via maintained trail

**PublicOutreach** [text 50 characters]

Briefly describe the educational or outreach activity that takes place at the wetland

**ResearchSite** [text 50 characters]

Briefly describe the sustained scientific research that takes place at the wetland

**MapSource** [text 50 characters]

Briefly describe the data source used to create the wetland polygon, e.g., “copied from NWI” or “heads-up digitized”.

**Comment** [text 50 characters]

Add brief comments, such as name of educational organization or date of boardwalk construction

## 5.5.18 Karst Composite Layer

Version date: 18 September 2017

Strategy: completed 9/16/2017 EAB

GIS method: 9/18/2017 EAB; verified 9/18/2017 EAB

Python coding: not needed

Final verification by EAB: 9/18/2017 EAB

*Note: this layer should be re-created as significant updates are made to the SSURGO soils database, perhaps every 10 years.*

Purpose:

Habitat and Ecological Integrity Function / Potential aspect / Karst factor

Description:

Rationale: A rich and distinctive flora and fauna are characteristic of calcareous wetlands.

Summary of strategy: Union of Karst Geology, Karst Soils and Calcareous Soils.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WaterQualityDatasets.gdb
  - Feature Class: KarstGeology
    - Note: this feature class is an export from the state geologic map: In "geology\_250k/Map Units", SELECT \* FROM ALL\_polygons WHERE: "TYPE" IN ('dolostone', 'limestone') (250 out of 5175 selected).
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SsurgoExports.gdb
  - Feature Class: KarstSoils
    - Note: this feature class is an export of statewide karst soils from SSURGO 2016:
      - SSURGO table: component\_all
      - "geomdesc" LIKE '%karst%'
      - 241 out of 9533 selected
      - Related tables – back to ssurgo\_wv
  - Feature Class: CalcareousSoils
    - Note: this feature class is an export of statewide calcareous soil map units (Fairplay, Lappans, Massanetta) from SSURGO 2016, based on consultation with Jared Beard, NRCS state soil scientist.

Output:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WaterQualityDatasets.gdb
  - Feature Class: KarstComposite

Method:

**## Union KarstGeology, KarstSoils, and CalcareousSoils**

ArcToolbox/Analysis Tools/Overlay/Union

Input Features: KarstSoils, CalcareousSoils

**Output Feature Class:**

M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WaterQualityDatasets.gdb\KarstComposite1

Join Attributes: ONLY\_FID

Check box “Gaps Allowed” (default)

**ArcToolbox/Analysis Tools/Overlay/Union**

Input Features: KarstGeology, KarstComposite1

**Output Feature Class:**

M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WaterQualityDatasets.gdb\KarstComposite

Join Attributes: ONLY\_FID

Check box “Gaps Allowed” (default)

*Note: if the second Union doesn't work because of difficulty opening the “KarstComposite1” feature class, then export the feature class to a shapefile and re-do the Union.*

### **5.5.19 NHD\_WVStreams**

Version date: 6/8/2021

Latest update: 2/22/2024

Previous version(s): 2017

Checked: 2/2024; 4/3/2024 for latest update

This layer is not used in the WVWRAM GIS Tool; however, it is used to assign stream codes to wetlands by DEP staff. Updates do not need to be sent to WV GISTC.

**Location:**

M:\wr\WTRSHD\_BRANCH\_INTERNAL\NHD\_AUID\_2021\NHD\_WVStreams\_20210608.shp

Description: TAGIS and in-house DEP staff used NHDFlowline and old stream files to match our codes to the StreamRiver lines then sent the file on to Chris D to work on further. After Chris got the file from TAGIS, she created the final AUIDs that we use as the stream code for assessment and those are in this file. Codes/descriptions/names/Trout data are continually updated by Megan and Whitman and this is the most recent file with everything together. Right Click on the layer in the Table of Contents, go to Data, View Item Description to see the metadata.

### **5.5.20 NHDFlowline**

Version date: 2/24/2024

Previous version(s): 4/5/2019

Input to: AquaAbund (geometry only), StreamEdge (geometry only), WFlowPath (geometry plus FCode attribute)

Note that this layer is also the input to another layer:

WETLAND\SourceFunctionalAssessment\WaterQualityDatasets.gdb\FirstSecondOrderFlowline  
s

Location: M:\basemap\NHD\_H\_West\_VirginiaTransfer2022.gdb\NHDFlowline

Description: This is the most recent line work for WV streams, received from WVGES in 2022.

### 5.5.21 NPDES

Version data: 2/28/2024

Previous version(s): 2017, 2/23/2022

Input to:

- Septic layer (owrnpdes\_, geometry and attribute perm\_type),
- Discharges metric (owrnpdes\_outlets and owrnpdes\_, geometry and attribute perm\_type)

Source data:

- M:\wr\owrnpdes\_outlets.shp
- M:\wr\owrnpdes\_.shp

Description: These geodatabases of NPDES permits are regularly updated by DEP staff.

Strategy: Copy the two shapefiles to a working folder. Check against the last versions of the layers to be sure they look reasonable. You can clip the layer to the state boundary to keep the file size smaller. You can delete the extraneous attributes (everything except standard geometry fields and perm\_type) to keep the file size smaller.

Optionally, you can also reduce file size by pre-selecting the records that are used by the WVWRAM GIS Tool, as follows:

```
SELECT * FROM owrnpdes_ WHERE: "perm_type" = '401 Certification' OR "perm_type" = 'Industrial' OR "perm_type" = 'Sewage' OR "perm_type" = 'UIC Sewage' OR "perm_type" = 'UIC Stormwater Industrial' OR "perm_type" = 'Septic Tank'
```

```
SELECT * FROM owrnpdes_outlets WHERE: "perm_type" = 'Industrial' OR "perm_type" = 'Sewage' OR "perm_type" = 'UIC Sewage' OR "perm_type" = 'UIC Stormwater Industrial'
```

On 2/28/2024, after doing this processing, the final numbers of records were:

- owrnpdes\_outlets.shp: 15,659 records
- owrnpdes\_.shp: 52,509 records

Then rename the old versions in WaterQualityDatasets.gdb and export the new versions to this geodatabase. Export again to shapefiles and zip for transfer to WVGISTC. Update the

WVWRAM Reference Manual table 5.4 and the WVWRAM Reference Manual Appendix NPDES description in section 5.5.x.

### 5.5.22 NPL\_point and NPL\_Bndry: National Priority List

Version: 2017

Input to: Discharges

Location on DEP Server:

M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WaterQualityDatasets.gdb

- Feature Class: NPL\_point\_20160406 (data provided by Peter Costello, DEP)
- Feature Class: NPL\_Bndry\_20160406 (data provided by Peter Costello, DEP)

Source: Data provided by Peter Costello, DEP in 2017. Only the geometry (points or polygons) is needed. The attributes are not needed.

### 5.5.23 NSPA: Wetland is in a Natural Streams Preservation Act Watershed Layer

Version date: 16 March 2016

Strategy: 2/14/2016

GIS method: completed 3/16/2016

Python code: not needed – this is the procedure to create a spatial dataset

Final review by EAB: 3/16/2016

Purpose:

Water Quality Function

This procedure creates a layer showing the watersheds drained by the streams in the Natural Streams Preservation Act.

Update Schedule for Layer:

None, except in the unlikely event that the legislation is updated

Description:

NSPA. Wetland is in the contributing watershed of a stream reach protected by the Natural Streams Preservation Act (2 points). These include (a) Greenbrier River from its confluence with Knapps Creek to its confluence with the New River, (b) Anthony Creek from its headwaters to its confluence with the Greenbrier River, (c) Cranberry River from its headwaters to its confluence with the Gauley River, (d) Birch River from the Cora Brown bridge in Nicholas county to the confluence of the river with the Elk River, and (e) New River from its confluence with the Gauley River to its confluence with the Greenbrier River.

<http://www.legis.state.wv.us/WVcode/Code.cfm?chap=22&art=13>



- GIS layer showing stream reaches in NSPA is at:  
M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceFunctionalAssessment\DNRWetlandData.gdb, Feature Class: ntrlStrmPresrvationActStrms. This version of the NSPA reaches, from the DNR server, is better-registered and more complete than the version on the DEP server (M:\wr\WTRSHD\_BRANCH\_INTERNAL\STREAM FILES\Natural Stream Preservation\nat\_strms\_preservation.shp)

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceFunctionalAssessment\DNRWetlandData.gdb
  - Feature Class: ntrlStrmPresrvationActStrms.
- M:\basemap\watersheds\_10digit.shp

Method:

**Create layer showing watersheds drained by NSPA streams**

Open 10-digit watershed layer and NSPA layers. Select 10-digit watersheds drained by NSPA streams and export to a new feature class “WaterQualityDatasets.gdb / NatStrProAct\_HUC10.shp”.

**Final data layer is stored in:**

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceFunctionalAssessment\Watershed.gdb
  - Feature Class: NatStrPreAct\_HUC10

### 5.5.24 NWIExports.gdb: NWI Exports Layer

Version date: 4 March 2024

Strategy: 2/15/2018 EAB

GIS method: completed 2/15/2018 EAB, small update 3/4/2024 SJM/KJJ

Python code: not needed – this is the procedure to create a spatial dataset

Final review by EAB: 2/18/2018; Final review by SJM: 4/2/2024

Purpose:

Input to HydSW, IrrEdge, StreamEdge, VegByLP, WFlowPath metrics

Update Schedule for Layers:

Every 5 years, or whenever the National Wetlands Inventory is significantly updated for the state. Note that the NWI Data Verification Tools must be run on the statewide dataset, and any errors fixed, prior to creating exports.

Description:

The National Wetlands Inventory contains mapped polygons of rivers, lakes, and ponds, in addition to vegetated wetlands. These aquatic resources are of importance in understanding the function of adjacent or nearby wetlands. Exports used in functional assessment include: NWIOpenWater, Rivers, Lakes, and RiversLakes.

Source Data:

M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\EnhancedNWI\_20150511.gdb

Feature Dataset: CONUS\_WVWetlandsProj

Feature Class: EnhWVWetland

Output Data:

M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceFunctionalAssessment\NWIExports.gdb

Feature Class: NWIOpenWater

Feature Class: Rivers

Feature Class: Lakes

Feature Class: RiversLakes

Method:

**## Select NWI Open Water polygons. These are attributed as lakes, rivers, and open water palustrine (aquatic bed, unconsolidated bottom, unconsolidated shore) AND have a hydrologic regime that is (permanently flooded, semipermanently flooded, intermittently exposed)**

## **## AND are not spoil.**

Clear all selections.

```
Select * FROM EnhWVWetland WHERE: ("ATTRIBUTE" LIKE 'L%' OR "ATTRIBUTE"  
LIKE 'R%' OR "ATTRIBUTE" LIKE 'PAB%' OR "ATTRIBUTE" LIKE 'PUB%' OR  
"ATTRIBUTE" LIKE 'PUS%') AND ("ATTRIBUTE" LIKE '%H%' OR "ATTRIBUTE" LIKE  
"%G%" OR "ATTRIBUTE" LIKE "%F%") AND "ATTRIBUTE" NOT LIKE '%s%'
```

## **## Create open water layer from selection**

R-click EnhWVWetland / Data / Export Data

Export: Selected features

Output feature class: M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\NWIEExports.gdb

Feature Class: NWIOpenWater

Dissolve the NWIOpenWater feature class and check for Godzillas.

Dissolve: under “Dissolve Fields,” select ATTRIBUTE in order to maintain this field in the attribute table after the Dissolve

Check for Godzillas per the directions under FloodplainARAFEMA

Note: in the last step for checking for Godzillas, make sure to keep all attributes in this case. This will mean cleaning up the Attribute table so that all ATTRIBUTE codes are in one column.

## **## Select NWI rivers and create Rivers layer**

Clear all selections

```
SELECT * FROM EnhWVWetland WHERE: "ATTRIBUTE" LIKE 'R%'
```

R-click EnhWVWetland and select Data / Export Data

Export: Selected features

Output feature class: Rivers

## **## Select NWI lakes and create Lakes layer**

Clear all selections

```
SELECT * FROM EnhWVWetland WHERE: "ATTRIBUTE" LIKE 'L%'
```

R-click EnhWVWetland and select Data / Export Data

Export: Selected features

Output feature class: Lakes

## **## Select the NWI rivers and lakes and create RiversLakes layer**

Clear all selections.

Select \* FROM EnhWVWetland WHERE: "ATTRIBUTE" LIKE 'R%' OR "ATTRIBUTE"  
LIKE 'L%'

R-click EnhWVWetland and select Data / Export Data

Export: Selected features

Output feature class: RiversLakes

### 5.5.25 PalustrinePlots

Version date: 3/1/2024

Previous version date(s): March 2015, 2/23/2022

Input needed from PalustrinePlots: point geometry plus attributes Soil\_Textu, Depth\_of\_o

Input to: Clay (no longer used), Histosol, Organic

Location: WETLAND\WetlandsGeodatasets.gdb\PalustrinePlots

(note that the 2022 version did not get copied over to WetlandsGeodatasets – it is located in M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WVWRAM\_Updates\_for\_WVGISTC\WetlandsGeodatasetsTransfer2022.gdb)

Update note: Palustrine plot data were collected in a major effort by DNR between 1994 and 2012. Since that time there have been only a handful of new palustrine plots. Updating this source is a low priority and can be done every 10 years or even less often, unless there is a new plot sampling effort by DNR.

Description: Palustrine plot data collected by DNR Natural Heritage Program ecologists. These vegetation plots include soils data that are used by the WVWRAM GIS Tool, including information on Soil\_Textu (Soil Texture), and Depth\_of\_o (Depth of organic soil (cm)). It is important to ensure that any new data from DNR includes fields with exactly the same names (re-name fields as needed).

Source: Request Plots table from PlotData MS-Access database (ecology vegetation plots) from DNR Natural Heritage Program. In 2024, the database manager is Brian Streets. You may need to sign a data use agreement if DEP does not already have one, explaining how we will use the data. If DNR prefers, they can filter the data themselves before sending it, so that no sensitive data is inadvertently shared.

Strategy: Open the PlotData database and create a query on the Plots table with Plot Code, Dominant Vegetation, Cowardin System LIKE “\*pal\*”, GPS accuracy < 1001, Soil Texture, Depth of organic (cm), Corrected Lat, Corrected Long, Corrected UTM X, and Corrected UTM Y (1786 records in 2024). Copy and paste to an Excel file. Delete the Plot Codes that begin with ROBI (old) and MARS (blind duplicates). Confirm that GPS accuracy is < 1001 and all Cowardin System values include the word “palustrine”.

Rename the Soil Texture field to Soil\_Textu. Rename Depth of organic soil (cm) to Depth\_of\_o.

Then modify Depth\_of\_o by checking the Soil Texture. If Soil Texture is either peat or muck and Depth of organic (cm) is null, then add an estimated value of 10 to Depth\_of\_o. If Soil Texture = peat and the Dominant Vegetation ends in “peatland”, then add an estimated value to 20 to Depth\_of\_o. Then search on null values for Depth\_of\_o and if the Dominant Vegetation is peatland or poor fen, add a value of 20. If the Dominant Vegetation is not peatland or poor fen, but Sphagnum is listed, add a value of 10 for Depth\_of\_o. For the rest of the blank values in Depth\_of\_o, fill in with zero.

If you wish, you can clean up the data by selecting only those records that meet the criteria:  
"Soil\_Textu" LIKE '%clay%' OR "Soil\_Textu" LIKE '%peat%' OR "Soil\_Textu" LIKE '%muck%' OR "Depth\_of\_o" > 1

Next, clean up the lat/long. Check to be sure all records have coordinates. If the lat/long is missing, check the corrected UTM or the field lat/long. If the lat/long are not in numeric format, then multiply them by 1 into a new field.

(887 records in 2024)

Import the Excel file to ArcGIS. Check it against the last version of PalustrinePlots.

Then rename the old version of PalustrinePlots2022 or whatever the previous version date was. Export the new version to a feature class: WetlandsGeodatasets.gdb\PalustrinePlots. Export again to a shapefile and zip for transfer to WVGISTC. Update the WVWRAM Reference Manual table 5.4 and the WVWRAM Reference Manual Appendix PalustrinePlots description in section 5.5.x.

### **5.5.26 PasturesNotHayfields: Grazed NLCD Grasslands**

Version date: 14 March 2023

Python code: N/A

Purpose: Flood Attenuation Function: Persistent Ungrazed Vegetation, and Water Quality Function / Opportunity aspect / LandUse50m & LandUseWshd factors

Location: WaterQualityDatasets.gdb

Description: This layer is a compilation of pastures grazed by livestock as field-verified by WVDEP's Watershed Assessment Branch (James Summers from 2013-2023). James Summers provided multiple shapefiles that were copied into a single shapefile, with attributes then stripped to save computing space. This is a presence/absence input to WVWRAM.

### **5.5.27 Peatlands\_20160228**

Version date: 2/28/2016

Input to: FloodArea, Histosol, Organic, Runoff, SoilOrgCalc, SoilRunoff

Location on DEP server: WETLAND\SourceFunctionalAssessment\WaterQualityDatasets.gdb

Description: Wetlands with an estimated peat depth of 15 cm or more, based on field data (plots, EAB field observations) or air photo signature. This map is relatively static, but new peatlands can be added if observed.

### 5.5.28 PropertyBoundaries\_WVDNR\_20171011

Version date: 2/23/2022 (no updates since 2017)

Previous version(s): 10/11/2017

Input to: Habitat / Value to Society / Huse / Public Use

Location on DEP server:

WETLAND\SourceAsReceived\201710\_WVDNR\_property\_boundary.gdb\PropertyBoundaries\_WVDNR\_20171011 (115 polygons in 2022)

Description: Boundaries of DNR managed areas, including Wildlife Management Areas and State Forests.

Source: Data provided in 2017 by Jess Perkins at WVDNR.

Method: Attributes must be retained in this layer. Attributes are used to help calculate the Public Use metric. The attributes that are used are "hWaterfowl" = 1 OR "hGrouse" = 1 OR "hWoodcock" = 1 OR "tBeaver" = 1 OR "tMink" = 1 OR "tMuskrat" = 1 OR "hDeer" = 1 OR "hBear" = 1 OR "hRabbit" = 1 OR "tBobcat" = 1 OR "tCoyote" = 1 OR "tRedFox" = 1 OR "tRaccoon" = 1 OR "tOpossum" = 1.

### 5.5.29 Public\_surface\_water\_intakes

Version date: 2017

Input to: WaterSupply metric

Description: Public surface water intakes and source water protection area data layers. Note that some of these data are also served publicly at <http://tagis.dep.wv.gov/WVWaterPlan/>

Source:

- M:\environmental\CONFIDENTIAL-public\_surface\_water\_intakes\CONFIDENTIAL-source\_water\_assessment\_and\_protection.gdb
  - Feature Class: ZPC\_statewide\_5hrabove (ZPC\_5\_hr\_travel, geometry only)
  - Feature Class: ZCC\_statewide (Zone of Critical Concern, geometry only)
  - Feature Class: Source\_Water\_Protection\_Areas (Conjunctive Delineation, Wellhead Protection Areas, geometry plus attributes: P\_TYPE, PAC\_SRC)
- M:\environmental\CONFIDENTIAL-public\_surface\_water\_intakes\pswi\_distance\_analysis\_9m.gdb
  - Feature Class: pswi\_watersheds\_with\_out\_of\_state\_drainage (Surface Intake Drainage Area, geometry only)

Strategy: These layers are maintained outside of WQSAS. The layers can be temporarily copied to the Working folder for processing, but should be deleted after processing so that the only copies are the master copies on M:\environmental and the processed zipped shapefile that is sent to WV GISTC. Retain only the filename, geometry, and for Source\_Water\_Protection\_Areas, the necessary attributes, as below:

```
SELECT * FROM Source_Water_Protection_Areas WHERE: "P_TYPE" IN (NULL,
'Secondary Protection Area', 'Protection Area', 'rotection Area', 'Wellhead Critical Area') AND
"FAC_SRC" IN ('GU', 'SW')
```

### 5.5.30 PublicLandBoundaries

Version date: 2/23/2022 (no updates since 2017)

Previous version(s): 10/11/2017

Input to: Habitat / Value to Society / Huse / Public Use

Location on DEP server: WETLAND\SourceAsReceived\Boundaries2017\

Description: Boundaries of various types of public lands.

Source: Data provided in 2017 by Jess Perkins at WVDNR.

### 5.5.31 Railway

Version date: 2017

Updates: checked 2/3/2022 and no updates were available

Input to: BufferPerim, RoadRail metrics

Type of input needed from SDE\_railway\_tiger: geometry only, no attributes needed

Source: M:\LayerFiles\arcsde\_backup.gdb\basemap\_cultural\_non\_replica\SDE\_railway\_tiger

Note that the

“M:\LayerFiles\arcsde\_backup.gdb\basemap\_cultural\_non\_replica\SDE\_railway\_tiger” layer is more accurately and completely mapped than the

“M:\basemap\tiger\_2013\WV\_Transportation\_UTM.gdb\Rail” layer.

### 5.5.32 RestoredWetlands

Version date: 12 October 2017

Strategy: 3/16/2017 EAB

GIS method: 10/12/2017 EAB

Python code: not needed

Final review by EAB: 10/12/2017

Purpose:

Input to Habitat / Value to Society / HInvest



Description: Restored, enhanced, or created Wetlands, including In-Lieu Fee and Mitigation Banks with polygon data (point data is stored in ILF\_banks layer)

Rationale: Wetlands that have been restored, enhanced or created represent investments of time and money, and are of high value to society.

Source Data:

- Project documents and/or air photos

Method:

Create named wetland polygons where there are known investments in restoration, enhancement, or wetland creation. Priority is given to adding wetland polygons that are not already included in the RIBITS database maintained by USACE (ILF & banks) or the WV\_ProtectedLands database (Wetland Reserve Program) maintained by the Freshwater Institute.

Most additions will need to be heads-up digitized from project documents or from recent air photos. Many project boundaries will be well-defined through wetland delineation. If exact boundaries are not easily available, then the boundaries can be approximate, e.g. +/- 100m, and do not need to be attributed to NWI codes. During wetland functional assessment, this layer will be intersected with Wetland Units, and therefore the boundaries do not need to be exact.

Data Fields:

**WetlandName** [text 50 characters]

Give the wetland a name based on the name in the project documents.

**RestoreType** [text 50 characters]

Describe the type of activity: restoration, enhancement, creation

**RegType** [text 20 characters]

Describe the category of regulatory action, if any: ILF, mitigation bank

**RestoreDate** [text 20 characters]

The date that restoration, enhancement, or creation was completed.

**Organization** [text 50 characters]

Name of group or organization doing the restoration, enhancement, or creation work.

**MapSource** [text 50 characters]

Briefly describe the data source used to create the wetland polygon, e.g., “copied from NWI” or “heads-up digitized”.

**Comment** [text 50 characters]

Add brief comments, such as name of educational organization or date of boardwalk construction

### 5.5.33 RunoffLand: Lands that Produce Runoff Layer

Version date: 4 March 2024

Previous version(s): 28 February 2017

Strategy: completed 4/21/2016 EAB

GIS method: 4/21/2016 EAB; completed 11/28/2016 JCC; revised 2/28/2017 MCA to reduce the size of Godzilla polygons, which were causing calculations to hang; revised 2/16/2024 EAB to show number of records at each step in 2024 layer creation. 3/4/2024 SJM to remove Godzilla polygons.

Python coding: coding not needed, but need to create layer

Final verification by EAB: 11/28/2016; revisions verified 2/28/2017

Update schedule: every five years

Flood Attenuation Function / Opportunity aspect / Runoff50m & RunoffWshd factors

Description:

Rationale: Impervious surfaces, urban areas, agricultural areas, mining, industrial and commercial land uses, and recently logged areas contribute to increased runoff. Soils with low infiltration and high runoff characteristics also contribute to runoff.

Summary of strategy: Vectorize NLCD2011 and export land cover classes that produce runoff (impervious surfaces plus cultivated crops). Union with recent timber harvests and SSURGO soils that have high runoff/low infiltration characteristics.

NLCD Values selected

- 21 Developed, Open Space
- 22 Developed, Low Intensity
- 23 Developed, Medium Intensity
- 24 Developed, High Intensity
- 31 Barren Land
- 82 Cultivated Crops

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WaterQualityDatasets.gdb
  - Feature Class: TimberHarvest
  - Feature Class: NLCDpolys (this was created for the DisturbedLand layer)
- M:\basemap\ssurgo\ssurgo.gdb
  - Feature Class: ssurgo\_wv

Output:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WaterQualityDatasets.gdb
  - Feature Class: RunoffLand

Method:

**## Select runoff-producing land cover types from NLCD.**

Select by attributes.

Method: Create a new selection.

SELECT \* FROM NLCDpolys WHERE: "grid\_code" IN (21, 22, 23, 24, 31, 82)  
(3282380 records selected out of 7102272 in 2024)

**## Export runoff-producing land cover types.**

R-click NLCDpolys / Data / Export Data

Export: Selected features

Output feature class: RunoffNLCD

(3282380 records)

**## Clip the layer to the state boundary**

ArcToolbox / Analysis Tools / Extract / Clip

Input feature: RunoffNLCD

Output: RunoffNLCD\_clip

*(Note that this took 11 minutes of processing time in 2024)*

(1258409 records)

**## Dissolve to reduce file size and processing time.**

ArcToolbox / Data Management Tools / Generalization / Dissolve

Input feature: RunoffNLCD\_clip

Output feature class: RunoffNLCD\_diss

Do not check box "Create multipart features"

(402178 records)

*##Note: disable background processing if these steps take too long to run.*

**## Union land use selections.**

For the union to work, the Z and M values must be removed from the TimberHarvest feature class. Union can't be performed when one feature class has these values and the other (RunoffNLCD\_diss) does not.

ArcToolbox/Conversion Tools/To Geodatabase/Feature Class to Geodatabase

Input features: TimberHarvest

Output Geodatabase: RunoffLand.gdb

Environments... (Button): Disable the Z and M values

ArcToolbox/Analysis Tools/Overlay/Union

Input Features: TimberHarvest, RunoffNLCD\_diss

Output Feature Class: RunoffNLCDTimb\_union

Join Attributes: ONLY\_FID  
Check box "Gaps Allowed" (default)  
(428912 records)

**## Dissolve to reduce file size and processing time.**

ArcToolbox / Data Management Tools / Generalization / Dissolve  
Input feature: RunoffNLCDTimb\_union  
Output feature class: RunoffNLCDTimb\_diss  
Uncheck box "Create multipart features"  
(368389 records)

**## Select SSURGO soils with high runoff/low infiltration characteristics.**

Select by attributes.  
Method: Create a new selection.  
SELECT \* FROM ssurgo\_wv WHERE: "hydgrpdc" = 'D'  
(73960 out of 413438 selected)

**## Export SSURGO soils with high runoff/low infiltration characteristics.**

R-click ssurgo\_wv / Data / Export Data  
Export: Selected features  
Output feature class: RunoffSoil  
(73960 records)

**## Dissolve to reduce file size and processing time.**

ArcToolbox / Data Management Tools / Generalization / Dissolve  
Input feature: RunoffSoil  
Output feature class: RunoffSoil\_diss  
Uncheck box "Create multipart features"  
(23097 records)

**## Union land use and soil selections.**

ArcToolbox/Analysis Tools/Overlay/Union  
Input Features: RunoffSoil\_diss, RunoffNLCDTimb\_diss  
Output Feature Class: RunoffLandUnion  
Join Attributes: ONLY\_FID  
Check box "Gaps Allowed" (default)  
(442995 records)

**## Dissolve to reduce file size and processing time.**

ArcToolbox / Data Management Tools / Generalization / Dissolve  
Input feature: RunoffLandUnion

Output feature class: RunoffLand in WaterQualityDatasets.gdb  
Uncheck box “Create multipart features” (default)  
(313768 records)

**## Simplify Godzilla polygons with large numbers of vertices, by one of two methods  
## use the Dice tool on each overly-complex polygon and union all diced layers together,  
then add the unioned layer to the original with the diced polygons deleted. (See Section  
5.5.10 FloodplainARAFEMA Godzilla section for more instructions.)  
## or add field to count vertices as in DisturbedLand method  
(5 Godzilla polygons with more than 100,000 vertices in 2024)**

### 5.5.34 SDE\_NHD\_waterbodies\_24k\_rivers & 50\_mi\_drainage

Version date: 2016

Updates: Checked in 2024 with Megan Maggard. No updates available.

Input to: WFlowPath (SDE\_NHD\_waterbodies\_24k\_rivers, geometry only, no attributes) and  
WshdPos (SDE\_NHD\_reach\_24k\_gt\_50\_mi\_drainage, geometry and attributes GNIS\_Name  
and DA\_sq\_mi)

Location: M:\LayerFiles\arcsde\_backup.gdb \ basemap\_physical\_non\_replica \

- SDE\_NHD\_waterbodies\_24k\_rivers
- SDE\_NHD\_reach\_24k\_gt\_50\_mi\_drainage

Description: SDE\_NHD\_waterbodies\_24k\_rivers is a polygon layer containing the larger rivers  
and streams. SDE\_NHD\_reach\_24k\_gt\_50\_mi\_drainage contains the reaches that have a  
drainage area greater than 50 square miles.

### 5.5.35 Septic: Septic System Failure Risk Layer

Version date: 21 February 2024

Previous version(s): 17 March 2016

Strategy: completed 3/11/2016 EAB

GIS method: completed 3/11/2016 EAB; verified 3/11/2016 EAB

Python coding: started & completed 3/17/2016 MCA

Final review by EAB: 3/17/2016; in 2024 EAB updated most of these instructions for ArcGIS Pro rather than ArcMap.

Purpose:

Water Quality Function, Opportunity aspect, input to Discharges (discharges to the wetland within 100 meter buffer)

This procedure creates a data layer named Septic. No points at this level, maximum of 1 point can be assigned in Discharges variable

Update schedule:

Layer should be updated (re-created from source data) approximately every 5 years, or with major updates to SAMB or Tiger sources.

Description:

Rationale: Septic systems can pollute groundwater because nitrogen is not removed underground. Plumes of nitrogen from septic systems can be traced at least 250ft in the groundwater (Aravena and others 1993). Use an aerial photograph of the unit to determine if there are any residences within 250ft of the unit. Septic systems are still in common use in many areas outside of city boundaries. If you are outside city limits in areas with lots of 1/2 acre or larger you can assume the houses are on septic systems unless another type of water supply system is indicated on the water supply GIS layer.

Summary of strategy: Calculate as known septic systems (NPDES permit) or presence of structures. Exclude sewerred areas, urbanized areas, and areas with low or very low risk of septic failure.

Source Data:

- M:\wr\owrnpdes\_.shp (updated 2024)
- M:\basemap\building\_footprints (updated 2024)
- ~~M:\basemap\WVSAMB\structures\_SAMB\_points\_UTM83.shp~~
  - Geometry Type: Point
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceFunctionalAssessment\WaterQualityDataset s.gdb
  - Feature Class: SeweredAreas (updated 2024)
  - Feature Class: SepticFailureRiskStatsgo
- M:\LayerFiles\arcsde\_backup.gdb
  - Feature Dataset: tiger2010      Feature Class: urbanized\_areas

Method:

**## PART 1: Select structures that intersect sewered areas or urbanized areas.**

Select by Location

Selection type: new selection

Input feature: building\_footprints

Selecting feature: SeweredAreas

Relationship: intersect

Select by Location

Selection type: add to the currently selected features in

Input feature: building\_footprints

Selecting feature: urbanized\_areas

Relationship: intersect

**## Reverse selection.**

Open attribute table of building\_footprints and click "Switch Selection"

**## Select only those structures that intersect moderate and high risk septic failure areas.**

Open attribute table of SepticFailureRiskStatsgo

Select by attributes

SELECT \* FROM SepticFailureRiskStatsgo WHERE: "SepticZone" = 'high' OR "SepticZone" = 'moderate'

New selection

Select by Location

Selection type: select from the current selection

Input feature: building\_footprints

Selecting feature: SepticFailureRiskStatsgo

Relationship: intersect

**## Export selected polygons.**

R-click building\_footprints and Data/Export Data/Export selected features

Output feature class: SepticStructures

**## PART 2: Select septic permits from ownrpdes\_ and export to point feature class.**

Select by attributes from ownrpdes\_

SELECT \* FROM ownrpdes\_ WHERE "perm\_type" = 'Septic Tank'

R-click ownrpdes\_ and Data/Export Data/Export selected features

Output feature class: SepticTanks

**## Select septic permits that intersect sewerred areas or urbanized areas.**

Select by Location

Selection type: select features from

Input feature: SepticTanks

Selecting feature: SeweredAreas

Relationship: intersect the source layer feature

Select by Location

Selection type: add to the currently selected features in

Input feature: SepticTanks

Selecting feature: urbanized\_areas

Relationship: intersect the source layer feature

**## Reverse selection.**

Open attribute table of SepticTanks and click “Switch Selection”

**## Select only those permits that intersect moderate and high risk septic failure areas.**

Open attribute table of SepticFailureRiskStatsgo

Select by attributes

```
SELECT * FROM SepticFailureRiskStatsgo WHERE: "SepticZone" = 'high' OR "SepticZone" = 'moderate'
```

Select by Location

Selection type: select from the currently selected features in

Input feature: SepticTanks

Selecting feature: SepticFailureRiskStatsgo

Relationship: intersect the source layer feature

**## Export points.**

R-click building\_footprints and Data/Export Data/Export selected features

Output file: SepticTankRisk

**## PART 3: Convert SepticStructures polygons to points. Append SepticTankRisk to SepticStructures to include both septic tanks and structures.**

Data Management / Features / Feature to Point

(note that if you are working with a shapefile, it will need to be converted to a feature class)

In ArcCatalog, R-click SepticStructures and Load/Load Data

Input data: SepticTankRisk

Add



Check radio button “I do not want to load all features into a subtype” (default)  
No need to link any target fields with matching source fields  
Check radio button “Load all of the source data”

Output file should be named Septic

Save to WaterQualityDatasets.gdb. Place updated zipped shapefile in folder to send to WV GISTC. Update table 5.4 in WWWRAM Reference Manual.

### 5.5.36 SepticFailureRiskStatsgo: Septic Failure Risk from NRCS Statsgo Layer

Version date: 24 January 2018 (checked in 2024, no updates)

Strategy & GIS method: 3/16/2016 EAB

Python coding: not needed

Final review by EAB: 3/17/2016

Purpose:

Water Quality Function, Opportunity aspect, Discharges, input to Septic System Failure Risk (Septic) Layer.

Update schedule:

Layer should be updated (re-created from NRCS source data) approximately every 5 years, or with major updates to NRCS data portal.

Description:

Rationale: Soils with high septic failure risk are more likely to produce groundwater pollution.

NRCS has mapped soils with high septic failure risk in its Statsgo dataset. When I checked back in 2018, Statsgo appears to have been replaced with the Web Soil Survey. I found the Septic data in:

Soil Data Explorer / Suitabilities and Limitations Ratings / Sanitary Facilities / Septic Tank Absorption Fields. It may be worth looking at other NRCS products like the gridded SSURGO, which may be better or more easily downloaded data. Also, check with Steve Stutler or whomever is managing TMDL mapping for WVDEP / WAB, as they may have more knowledge of the best update source.

Source Data:

Download from NRCS.

Method:

Download data and save to location below.

Output Data:

M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceFunctionalAssessment\WaterQualityDatasets.gdb\SepticFailureRiskStatsgo

### 5.5.37 SeweredAreas: Sewered Areas Layer

Version date: 20 February 2024

Previous version(s): 2 February 2018

Strategy & GIS method: 3/16/2016 Steve Stutler, WVDEP / WAB

Python coding: not needed

Final review by EAB: 3/17/2016

Purpose:

Water Quality Function, Opportunity aspect, Discharges, input to Septic System Failure Risk (Septic) Layer.

Update schedule:

Layer should be updated (re-created from source data) approximately every 5 years, or with major updates to TMDLs and associated sewer areas mapping.

Rationale: Sewered areas are unlikely to receive groundwater pollution from septic systems.

Source Data and Method:

M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceFunctionalAssessment\WaterQualityDatasets.gdb\SeweredAreas2018 (Steve Stutlar's layer, 1043 polygons)

M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceAsReceived\Sewered Areas\WVIJDCutility\_SewerServedArea071123.shp (627 polygons)

Sewered areas have been mapped within TMDL watersheds. This coverage was maintained by Steve Stutler, WVDEP / Watershed Assessment Branch / TMDL / Listing & Reporting until his retirement. Steve Stutlar's layer still contains areas that are sewered but do not show up on the current layer maintained by WVUDC Utility GIS. Therefore, these two layers should be merged. Steve's process was to check the NPDES permits and outlets and create a shapefile of records that are likely to have sewage in them, e.g., package plants, publicly owned treatment works, and collection systems. He then figures out the areas covered by those sewered outlets, often by going to the facility and having someone familiar with the system draw a sketch map on an air photo or other map. Steve then converts this field map to GIS polygons. In 2018, there were 1043 polygons in the layer.

Strategy: Dissolve both input files and then union them. Dissolve the final sewered areas and save to WaterQualityDatasets.gdb.

**## Dissolve layers to reduce file size and avoid Godzilla polygons.**

ArcToolbox / Data Management Tools / Generalization / Dissolve

Input feature: SeweredAreas2018

Do not create multipart features

Output: SeweredAreas2018Dissolve  
(581 polygons)

ArcToolbox / Data Management Tools / Generalization / Dissolve  
Input feature: WVIJDCutility\_SewerServedArea071123.shp  
Do not create multipart features  
Output: WVIJDCSewer2023Dissolve  
(282 polygons)

### **## Union sewered areas.**

*## Note that with ArcEditor license, Union can only accept two layers at a time. The unions take  
## some time to process. Dissolve each intermediate layer prior to Union-ing.*

ArcToolbox/Analysis Tools/Overlay/Union  
Input Features: SeweredAreas2018Dissolve, WVIJDCSewer2023Dissolve  
Join Attributes: ONLY\_FID  
Check box "Gaps Allowed" (default)  
Output: SeweredAreasUnion  
(1147 polygons)

**## In 2024, we then added the small updated watershed files of sewered areas that were created for TMDL. This involved lots more Unions. These files were located in M:\wr\WTRSHD\_BRANCH\TMDL FINAL GIS DATA**

### **## Dissolve layer to reduce file size and avoid Godzilla polygons.**

ArcToolbox / Data Management Tools / Generalization / Dissolve  
Input feature: SeweredAreasUnion  
Do not create multipart features  
Output: SeweredAreasUnionDissolve  
(470 polygons)

### **## Check for godzillas (not really needed for this layer)**

In attribute table of SeweredAreasUnionDissolve, add field: VertexCount (long integer)  
R-click, Field Calculate, Python code selected, VertexCount = !shape!.pointcount  
Sort descending to see if there are any polygons with more than 100,000 vertices  
If there are, break them into smaller polygons with the edit/cut tool.  
When finished, you can delete the VertexCount field.

### **## Export SeweredAreasUnionDissolve to:**

M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceFunctionalAssessment\WaterQualityDatasets.gdb\SeweredAreas

## **5.5.38 Slope**

Version date: 2/24/2024

Previous version(s): 2017

Input to Slope and SlopeWshd metrics (raster values)

Location: M:\elevation\statewide\_slope\_pct.tif (updated version)

Previous version was located, and is still available, at:

M:\dems\ned\_slope\_aspect.gdb\NED\_3meter\_meters\_augmented\_slope\_pct\_int

We spoke with Mike Shank about the updated version, and he pointed us to the new file location. This large file (90GB) was uploaded to Google Drive and transferred to Yibing. The tif format was accepted.

### 5.5.39 Ssurgo\_wv

Version date: 2017

Updates: checked 2/23/2022 and no updates available on DEP server; updates must be downloaded from NRCS which is somewhat complicated. Since soil mapping changes less often than many other metrics, this layer is a lower priority for updating.

Input to RunoffLand layer (geometry plus attribute "hydgrpdc") and SoilRunoff metric (geometry plus attribute "hydgrpdc")

Location: M:\basemap\ssurgo\SSURGO.gdb\ssurgo\_wv

### 5.5.40 Ssurgo exports: Calcareous Soils and Karst Layer

Version date: 27 February 2017

Strategy: completed 3/1/2017 EAB

GIS method: 3/1/2017 EAB

Python coding: not needed

Final verification by EAB: 3/1/2017

Purpose:

Habitat Function / Intrinsic Potential / Soils

Description:

Rationale: Calcareous soils and karst areas support unique, rich, and often rare biodiversity. They are particularly vulnerable to hydrologic damage and to invasive species encroachments. Summary of strategy: Select calcareous soil series or soils with "karst" in the geomorphic description, respectively.

Source Data:

M:\basemap\ssurgo\ssurgo.gdb  
Feature Class: ssurgo\_wv

Output:

M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SsurgoExports.gdb  
Feature Class: CalcareousSoils  
Feature Class: Karst

Method:

### **Calcareous Soils**

SSURGO query based on advice from Jared Beard, State Soil Scientist:

SSURGO table: ssurgo\_wv  
Select "muname" IN ( 'Fairplay (marl) silt loam', 'Lappans (marl) loam', 'Lappans (marl) silt loam', 'Massanetta loam', 'Massanetta silt loam')  
108 out of 413438 selected

This selects soil polygons in Jefferson and Berkeley Counties, with a few additional polygons in Pendleton and Hardy Counties.

My original thought was to query the chorizon table for “claysizedcarb\_r” > 0, but this returns only the polygons in Jefferson County.

### **Soils with geomorphic description of “karst”**

SSURGO table: component\_all  
"geomdesc" LIKE '%karst%'  
241 out of 9533 selected  
Related tables – back to ssurgo\_wv  
5575 out of 413438 selected

Note:

This includes some but not all of the limestone areas of the state, stopping at certain county boundaries. So I think the geology layer is better for getting at karst soils statewide. However, the SSURGO data is much finer-scale and gets smaller patches nicely, which are sometimes missed by the geology layer. So, use both geology and soils layers to delineate karst areas.

## **5.5.41 SwimmingAreas: Swimming Areas Layer**

Version date: 22 January 2018

Strategy: 2/14/2016

GIS method: completed 3/17/2016

Python code: not needed – this is the procedure to create a spatial dataset

Final review by EAB: 3/17/2016

Purpose:

Water Quality Function / Value to Society / WQ Use

This procedure creates a layer showing known public swimming areas in the state.

Update Schedule:

Every 5 years.

Description:

Water quality is of particular importance in public swimming areas. Wetlands upstream of public swimming areas contribute to better water quality by filtering out pollutants, nutrients, and sediment.

Source Data:

Internet sources, especially:

<http://www.swimmingholes.org/wv.html> (last updated 2.2016)

and interviews with state staff about known swimming areas

Output Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WaterQualityDatasets.gdb
  - Feature Class: SwimmingAreas2016

Method:

As new swimming areas are identified or closed, update layer as appropriate.

### 5.5.42 TimberHarvest: Recent Timber Harvests Statewide Layer

Version date: 14 February 2024  
Earlier version(s): 20 October 2017  
Strategy: completed 3/14/2016 EAB  
GIS method: completed 3/14/2016 EAB  
Updates: 10/20/2017 EAB, 2/14/2024 EAB  
Python coding: not needed

#### Purpose:

Water Quality Function, Opportunity aspect  
This method outputs a “TimberHarvest” feature class for use in compiling the DisturbedLand and RunoffLand layers. It is an intermediate layer that does not need to be transferred to WV GISTC, where the WVWRAM GIST Tool is hosted.

#### Description:

Compilation of recent logging permits from WVDOP (Steve Harouff) and timber sales from WVDNR (Jeremy Rowan). Request data for active sites in the last five years.  
Summary of strategy: If the data have not already been filtered by DNR and DOF, then delete records that are older than the last five years. Dissolve each polygon layer (no multipart polygons) to reduce file size. Buffer points to create 80-acre polygons (average size of cut), which corresponds to a buffer distance of 321 meters. Union the layers two at a time, with Join Attributes: ONLY\_FID and check box “Gaps Allowed”. Dissolve polygons layers in between each union to keep file size minimal and to avoid creating Godzilla polygons with enormous numbers of vertices.

#### Update schedule:

Every five years

#### Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceAsReceived\Timber Harvest
  - LSCA\_Harvest\_Landings\_2019\_02022024
  - LSCA\_Harvest\_Polys\_2019\_02022024
  - WVWMATimberSales\_2019\_2024

#### Input Variables:

None

#### Method:

The grayed-out steps below from 2017 were not necessary in 2024 because the input data were pre-filtered by DNR and DOF.

**## Select recent sales (2010 to present) from WVDNR data.**



Select by attributes

Layer: TimberSalesFeb2016WVDNR

Method: Create a new selection

```
SELECT * FROM TimberSalesFeb2016WVDNR WHERE: "YearContra" > 2010 AND  
"FEATURE" NOT IN ('Leave Area', 'No Cut area') AND "TYPE" NOT IN ('Leave', 'No Sale',  
'Removed')
```

### ## Export selection to new feature class

R-click TimberSalesFeb2016WVDNR / Data / Export Data / Export selected features

Output feature class: TimberHarvest\_DNR

**## Select active permits from WVDOP polygon data, which dates back to 2012.**

**## Note that starting in 2018, these data must be filtered for the last 5 years.**

Select by attributes

Layer: LSCA\_Harvest\_Polys\_031017.shp

Method: Create a new selection

```
SELECT * FROM LSCA_Harvest_Polys_031017.shp WHERE: "Active_Sta" = 'Active'
```

### ## Export selection to new feature class

R-click LSCA\_Harvest\_Polys\_031017.shp / Data / Export Data / Export selected features

Output feature class:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceFunctionalAssessment\WaterQualityDataset  
s.gdb
  - Feature Class: TimberHarvest\_DOE\_031017

### ## Select recent permits (2010 to present) from WVDOP point data.

Select by attributes

Layer: LSCA\_HARVEST\_NOTIFS\_021716.shp

Method: Create a new selection

```
SELECT * FROM LSCA_HARVEST_NOTIFS_021716.shp WHERE: "START" > date '2010-  
01-01'
```

### ## Export selection to new feature class

R-click LSCA\_HARVEST\_POLYS\_021716.shp / Data / Export Data / Export selected features

Output feature class: TimberHarvest\_DOEpt

### ## Buffer points by 321 meters to create 80 acre polygons

Analysis Tools / Proximity / Buffer

Input Features: LSCA\_Harvest\_Landings\_2019\_02022024

Output Feature Class: LSCA\_Harvest\_Landings\_buffer  
Distance (Linear Unit): 321 meters  
Dissolve Type: NONE

**## Dissolve each input polygon layer to reduce file size and avoid creating Godzilla polygons**

ArcToolbox / Data Management Tools / Generalization / Dissolve  
Input feature: LSCA\_Harvest\_Landings\_buffer  
Do not allow multi-part features  
Output: LSCA\_Harvest\_Landings\_buf\_dissolve

ArcToolbox / Data Management Tools / Generalization / Dissolve  
Input feature: LSCA\_Harvest\_Polys\_2019\_02022024  
Do not allow multi-part features  
Output: LSCA\_Harvest\_Polys\_dissolve

ArcToolbox / Data Management Tools / Generalization / Dissolve  
Input feature: WVWMATimberSales\_2019\_2024  
Do not allow multi-part features  
Output: WVWMATimberSales\_dissolve

**## Union the three timber layers, two at a time, into a single polygon feature class. Dissolve between unions.**

Analysis Tools / Overlay / Union  
Input Features: LSCA\_Harvest\_Landings\_buf\_dissolve  
                  LSCA\_Harvest\_Polys\_dissolve  
Output Feature Class: TimberHarvest\_DOF\_union  
Join Attributes: ONLY\_FID  
Check box "Gaps Allowed"

ArcToolbox / Data Management Tools / Generalization / Dissolve  
Input feature: TimberHarvest\_DOF\_union  
Do not allow multi-part features  
Output: TimberHarvest\_DOF\_uni\_dissolve

Analysis Tools / Overlay / Union  
Input Features: TimberHarvest\_DOF\_uni\_dissolve  
                  WVWMATimberSales\_dissolve  
Output Feature Class: TimberHarvest\_union  
Join Attributes: ONLY\_FID  
Check box "Gaps Allowed"

**## Dissolve TimberHarvest**

ArcToolbox / Data Management Tools / Generalization / Dissolve  
Input feature: TimberHarvest\_union  
Do not allow multi-part features  
Output: TimberHarvest

This final step is probably not necessary – it was probably caused in 2017 by neglecting to dissolve each polygon layer prior to union-ing.

**## Check the layer for Godzilla polygons with more than 100,000 vertices**

## (Calculate field for VertexCount: !shape!.pointcount)

## Cut Godzilla polygons to decrease number of vertices

## Explode large multipart polygons as you see them

## Check geometry to be sure there aren't any errors

**## Simplify Godzilla polygons with large numbers of vertices, in other words,**

**## use Simplify Polygons tool on each overly-complex polygon**

**## Check the layer again for Godzilla polygons with more than 100,000 vertices**

## Add long integer field "VertexCount" to TimberHarvest

## ArcToobox/Fields/Calculate field

for VertexCount: !shape!.pointcount)

<https://blogs.esri.com/esri/arcgis/2010/07/23/dicing-godzilla-features-with-too-many-vertices/>

- Data entry using **stream digitizing** (as opposed to point-by-point digitizing) is the usual culprit—it is easy to create features with too many vertices using stream digitizing.
- Features **imported from other software** are another source of Godzillas. Typically, the software that creates them is single-purpose data entry software with no analytic capability like ArcGIS.
- The **Dissolve** tool can create a Godzilla by combining smaller (but still fairly large) features into one feature. This is known as the **combinatorial problem**. The Dissolve tool has logic that prevents it from creating a Godzilla (you'll receive the warning code 000059) but this logic is based on the machine's available memory at the time Dissolve is run. So, while the output may not be a Godzilla on the machine where Dissolve ran, it may be on another machine with less available memory.

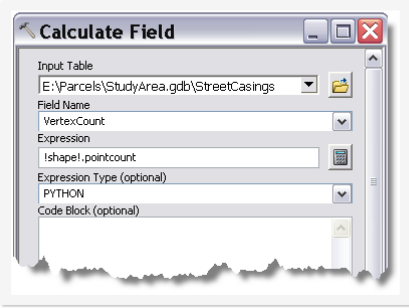
**How many vertices define a Godzilla?**

Unfortunately there is no simple answer since it depends entirely on the available memory your machine has—more memory means more vertices per feature can be processed. You can increase available memory by closing down all other applications other than ArcGIS, turning off background processing as described in the Desktop help topic [Foreground and background processing](#), and re-running your operation. But this is a one-time solution: what you really need to do is get rid of the Godzillas.

**Finding Godzillas**

If you think you've got a Godzilla, your first task is to count the number of vertices for every feature in your feature class. The recipe for this is:

- Use the **Add Field** tool to add a new field named VERTEXCOUNT. The field type is LONG.
- Next, use the **Calculate Field** tool with this expression: `!shape!.pointcount`, as illustrated below.
- After Calculate Field runs, open the feature class attribute table and sort on the VERTEXCOUNT column, or use the **Summary Statistics** tool to find the MAX of VERTEXCOUNT



The VERTEXCOUNT field you added and calculated is not automatically recalculated or maintained. Anytime the geometry of features change, you'll have to run Calculate Field again. Of course, if you no longer need the VERTEXCOUNT field, use **Delete Field** to remove it.

**Simplifying your data**

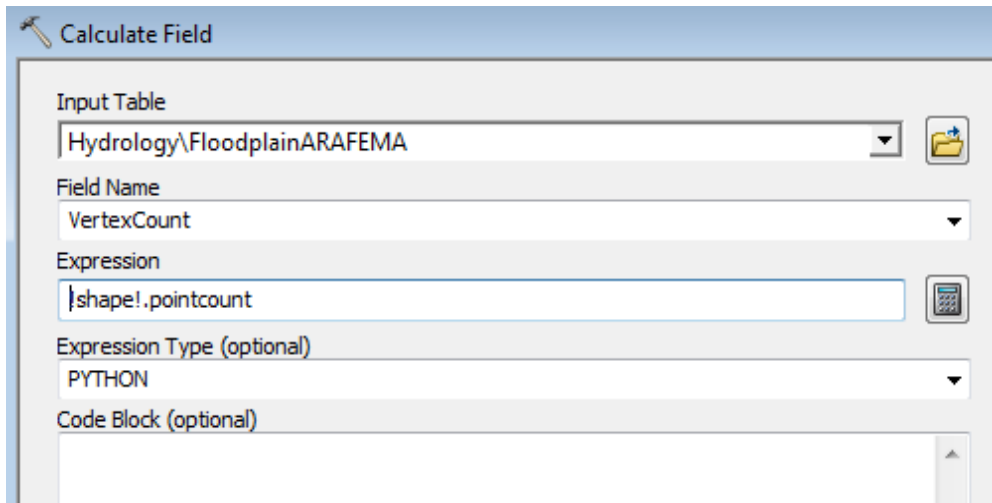
The first question you should ask is if you really need all those vertices to describe the shape of your Godzilla. If you don't need all the vertices, use the **Simplify Polygon** or **Simplify Line** tool. These tools weed out unnecessary vertices. After running Simplify Polygon or

## Cut Godzilla polygons to decrease number of vertices

## Explode large multipart polygons as you see them

## Check geometry to be sure there aren't any errors

This procedure creates “Godzilla” polygons with excessive numbers of vertices. Calculate the number of vertices:



The result shows that the 7 polygons have over 1 million vertices each.

FloodplainARAFEMA					
	OBJECTID *	Shape *	Shape_Length	Shape_Area	VertexCount
▶	1	Polygon	53996324.896162	3040573755.522367	1034084
	2	Polygon	101107564.309451	5855371181.578798	1933262
	3	Polygon	62267314.5704	3468097047.91795	1886231
	4	Polygon	30714255.396928	1388000988.94105	1050397
	5	Polygon	114432544.912949	8820651120.886469	2259243
	6	Polygon	59925642.260688	3737146642.180347	1443725
	7	Polygon	73312174.266924	5532878563.257989	1415591

We want to reduce the number of vertices, and it is okay to greatly increase the number of polygons. Use the Advanced Editing menu. Select the first polygon and Explode Multipart Feature. Repeat for all the polygons with excessive numbers of vertices. A reasonable target is no more than 200,000 vertices, or to run on machines with less computing power, aim for 50,000 max.

There are now have 38,273 polygons.

Re-calculate the Vertex Count and sort descending to see how large the remaining polygons are.

There are still 8 godzilla polygons.

Select the largest polygon and display it. In this case, much of the polygon is outside the state boundary.

Clip to the state boundary.

Re-calculate the Vertex Count. Clipping to the state boundary reduced the number of vertices and polygons, but we still have 13 polygons that are large.

OBJECTID *	Shape *	VertexCount	Shape_Length	Shape_Area
8948	Polygon	573901	19270481.705695	989379087.7021
8940	Polygon	467993	12535554.187262	433159996.1671
8945	Polygon	348716	6875947.453924	307247750.1287
8944	Polygon	336470	7473546.604928	334037041.8003
8913	Polygon	282900	5191616.606475	297577899.8208
8930	Polygon	276153	6136721.073907	225465784.2883
8929	Polygon	256662	4928284.028657	146594338.5023
8939	Polygon	246231	5963703.548092	366715972.1137
8919	Polygon	228153	6961973.809428	262696562.9930
8911	Polygon	221481	5168390.652119	167526751.5629
8910	Polygon	213398	4228302.81113	156445035.2970
8927	Polygon	208399	5386408.614975	210113513.0173
8928	Polygon	170198	3400359.208558	148308467.4043
8926	Polygon	135293	1579435.590921	62698823.94625
8942	Polygon	134210	5126978.804533	217803415.6553
8912	Polygon	115970	2307092.411527	181863952.7191
8943	Polygon	104122	3943513.934997	215158508.6281
357	Polygon	89342	2719157.106055	69784217.29904
370	Polygon	88183	1837249.859314	59212403.13553

Explode Multi-part Features again for polygons with more than 100,000 vertices.

Re-calculate the Vertex Count. 9 polygons still have counts > 200,000.

Select the largest polygon and zoom to it. Find good places to cut it (subwatersheds along major rivers require only a single cut) and cut it into smaller chunks. Repeat for all the other large polygons.

Re-calculate the Vertex Count to verify that no godzillas are left.

### 5.5.43 TMDL: Wetland is in a Watershed with a TMDL Plan Layer

*NOTE: This layer was discontinued in 2022 when the statewide TMDLs were completed and the existence of a TMDL plan no longer served to distinguish between wetlands.*

Version date: 16 March 2016

Strategy: 3/16/2016 EAB

GIS method: drafted 3/16/2016 EAB

Python code: not needed

Final review by EAB: 3/16/2016

Purpose:

Water Quality Function, Value to Society aspect, WQPlan factor

This procedure creates a layer showing the watersheds with a TMDL plan.

Description:

TMDL (Total Maximum Daily Load). A TMDL exists for the drainage in which the wetland is found (2 points). A Total Maximum Daily Load (TMDL) plan is a plan of action used to clean up streams that are not meeting water quality standards. The TMDL program is part of the Watershed Branch of the WVDEP. TMDLs have been completed for 32 watersheds in West Virginia, listed at: <http://www.dep.wv.gov/wvc/watershed/tmdl/Pages/default.aspx>

Update schedule:

Update every 5 years or with major releases of new TMDL plans.

Source Data:

- M:\wr\WTRSHD\_BRANCH\TMDL FINAL GIS DATA\TMDL Subsheds (SWS) alphabetical order.lyr

Method:

#### **Create layer showing watersheds with a TMDL plan**

Open TMDL Subsheds layers. Export the first watershed to a new feature class "TMDL" and load data from all subsequent watersheds into this polygon feature class.

Output Data:

M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WaterQualityDatasets.gdb

- Feature Class: TMDL

#### 5.5.44 TotalLossRP100: Losses from 100-yr flood

Version date: 9 November 2016

Location on DEP server:

WETLAND\SourceFunctionalAssessment\FloodplainData.gdb\TotalLossRP100

Strategy: 4/21/2016 EAB

GIS method: 4/21/2016 EAB

Python coding: not needed (unless it makes it easier to compile the layer)

Complete 11/9/2016 MCA (I used python to make this process quicker and easier)

Final verification by EAB: 11/9/2016

Input to: Flood Attenuation / Value to Society / EconRisk

Description:

Rationale: Estimated total loss from 100-yr flood. Wetlands upstream of economically valuable flood-prone infrastructure (structures, roads, developed lands, cropland) can reduce the costs and negative impacts of flood damages on society.

Summary of strategy: Merge the county “Hazus” shapefiles into a statewide layer.

Source Data:

M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\Floodplain\wvHazusOutputs\_wvdhsem\_012011\_gcs83\_gdb\wvHazusOutputs\_wvdhsem\_012011\_gcs83.gdb

Feature Dataset: Analysis\_Data

Feature Class: (all counties)

Output Layer:

M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\Floodplain\FloodplainData.gdb  
Feature Class: TotalLossRP100

Method:

**## Create new feature class to store statewide total loss data.**

R-click Analysis Data / Barbour and select Data / Export Data

Output feature class:

M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\Floodplain\FloodplainData.gdb  
Feature Class: TotalLossRP100

**## Delete unnecessary fields to keep file size manageable**



Delete all fields EXCEPT  
ObjectID, Shape, TotalLossRP100, Shape\_Length, Shape\_Area

### **## Load counties into statewide feature class**

In ArcCatalog, R-click TotalLossRP100 and select Load / Load Data  
This brings up the Simple Data Loader. Select Next.

Input data: Browse to Berkeley in Hazus / Analysis\_Data. Open.

List of source data to load (click “Add” button below and Berkeley will appear in the white box.  
Next.

Choose an existing geodatabase (automatically populated with FloodplainData.gdb)

Select the target feature class (automatically populated with TotalLossRP100)

Check radio button “I do not want to load all features into a subtype” (default)

Next.

For each target field, select the source field that should be loaded into it (TotalLossRP100 should  
be pre-selected).

Next.

Check radio button “Load all of the source data” (default).

Next.

Finish.

Repeat “load counties” step for the rest of the counties in the state.

### **5.5.45 Trails**

Version date: 9/27/2017

Input to: BufferPerim, PublicUse

Location on DEP server: WETLAND\SourceAsReceived\trails\_Sep\_27\_2017\_webmercator.shp

Source: Trails layers are available from the WV GISTC Data Clearinghouse (Monongahela  
National Forest Datasets and Recreational Trails of West Virginia). Union the available sources  
into a single layer.

### **5.5.46 Trout\_Streams**

Version date: 2/29/2024

Previous version(s): 2017, 2/23/2022 (formerly located at  
M:\wr\WTRSHD\_BRANCH\TROUT\Trout\_Streams.shp which is obsolete)

Input to: Fisheries metric (geometry only, no attributes needed)

Location: HabitatData.gdb\Trout\_Streams.

Source data:

M:\wr\WTRSHD\_BRANCH\_INTERNAL\NHD\_AUID\_2021\NHD\_WVStreams\_20210608.shp

Strategy: Kylie's instructions from 2/2/2024: Select streams with trout designations from NHD\_WVStreams\_20210608 by selecting non-null entries in trout fields. MLM regularly updates NHD\_WVStreams\_20210608 with new trout designations.

Pull NHD\_WVStreams\_20210608.shp into the project

Select trout streams with the Select By Attributes tool

Where TROUT\_E\_P is not equal to (Blank field)

OR TROUT\_RCH is not equal to (Blank field)

(on 2/29/2024, this selected 9,427 records)

Right click on the NHD\_WVStreams20210608 in the Contents pane and select Data -> Export Features

All attributes except basic geometry (FID, Shape, Shape\_Length) can be removed from the file, since only the geometry is used. Leaving TROUT\_RCH column for reference.

Export to HabitatData.gdb as Trout\_Streams and create feature class/shapefile to transfer to WVGISTC.

### **5.5.47 Urbanized\_areas**

Version date: 2010

Updates: checked 2/24/2024 and no updates available.

Input to: DisturbedLand and Septic layers. No need to send this layer to WV GISTC. It is an intermediate layer used to create other layers.

Location: M:\LayerFiles\arcsde\_backup.gdb\tiger2010\urbanized\_areas

### **5.5.48 Watershed Plan: Watershed Plan Layer**

Version date: 3/1/2024

Previous version(s): 24 January 2018

Input to: Water Quality Function / Value to Society / WQPlan metric (geometry only, no attributes needed)

#### Description:

Wetland is within a state nonpoint source watershed management plan area or local water quality planning area. These plans use TMDL and other data sources as inputs. Local and watershed planning efforts are important in maintaining existing water quality.

#### Source Data:

Nonpoint source watershed plans are linked from DEP's website:

<https://dep.wv.gov/WWE/Programs/nonptsource/WBP/Pages/WBP.aspx>

and displayed on an EPA map service:

<https://epa.maps.arcgis.com/apps/webappviewer/index.html?id=7ed40b035aa54c618e72874cbe0408f9>

In 2024, we did not have any information on local watershed plans, so they are not yet included. DEP/WIB staff may know of local watershed plans. In 2024 there were 23 records, and local watershed plans will be sought in the future.

#### Output Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WaterQualityDatasets.gdb (WatershedPlan)

#### Method:

Identify/assemble nonpoint source watershed plans and local watershed plans. Digitize boundaries of plan as needed. In 2024, this involved bringing the HUC12 watersheds into a GIS project along with the old WatershedPlan layer and a basemap. This was visually compared to the new nonpoint source management plan map on the EPA website. The added or subtracted watersheds were copied from the HUC12 layer to make a layer for additions and one for subtractions. The additions were unioned with the old WatershedPlan layer and the subtractions were deleted. Where the HUC12 boundary did not match, the boundary was hand-drawn with the mouse. The layer was clipped to the state boundary and dissolved. Finally, the crude boundaries with lots of tiny gaps were replaced by cutting out the sections with gaps, then filling them back in using autocomplete polygon and merge polygons. Extra attribute fields were deleted since this layer only uses geometry.

### 5.5.49 Watersheds\_12digit

Version date: 2015

Input to: EconRisk and HUC12WQ metrics (geometry only)

Location: M:\basemap\watersheds\_12digit

Checking that location in Feb 2024, the layer is still there, and there are two versions, an old (2006) version and a new 2023 version with its most recent load date 2015. No need to update since this should be the same as the current version.

### 5.5.50 Wellpads

Version date: 4 March 2024

Location: WellPads in WaterQualityDatasets.gdb

GlobalVars code: srcWellPads =

r"M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceFunctionalAssessment\WaterQualityDatasets.gdb\WellPads"

Purpose: Input to Discharges metric

Source & Description: Data provided in 2016 by Laura Adkins, DEP; provided via Charles (Taylor) Brewer in 2024. We want the well pads permitted within the last 5 years (PERMIT\_ISSUE\_DATE after 1/1/2019). Points and/or polygons are fine (these were point data in 2016 and 2024). Wetlands will be considered stressed if they are within 100 m of a recently constructed wellpad. In 2016, there were 471 points in this dataset, and 131 points in 2024. This is a geometry-only layer, i.e., the attributes are not used by WWWRAM (but note that the data need to be screened to include only permits from the last 5 years).

Method:

Data provided will likely be in an excel spreadsheet, perhaps in .xlsx format

From the catalog, drag "Sheet1\$" into the contents pane.

Right click on Sheet1\$ and select Display XY Data. Select UTM\_E for the X Field and UTM\_N for the Y Field. Change the coordinate system to Current Map, which will be NAD\_1983\_UTM\_Zone\_17N.

Click OK and this will generate the layer.

Delete all attributes except for FID, Shape, FacilityNa, and entrydate to streamline the file.

Export to WaterQualityDatasets.gdb as WellPads.

### 5.5.51 WetlandBirds: Wetland Breeding Bird Occupancy Layer

Version date: 20 February 2017

Location:

WETLAND\SourceFunctionalAssessment\HabitatData.gdb\WetlandBirds\_WetBirdColumnOnly

Input to Habitat / Landscape Opportunity (LandEco: Landscape Ecological Connectivity) / WetldBird

Strategy: 2/20/2017 EAB

GIS method: 2/20/2017 EAB

Final review by EAB: 2/20/2017

## **Wetland Birds: WV Birds that benefit from wetland protection**

Layer created from WV Breeding Bird Atlas data on 2/17/2017 by Elizabeth Byers, Senior Wetland Scientist at WVDEP, in consultation with Rich Bailey, Ornithologist at WVDNR.

Update schedule:

This layer does not need to be updated until the next reiteration of the state Breeding Bird Atlas, which is on an approximately 20-year cycle, i.e. circa 2038.

Description:

Rationale: Landscapes with high occupancy and density of wetland-dependent breeding birds provide high biodiversity opportunity (maintenance and dispersal of native species richness, rare species, and natural communities).

Distributions of the following species were rolled up into a “wetland bird heat map” for WV. Full weight is given to wetland-dependent birds, and half-weight to non-wetland-dependent species that benefit from wetland protection as part of their habitat requirements. Species with no data were not included. GIS method is described below.

*\*Block Occupancy Model*

*+Raw Block Data Only*

### Wetland-dependent

- **+ABDU *Anas rubripes* American Black Duck**
- **\*ALFL *Empidonax alnorum* Alder Flycatcher**
- **+AMBI *Botaurus lentiginosus* American Bittern**
- **\*AMWO *Scolopax minor* American Woodcock**
- **COMO *Gallinula chloropus* Common Moorhen** (not detected during atlas)
- **\*COYE *Geothlypis trichas* Common Yellowthroat** (not SGCN but declining)
- **\*GBHE *Ardea herodias* Great Blue Heron**
- **\*GRHE *Butorides virescens* Green Heron**
- **+HOME *Lophodytes cucullatus* Hooded Merganser**
- **KIRA *Rallus elegans* King Rail** (considered extirpated)
- **+LEBI *Ixobrychus exilis* Least Bittern**
- **MAWR *Cistothorus palustris* Marsh Wren** (not detected during atlas)
- **\*NOWA *Seiurus noveboracensis* Northern Waterthrush**
- **+OSFL *Contopus cooperi* Olive-sided Flycatcher**
- **+PROW *Protonotaria citrea* Prothonotary Warbler**
- **RUBL *Euphagus carolinus* Rusty Blackbird** (not a breeding bird in WV)
- **SEWR *Cistothorus platensis* Sedge Wren**
- **+SORA *Porzana carolina* Sora**
- **\*SWWA *Limnothlypis swainsonii* Swainson’s Warbler**
- **+VIRA *Rallus limicola* Virginia Rail**
- **\*WIFL *Empidonax traillii* Willow Flycatcher** (not SGCN but declining)

- **+WISN *Gallinago delicata* Wilson's Snipe**
- **YBFL *Empidonax flaviventris* Yellow-bellied Flycatcher** (not detected during atlas)
- **\*YEWA *Setophaga petechia* Yellow Warbler** (not SGCN but declining)

Not wetland-dependent, but benefit from wetland protection as part of their habitat requirements

- \*BAEA *Haliaeetus leucocephalus* Bald Eagle
- \*BANS Bank Swallow *Riparia riparia*
- \*BBCU Black-billed Cuckoo
- \*BTBW Black-throated Blue Warbler
- \*BWWA Blue-winged Warbler
- \*CAWA *Cardellina canadensis* Canada Warbler
- +CCSP *Spizella pallida* Clay-colored Sparrow
- \*CLSW Cliff Swallow
- \*COME *Mergus merganser* Common Merganser
- \*EAME *Sturnella magna* Eastern Meadowlark
- \*EWPW *Anrostomus vociferus* Eastern Whip-poor-will
- \*GWWA Golden-winged Warbler
- +LEOW *Asio otus* Long-eared Owl
- \*LOWA *Seiurus motacilla* Louisiana Waterthrush
- +NAWA *Vermivora ruficapilla* Nashville Warbler
- +NOGO *Accipiter gentilis* Northern Goshawk
- +NOHA *Circus cyaneus* Northern Harrier
- +NSWO *Aegolius acadicus* Northern Saw-whet Owl
- +OSPR *Pandion haliaetus* Osprey
- +PBGR *Podilymbus podiceps* Pied-billed Grebe
- \*RHWO Red-headed Woodpecker
- SEOW *Asio flammeus* Short-Eared Owl (winter/migration only)
- +SPSA *Actitis macularius* Spotted Sandpiper
- +UPSA *Bartramia longicauda* Upland Sandpiper
- \*YBSA *Sphyrapicus varius* Yellow-bellied Sapsucker

Source Data:

Raw data from the WVDNR Breeding bird atlas, including block occupancy maps and distribution maps by species

- \Breeding Bird Atlas\WVBBA2 Occupancy Maps.gdb
  - Feature Class: BlockOccupancy
- \Breeding Bird Atlas\Distribution\_Maps.gdb
  - Feature Class: Blocks\_2653\_BBA2\_PriorityNonpriority

Output Data:

M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceFunctionalAssessment\HabitatData.gdb

Feature Class: WetlandBirds\_WetBirdColumnOnly

Method:

Block Occupancy Models:

Scores are presented as occupancy probabilities from 0 to 1

Create new fields (float) for:

- WetDepSum: sum of occupancy scores for wetland dependent birds
- NDepSum: sum of occupancy scores for non-wetland dependent birds
- WetOccAvg: sum of the averaged scores, with full weight to WetDepSum and half-weight to NDepSum

WetDepSum = [ALFL]+ [AMWO]+ [COYE]+ [GBHE]+ [GRHE]+ [NOWA]+ [SWWA]+  
[WIFL]+ [YEWA]

Count = 9

Weight = 1

NDepSum = [BAEA]+ [BANS]+ [BBCU]+ [BTBW]+ [BWWA]+ [CAWA]+ [CLSW]+  
[COME]+ [EAME]+ [EWPW]+ [GWWA]+ [LOWA]+ [RHWO]+ [YBSA]

Count = 14

Weight = 0.5

WetOccAvg = WetDepSum/9 + NDepSum/(14\*0.5)

Calculating the sum rather than the average of the weighted scores allows the heavier-weighted wetland-dependent birds to retain more of their value, with the non-wetland dependent birds added as an increment. This may not be the most elegant solution but it does appear to preserve the overall patterns of distribution pretty well.

Raw Block Data:

Scores are codes (see below) that must be converted to occupancy scores.

Codes:

0 Block note surveyed	11 Not reported in priority block
1 Not reported	12 Also detected (other datasets)
2 Also detected (other datasets)	13 Observed in priority block
3 Observed	14 Possible in priority block
4 Possible	15 Probable in priority block
5 Probable	16 Confirmed in priority block
6 Confirmed	

Create new field for each species and populate with approximate occupancy scores based on original codes.

Select values 2,3,12,13 and populate new species field with 1

e.g., Select "ABDU\_2" IN (2,3,12,13) and field calculate "ABDU" = 1

Select value 4,14. New species field= 2

Select value 5,15. new species field = 3

Select value 6,16. New species field = 4

Create fields to store the summations and average values:

- Wetland: average of occupancy scores for wetland dependent birds
- WetPartial: weighted (0.5) average of occupancy scores for non-wetland dependent birds
- WetSum: sum of the two averages

Sum values in “Wetland”, then divide by (4 x 9 spp) so that confirmed occupants have a score of “1”, and others less.

“Wetland” = ([ABDU] + [AMBI] + [HOME] + [LEBI] + [OSFL] + [PROW] + [SORA] + [VIRA] + [WISN]) / (4\*9)

For non-wetland-dependent birds, do the same calculations, but the final summation will be divided by (8 x 10 spp) for half the weight of the wetland birds.

“WetPartial” = ([CCSP] + [LEOW] + [NAWA] + [NOGO] + [NOHA] + [NSWO] + [OSPR] + [PBGR] + [SPSA] + [UPSA]) / (8\*10)

These scores are then added together.

“WetSum” = [Wetland] + [WetPartial]

Calculating the sum rather than the average of the weighted scores allows the heavier-weighted wetland-dependent birds to retain more of their value, with the non-wetland dependent birds added as an increment. This may not be the most elegant solution but it does appear to preserve the overall patterns of distribution pretty well.

#### Combine the two source layers

Join the two source layers based on the Block\_ID. Add the Raw Block “WetSum” to the Occupancy Model “WetOccAvg” for a total block occupancy.

Adding rather than averaging gives about twice as much weight to the block-only species (since there are fewer species) in the few blocks where they occur. It also minimizes downgrading the blocks that were not surveyed, since the occupancy models retain their weight in those blocks, i.e. they are not averaged with zero. This is not a perfect solution but it does a decent job of retaining the overall pattern of wetland bird occupancy, without much complexity in the calculation.

“WetBird” = [WetOccAvg] + [WetSum]

#### Set thresholds for display

Very High Occupancy: atlas block in upper 10% of values (WetBird > 0.493)

High Occupancy: atlas block in upper 10-50% of values (WetBird > 0.408)

Moderate Occupancy: atlas block in upper 50-75% of values (WetBird > 0.354)

Low Occupancy: atlas block in lower 50% of values (WetBird ≤ 0.354)

### 5.5.52 Wb-rivers: Wide rivers

Version date: 2019

Input to: LandPos metric (geometry only)

Location: M:\basemap\national\_hydrology\_dataset\wb-rivers.shp



Checking that location in Feb 2024, the layer is still there and it is dated 2008. No updates apparently available.

Description: This layer is used in LandPos to assign Lotic River Landscape Position to wetlands in an active floodplain within 200m of a wide river.

### **5.5.53 WV\_Protected\_Lands**

Version date: 2015

Input to: HInvest, OwnerAccess (both geometry and attributes are needed)

Location:

WETLAND\SourceAsReceived\WV\_Protected\_Lands\_2015\_PUBLIC\WV\_Protected\_Lands\_2015\_PUBLIC.shp

Source: Michael Schwartz of Freshwater Institute used to update this layer. When EAB checked in 2024, the 2015 version was still the latest version. Michael Schwartz is now retired and no longer updating the layer. Jess Perkins' GIS team at DNR may possibly take on these updates, and she would be the person to check with.

### **5.5.54 WV\_Transportation**

Version date: 2013

Updates: Checked on 2/26/2024 and no updates were available at that time.

Input to: BufferPerim, RoadRail

Type of input needed from WV\_Transportation is the geometry only (no attributes) of five feature classes. The RoadRail metric uses the feature class All\_Roads (geometry only). The BufferPerim metric uses the geometry only (no attributes) of Interstates, Local\_Roads, Other\_Roads\_And\_Trails, and Primary\_Roads.

Location: M:\basemap\tiger\_2013\WV\_Transportation\_UTM.gdb

## 5.6 ArcGIS Methods for Calculating Metrics

The following sections described the source data and methods to calculate the GIS metrics used in the West Virginia Wetland Rapid Assessment Method.

### 5.6.1 AllResults: Results of All GIS Metrics

Version date: 2 April 2018

Purpose:

Store results for each run of the wetland functional assessment tool, including identifiers and metrics.

Description:

Rationale: Storing the results in a single feature class allows for easy archival, sharing, report generation, and analysis. GIS results are exported to a table for import into the WVWRAM MS-Access database.

Strategy: Copy the values for the metrics below into a single feature class. This can be done by a Spatial Join, a Join on WUKey, or in ArcCatalog through Load Data.

Source Data:

M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandFunctionResults\WetlandFunction\_[date\_time].gdb\

Output:

M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandFunctionResults\Runs\WetlandFunction\_[date\_time].gdb  
o Feature Class: WU\_AllResults

Method:

**## STEP 1: Create feature class to store the results**

**## Note that WUKey is included and will be an important linking field**

Open WetlandFunction\_[date\_time].gdb\WU\_[date] and Data / Export Data (all features)  
Output feature class: WU\_AllResults1

**## STEP 2: Add the identifier fields (link to original input polygons)**

*## Copy the values for the fields below to the AllResults feature class. This can be done using a Spatial Join, ## Join on WUKey, or in ArcCatalog through Load Data.*

SiteCode (if available in original file)  
WetlandName (required)  
SurveyDate (required)

**## STEP 3: Add scoring fields**

**## Link to WU\_Function and add metrics, with the four roll-up scores listed first**

*## Copy the values for the fields below to the AllResults feature class. This can be done using a Spatial Join, ## Join on WUKey, or in ArcCatalog through Load Data.*

Function  
RegFunction  
Condition  
DNRLandAcq  
BRank  
FAFunction  
FAOpportun  
FAPotential  
FASociety  
HCondition  
HFuncNoBR  
HFunction  
HOpportun  
HPotential  
HSociety  
WQFunction  
WQOpportun  
WQPotential  
WQSociety

**## STEP 4: Add metrics**

**## Link to feature classes in WetlandFunction\_[date\_time].gdb\ WU\_[fieldname]**

*## Copy the values for the metrics below into a single feature class. This can be done using a Spatial Join, ## Join on WUKey, or in ArcCatalog through Load Data.*

AquaAbund	Dist50mFQ (in VegFQ)	HUC12WQ
BRankHUC	Disturb50m	HUse
BufferContig	DisturbWshd	HydIntact (in HydroH)
BufferLand	EconRisk	HydroH
BufferPerim	Fisheries	HydSW (in HydroH)
ChemTime	FloodArea	ImpairedIn
Clay	FloodIn	ImpairedOut
ClayOrganic	Floodplain	IrrEdge
ConnectFL (in Connect)	Floodway	Karst
ConsFocus	Headwater	LandEco
Depressions	HInvest	LandHydro
Discharges	Histosol	LandInteg

LandPos	Slope	VegPerUng
LandResil	SlopeWshd	VegPerUng1
LowSlope	SoilH	VegPerUng4
MarlPEM	SoilIntact (in Disturb50m)	VegVerStr
Microtopo	SoilOrgCalc	VegWoody
Organic	StreamEdge	VegWoody4
OwnerAccess	StrucPatch	VegWoodyFor
PublicUse	SWOutflow	VegWQ
RoadRail	SWOutflow2	WaterSupply
Runoff	VegAll	WetldBird
Runoff50m	VegByLP	WFlowPath
RunoffWshd	VegFA	WQPlan
SeaPondRat (in	VegFQ	WQUse
SeasonPond)	VegH	WshdPos
SeasonPond	VegHorInt (in Microtopo)	WshdUniq

**## END OF PROCEDURE**

## 5.6.2 AquaAbund: Aquatic Area Abundance

Version date: 3 October 2017

Strategy: 3/16/2017 EAB

GIS method: 10/3/2017 EAB; results verified 10/3/2017 EAB

Python code:

Final review by EAB:

Purpose:

Input to Habitat / Landscape Opportunity (LandHydro: Landscape Hydrologic Connectivity)

Description:

*Maximum 2 points*

Rationale: “Definition: The aquatic area abundance of an Assessment Area is assessed in terms of its spatial association with other areas of aquatic resources, such as other wetlands, lakes, streams, etc. It is assumed that wetlands close to each other have a greater potential to interact ecologically and hydrologically, and that such interactions are generally beneficial.”

“Rationale: ...The functional capacity of a wetland is determined not only by its intrinsic properties, but by its relationship to other habitats across the landscape. Several researchers have concluded that landscape-scale variables are often better predictors of stream and wetland integrity than localized variables (Roth et al. 1996; Scott et al. 2002). Wetlands that are close together without hydrological or ecological barriers between them are better able to provide refuge and alternative habitat patches for metapopulations of wildlife, to support transient or migratory wildlife species, and to function as sources of colonists for primary or secondary succession of newly created or restored wetlands. In general, good landscape connectivity exists only where neighboring wetlands or other habitats do not have intervening obstructions that could inhibit the movements of wildlife.” (CWMW 2013)

GIS Method (no field method):

Calculate % cover of wetlands, ponds, lakes, and rivers in a 1 km buffer. Use the Enhanced National Wetlands Inventory as the source data for wetlands, ponds, lakes, and rivers. Note that the Enhanced NWI includes pond features copied over from the NHD. The Enhanced NWI includes wide (polygonal) rivers but it does not include line features for small streams. This part of the metric is size-neutral.

Calculate total length stream reaches in a 1 km buffer. Note that this calculation gives an advantage to large wetlands, which have more area in the 1 km buffer. This advantage is realistic because large wetlands also serve as aquatic resource areas to themselves.

Merge and set appropriate thresholds based on distribution of values. Assign points as follows:

2 points: at least 5% cover of NWI aquatic resources OR at least 8 km of NHD stream reaches within 1 kilometer buffer

1 point: 1-5% cover of NWI aquatic resources OR 6-8 km of NHD stream reaches within 1 kilometer buffer

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb
  - FeatureClass: Buffer1km
    - Field: Buf1kArea
  - Feature Class: WU\_20150514
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\EnhancedNWI\_20150511.gdb
  - Feature Dataset: CONUS\_WVWetlandsProj
    - Feature Class: EnhWVWetland
- M:\basemap\NHD\_H\_West\_VirginiaTransfer2022.gdb
  - Feature Class: NHDFlowline

Method:

**## STEP 1 Calculate percent of 1 km buffer that contains aquatic features from NWI**  
*## Note that this method is very similar to STEP 2 of BufferPerim*

**## Create feature class to store intermediate results**

R-click WU\_20150514 and select Data / Export / All Features  
Output feature class: WetlandFunction.gdb / WU\_AquaAbund1

**## Intersect the 1 km buffers and the Enhanced National Wetlands Inventory.**

ArcToolbox / Analysis Tools / Overlay / Intersect

Input features: Buffer1km  
EnhWVWetland

Output feature class: Buffer1kAqua

Join attributes: ALL

Output type: INPUT

**## Dissolve aquatic portion of wetland buffer by WUKey**

ArcToolbox / Data Management Tools / Generalization / Dissolve

Input feature: Buffer1kAqua

Output Feature Class: Buffer1kAqua\_diss

Dissolve Fields: WUKey

Statistics Fields: Buf1kArea (Statistic Type = First)

Check box "Create multipart features" (default)

**## Add field and calculate ratio of aquatic area to total buffer area.**

Open attribute table of Buffer1kAqua\_diss

Add field "Aqua1kRat" (float)

Field calculate Aqua1kRat = [Shape\_Area] / [FIRST\_Buf1kArea]

### **## Join ratio of aquatic buffer to Wetland Units**

ArcToolbox / Data Management Tools / Joins / Add Join  
Input table: WU\_AquaAbund1  
Input Join Field: WUKey  
Join Table: Buffer1kAqua\_diss  
Output Join Field: WUKey

### **## Export joined data**

R-click WU\_AquaAbund1 and select Data / Export Data  
Output feature class: WU\_AquaAbund2

### **## Remove Join**

R-click WU\_AquaAbund1 and select Joins and Relates / Remove All Joins

### **## Set value of Aqua1kRat to zero for null intersections**

Open attribute table of WU\_AquaAbund2  
SELECT \* FROM WU\_AquaAbund2 WHERE: "Aqua1kRat" IS NULL  
Field Calculate Aqua1kRat = 0

### **## STEP 2 Calculate total length of NHD streams in 1 km buffer**

#### **## Intersect the 1 km buffers and the NHD stream reaches**

*## Note that this is a very large intersection and takes about 30 minutes*

ArcToolbox / Analysis Tools / Overlay / Intersect  
Input features: Buffer1km  
NHDFlowline  
Output feature class: Buffer1kStrm  
Join attributes: ALL  
Output type: INPUT

#### **## Add field to store Stream Reach Length**

Open attribute table of Buffer1kStrm  
Add field StrmLength (float)  
Field Calculate StrmLength = [Shape\_Length]

#### **## Delete unnecessary fields in this large table to reduce processing time in the Dissolve below**

*## Note that this takes a long time*

ArcToolbox > Data Management Tools > Fields > Delete Field

Input table: Buffer1kStrm

Drop Field: Check the boxes for all fields EXCEPT WUKey and StrmLength

### **## Dissolve stream reach lengths in the wetland buffer by WUKey**

ArcToolbox / Data Management Tools / Generalization / Dissolve

Input feature: Buffer1kStrm

Output Feature Class: Buffer1kStrm\_diss

Dissolve Fields: WUKey

Statistics Fields: StrmLength (Statistic Type = Sum)

Check box "Create multipart features" (default)

### **## Join sum of stream lengths to Wetland Units**

ArcToolbox / Data Management Tools / Joins / Add Join

Input table: WU\_AquaAbund2

Input Join Field: WUKey (first occurrence in list of attributes – the 2<sup>nd</sup> occurrence has nulls)

Join Table: Buffer1kStrm\_diss

Output Join Field: WUKey

### **## Export joined data**

R-click WU\_AquaAbund2 and select Data / Export Data / All Features

Output feature class: WU\_AquaAbund

### **## Remove Join**

R-click WU\_AquaAbund2 and select Joins and Relates / Remove All Joins

### **## Set value of FINALCODE to zero for null intersections**

Open attribute table of WU\_AquaAbund

SELECT \* FROM WU\_AquaAbund2 WHERE: "SUM\_StrmLength" IS NULL

Field Calculate SUM\_StrmLength = 0

### **## STEP 3: Assign points**

#### **## Add field AquaAbund, set initial value to zero**

Open the attribute table to WU\_AquaAbund

Add field "AquaAbund" (short integer) to attribute table

Field Calculate "AquaAbund" = 0

#### **## Assign points**



**## StrmLength one SD below mean = 0, within 1 SD of mean = 1, >1 SD above mean = 2 points**

```
SELECT * FROM WU_AquaAbund WHERE: "Aqua1kRat" > 0.01 OR "SUM_StrmLength" > 6000
```

Field Calculate AquaAbund = 1

```
SELECT * FROM WU_AquaAbund WHERE: "Aqua1kRat" > 0.05 OR "SUM_StrmLength" > 8000
```

Field Calculate AquaAbund = 2

### 5.6.3 Brank: Site Biodiversity Rank of Wetland

Version date: 8 November 2017

Strategy: 3/16/2017 EAB

GIS method: 10/19/2017 EAB; results verified 10/20/2017 EAB; revisions to GIS method on 11/5/2017 highlighted in yellow; results re-verified 11/5/2017

Python code: 10/30/2017, revised and packaged for stand-alone use 11/7/2017 YH

Final review by EAB: 11/7/2017

Notes on using the stand-alone packaged arcpy script to calculate Site Biodiversity Rank for all sites (not limited to wetlands)

1. Two layers are required:
  - a. Input polygons to be assessed (e.g. "ManagedLands")
    - i. Add field (long integer) name "WUKey" and populate it with a unique ID.
  - b. Source data file of ranked element occurrences named "BRankInput".
    - i. See the instructions for BRankInput to create that file. "BRankInput" can be screened to include only wetland species or other subsets of the full biodiversity database; however, the source data used in the python tool must be named "BRankInput".
2. Open the script BRank\_packaged \ BRank.pyt \ Site Biodiversity Rank
3. Specify the location of the input polygon layer.
4. Specify the location of "BRankInput".
5. Specify the target geodatabase for output.
6. Run the tool.
7. The output file will be named "WU\_BRank". Re-name it something meaningful like "BRank\_ManagedLands\_20171108". The code will not automatically overwrite the output file, so you must rename it or delete it before running the code again.

Purpose: Adjustment to Habitat Function

Rationale: Wetland supports rare, threatened, or endangered species or high quality natural communities. Certain wetlands are recognized as being exemplary in the state for their outstanding habitat value. Note that if a rare species or natural wetland community is documented at the site, or is found during rapid field assessment, then the wetland should be assigned a B-rank. Surveying for rare species and natural wetland communities is not a required part of the rapid assessment protocol; however, if a B-rank has already been documented by the state, then it will be included in the GIS assessment.

#### GIS Strategy:

The presence, quality, and concentration of rare species and natural vegetation communities is the basis for Site Biodiversity Ranks. B-rank methodology is implemented by WVDNR's Natural Heritage Program. Scoring for B-ranked wetlands is as follows:

- B1 Outstanding Global Biodiversity Significance
- B2 High Global Biodiversity Significance

B3	Global Biodiversity Significance
B4	Outstanding State Biodiversity Significance
B5	State Biodiversity Significance
B6	Local Biodiversity Significance

Screen out elements that would not occur in a wetland, i.e., would not include wetlands in any part of their habitat, foraging areas, or life cycle. This has already been done when creating the BRankInput file.

Site Biodiversity Ranks (B1-B6) are assigned at the highest rank for which any one of the criteria of that rank are met.

**B1 – Outstanding global biodiversity significance**

- Only known occurrence of an element rangewide, or
- A-ranked occurrence of a G1 element (or at least C-ranked if best available in state), or
- Concentration of A or B-ranked occurrences of G1 or G2 elements (4 or more)

**B2 – High global biodiversity significance**

- B or C-ranked occurrence of a G1 element, or
- A or B-ranked occurrence of a G2 element, or
- One of the most outstanding (e.g., among 5 best) occurrences rangewide (at least A or B-ranked) of a G3 element, or
- Concentration of C-ranked G2 and A- or B-ranked G3 element occurrences (4 or more)

**B3 – Global biodiversity significance**

- D-ranked occurrence of a G1 element (if best available in state), or
- C-ranked occurrence of a G2 element, or
- A or B- ranked occurrence of a G3 element, or
- A or B- ranked occurrence of a disjunct S1 element, or
- One of the most outstanding (e.g., among 5 best) occurrences of a G4 or G5 community (at least A or B-ranked) in an ecoregion. Of these, the 1 or 2 best in an ecoregion could be elevated to B2 status based on consultation with the Natural Heritage ecologist; or
- Concentration (4+) of C-ranked G3 and A- or B-ranked S1 element occurrences.

**B4 – Outstanding state biodiversity significance**

- D-ranked occurrence of a G2 element (if best available in state), or
- C-ranked occurrence of a G3 element, or
- A or B-ranked occurrence of S1 element (or at least C-ranked if best available in state), or
- A-ranked occurrence of an S2 element, or
- At least C-ranked occurrence of a disjunct G4 or G5 element, or
- A or B-ranked occurrence of a G4 or G5 community, or
- Concentration (4+) of C-ranked S1, B- or C-ranked S2, and A-ranked S3 element occurrences and C-ranked G4 or G5 communities.

**B5 – State biodiversity significance**

- D-ranked occurrence of G3 element (if best available in state), or

- C-ranked occurrence of S1 element, or
- B or C-ranked occurrence of S2 element, or
- A-ranked occurrence of an S3 element, or
- C-ranked occurrence of a G4 or G5 community, or
- Concentration (4+) of B- or C-ranked S3 element occurrences.

**B6 – Local biodiversity significance**

- B or C-ranked occurrence of S3 element

**Chart summarizing B-Rank criteria**

Single Occurrences					Flags with Occurrence Quality Rank in parentheses					
	A	B	C	D	Disjunct	OnlyRange	Best5Range	Best5Ecoregion	BestState	OnlyState (EOCount=1)
G1	B1	B2	B2			B1(D)			B1(BC), B3(D)	B1(BC), B3(D)
G2	B2	B2	B3						B4(D)	B4(D)
G3	B3	B3	B4				B2(AB)		B5(D)	B5(D)
G4-G5					B4(ABC)					
G4-G5 comm	B4	B4	B5					B3(AB)		
S1	B4	B4	B5		B3(AB)				B4(C)	B4(C)
S2	B4	B5	B5							
S3	B5	B6	B6							

Concentrations (4 or more occurrences)						
	A	B	C	D		
G1		B1				
G2	B1	B1	B2		B1	Outstanding Global Biodiversity Significance
G3	B2	B2	B3		B2	High Global Biodiversity Significance
G4-G5 comm			B4		B3	Global Biodiversity Significance
S1	B3	B3	B4		B4	Outstanding State Biodiversity Significance
S2		B4	B4		B5	State Biodiversity Significance
S3	B4	B5	B5		B6	Local Biodiversity Significance

**Notes on geographic extent of site and element occurrence (not incorporated – simple intersections are used)**

- If the site includes >50% of the area of the element occurrence, or if the element occurrence is a point contained within the site, then the site is awarded full credit for that element.
- If the site includes <50% of the area of the element occurrence, then it is ranked at one level lower, e.g. if the full element occurrence would confer a site rank of B3, then the partial occurrence qualifies the site for a rank of B4. This decision can be manually overridden by a Natural Heritage biologist, if there is evidence that the site supports the element at population numbers and quality of habitat meriting the higher rank.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb
  - Feature Class: WU\_20150514
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceFunctionalAssessment\HabitatData.gd
  - Feature class: BRankInput

Method:

**## STEP 1: Create feature class and add fields to store BRank values; screen input**

R-click WU\_20150514 and select Data / Export Data / All Features

Output feature class: WetlandFunction: WU\_BRank

**## Add fields to store partial B-Rank based on single elements, concentrations, and final BRank**

Open attribute table of WU\_BRank

Add field BSing (text, length = 10)

Add field BConc (text, length = 10)

Add field BRank (text, length = 10)

**## STEP 2: Assign Site Biodiversity Ranks based on single element occurrences**

**## Rank B6 selection**

Open attribute table of BRankInput

SELECT \* FROM BRankInput WHERE:

"Srank" = 'S3' AND "OQrank" IN ( 'B', 'C' )

Select by Location

Selection method: Select features from

Target layer: WU\_BRank

Source layer: BRankInput

Use selected features

Spatial selection method for target layer feature(s): intersect the source layer feature

R-click BSing and Field Calculate BSing = "B6"

**## Rank B5 selection**

Open attribute table of BRankInput

SELECT \* FROM BRankInput WHERE:

("Grank" = 'G3' AND "OQrank" = 'D' AND ("EO\_Count" = 1 OR "Flag" = 'BestState') ) OR

("Srank" = 'S1' AND "OQrank" = 'C') OR

("Srank" = 'S2' AND "OQrank" IN ('B','C') ) OR

("Srank" = 'S3' AND "OQrank" = 'A') OR

("SpecComm" = 'C' AND "Grank" IN ('G4', 'G5') AND "OQrank" = 'C' )

Select by Location

Selection method: Select features from

Target layer: WU\_BRank

Source layer: BRankInput

Use selected features

Spatial selection method for target layer feature(s): intersect the source layer feature

R-click BSing and Field Calculate BSing = "B5"

### ## Rank B4 selection

Open attribute table of BRankInput

```
SELECT * FROM BRankInput WHERE:
    ("Grank" = 'G2' AND "OQrank" = 'D' AND ("EO_Count" = 1 OR "Flag" = 'BestState') )
    OR
    ("Grank" = 'G3' AND "OQrank" = 'C') OR
    ("Srank" = 'S1' AND "OQrank" IN ('A', 'B')) OR
    ("Srank" = 'S1' AND "OQrank" = 'C' AND ("EO_Count" = 1 OR "Flag" = 'BestState') )
    OR
    ("Srank" = 'S2' AND "OQrank" = 'A') OR
    ("Grank" IN ('G4', 'G5') AND "OQrank" IN ('A', 'B', 'C') AND "Flag" = 'Disjunct') OR
    ("SpecComm" = 'C' AND "Grank" IN ('G4', 'G5') AND "OQrank" IN ('A', 'B'))
```

Select by Location

Selection method: Select features from

Target layer: WU\_BRank

Source layer: BRankInput

Use selected features

Spatial selection method for target layer feature(s): intersect the source layer feature

R-click BSing and Field Calculate BSing = "B4"

### ## Rank B3 selection

Open attribute table of BRankInput

```
SELECT * FROM BRankInput WHERE:
    ("Grank" = 'G1' AND "OQrank" = 'D' AND ("EO_Count" = 1 OR "Flag" = 'BestState') )
    OR
    ("Grank" = 'G2' AND "OQrank" = 'C') OR
    ("Grank" = 'G3' AND "OQrank" IN ('A', 'B')) OR
    ("Srank" = 'S1' AND "OQrank" IN ('A', 'B') AND "Flag" = 'Disjunct') OR
    (("SpecComm" = 'C' AND "Grank" IN ('G4', 'G5')) AND "OQrank" IN ('A', 'B') AND
    "Flag" = 'Best5Ecoregion')
```

Select by Location

Selection method: Select features from

Target layer: WU\_BRank

Source layer: BRankInput

Use selected features: (2783 features selected)

Spatial selection method for target layer feature(s): intersect the source layer feature  
(178 out of 43124 selected)

R-click BSing and Field Calculate BSing = "B3"

### ## Rank B2 selection

Open attribute table of BRankInput

SELECT \* FROM BRankInput WHERE:

```
("Grank" = 'G1' AND "OQrank" IN ('B', 'C')) OR  
("Grank" = 'G2' AND "OQrank" IN ('A', 'B')) OR  
("Grank" = 'G3' AND "OQrank" IN ('A', 'B') AND "Flag" = 'Best5Range')
```

Select by Location

Selection method: Select features from

Target layer: WU\_BRank

Source layer: BRankInput

Use selected features

Spatial selection method for target layer feature(s): intersect the source layer feature

R-click BSing and Field Calculate BSing = "B2"

### ## Rank B1 selection

Open attribute table of BRankInput

SELECT \* FROM BRankInput WHERE:

```
("Flag" = 'OnlyRange') OR  
("Grank" = 'G1' AND "OQrank" = 'A') OR  
("Grank" = 'G1' AND "OQrank" IN ('B', 'C') AND ("EO_Count" = 1 OR "Flag" =  
'BestState'))
```

Select by Location

Selection method: Select features from

Target layer: WU\_BRank

Source layer: BRankInput

Use selected features

Spatial selection method for target layer feature(s): intersect the source layer feature

R-click BSing and Field Calculate BSing = "B1"

Clear all selections

### ## STEP 3: Join Wetland Units with BRankInput

ArcToolbox / Spatial Join

Target features: WU\_20150514

Join features: BRankInput  
Output feature class: WU\_BRank\_join  
Join Operation: JOIN\_ONE\_TO\_MANY  
Keep all target features  
Field Map of Join Features: retain basically all (Shape\_Length1 and Shape\_Area1 are not needed)  
Match option: Intersect

**## STEP 4: Find the highest occurrence quality rank for each element in each Wetland Unit**

**## Set null values of RandID to zero to allow summarize function to work**

SELECT \* FROM WU\_BRank\_join WHERE: "RandID" IS NULL  
R-click RandID and Field Calculate RandID = 0

**## Add field to hold integer transformation of OQRank**

Add new field: OQrankInt (short integer)  
SELECT \* FROM WU\_BRank\_join WHERE: "OQrank" IS NULL  
Field Calculate OQrankInt = 0

SELECT \* FROM WU\_BRank\_join WHERE: "OQrank" = 'D'  
Field Calculate OQrankInt = 1

SELECT \* FROM WU\_BRank\_join WHERE: "OQrank" = 'C'  
Field Calculate OQrankInt = 2

SELECT \* FROM WU\_BRank\_join WHERE: "OQrank" = 'B'  
Field Calculate OQrankInt = 3

SELECT \* FROM WU\_BRank\_join WHERE: "OQrank" = 'A'  
Field Calculate OQrankInt = 4

Clear all selections

**## Find the highest OQrank for each WUKey |RandID pair**

Open attribute table WU\_BRank\_join  
Add new field: Concat (text, length = 20)  
Field Calculate Concat = [WUKey]&" | "& [RandID]

R-click the Concat field and Select "Summarize"  
Select a field to summarize: Concat  
Choose one or more summary statistics to be included in the output table:  
    WUKey: Minimum  
    RandID: Minimum



Srank: First  
Grank: First  
SpecComm: First  
OQrankInt: Maximum  
Specify output table: WU\_BRank\_summ

### **## STEP 5: Assign Site Biodiversity Rank based on concentrations of elements**

#### **## Rank B5 selection (Rank B6 does not have a criterion for concentrations) ## Select B- or C-ranked occurrences of S3 elements**

Open table WU\_BRank\_summ  
SELECT \* FROM WU\_BRank\_summ WHERE:  
    "First\_Srank" = 'S3' AND "Max\_OQrankInt" IN (2,3)

Open table WU\_BRank\_summ  
R-click “Minimum\_WUKey” and select Summarize  
Select a field to summarize: Min\_WUKey  
Choose one or more summary statistics to be included in the output table: none  
Specify output table: WU\_BRank\_summB5

#### **## Join table back to WU\_BRank**

R-click WU\_BRank and select Joins and Relates / Joins  
What do you want to join to this layer: Join attributes from a table  
Choose the field in this layer that the join will be based on: WUKey  
Choose the table to join to this layer: WU\_BRank\_summB5  
Choose the field in the table to base the join on: Min\_WUKey  
Keep all records

#### **## Select records with 4 or more elements and assign value to BConc**

Open attribute table of WU\_BRank with Join displayed  
SELECT \* FROM WU\_BRank\_WU\_BRank\_summB5 WHERE:  
    WU\_BRank\_summB5.Cnt\_Min\_WUKey > 3  
Field calculate BConc = “B5”

#### **## Remove Join**

R-click WU\_BRank and select Joins and Relates / Remove Joins / Remove All Joins

#### **## Rank B4 selection**

**## Select C-ranked S1, B- or C-ranked S2, and A-ranked S3 element occurrences and  
## C-ranked G4 or G5 communities**

Open table WU\_BRank\_summ

```
SELECT * FROM WU_BRank_summ WHERE:  
  ("First_Srank" = 'S1' AND "Max_OQrankInt" = 2) OR  
  ("First_Srank" = 'S2' AND "Max_OQrankInt" IN (2,3)) OR  
  ("First_Srank" = 'S3' AND "Max_OQrankInt" = 4) OR  
  ("First_SpecComm" = 'C' AND "First_Grank" IN ('G4', 'G5') AND "Max_OQrankInt" =  
  2)
```

Open table WU\_BRank\_summ

R-click "Minimum\_WUKey" and select Summarize

Select a field to summarize: Min\_WUKey

Choose one or more summary statistics to be included in the output table: none

Specify output table: WU\_BRank\_summB4

Summarize on the selected records only

### **## Join table back to WU\_BRank**

R-click WU\_BRank and select Joins and Relates / Joins

What do you want to join to this layer: Join attributes from a table

Choose the field in this layer that the join will be based on: WUKey

Choose the table to join to this layer: WU\_BRank\_summB4

Choose the field in the table to base the join on: Min\_WUKey

Keep all records

### **## Select records with 4 or more elements and assign value to BConc**

Open attribute table of WU\_BRank with Join displayed

```
SELECT * FROM WU_BRank_WU_BRank_summB4 WHERE:
```

```
  WU_BRank_summB4.Cnt_Min_WUKey > 3
```

```
Field calculate BConc = "B4"
```

### **## Remove Join**

R-click WU\_BRank and select Joins and Relates / Remove Joins / Remove All Joins

### **## Rank B3 selection**

**## Select C-ranked occurrences of G3 elements and A- or B-ranked occurrences of S1 elements**

Open table WU\_BRank\_summ

```
SELECT * FROM WU_BRank_summ WHERE:  
  ("First_Grank" = 'G3' AND "Max_OQrankInt" = 2) OR  
  ("First_Srank" = 'S1' AND "Max_OQrankInt" IN (3,4))
```

Open table WU\_BRank\_summ  
R-click "Minimum\_WUKey" and select Summarize  
Select a field to summarize: Min\_WUKey  
Choose one or more summary statistics to be included in the output table: none  
Specify output table: WU\_BRank\_summB3  
Summarize on the selected records only

### **## Join table back to WU\_BRank**

R-click WU\_BRank and select Joins and Relates / Joins  
What do you want to join to this layer: Join attributes from a table  
Choose the field in this layer that the join will be based on: WUKey  
Choose the table to join to this layer: WU\_BRank\_summB3  
Choose the field in the table to base the join on: Min\_WUKey  
Keep all records

### **## Select records with 4 or more elements and assign value to BConc**

Open attribute table of WU\_BRank with Join displayed  
SELECT \* FROM WU\_BRank\_WU\_BRank\_summB3 WHERE:  
    WU\_BRank\_summB3.Cnt\_Min\_WUKey > 3  
Field calculate BConc = "B3"

### **## Remove Join**

R-click WU\_BRank and select Joins and Relates / Remove Joins / Remove All Joins

### **## Rank B2 selection**

### **## Select C-ranked occurrences of G2 elements and A- or B-ranked occurrences of G3 elements**

Open table WU\_BRank\_summ  
SELECT \* FROM WU\_BRank\_summ WHERE:  
    ("First\_Grank" = 'G2' AND "Max\_OQrankInt" = 2) OR  
    ("First\_Grank" = 'G3' AND "Max\_OQrankInt" IN (3,4))

Open table WU\_BRank\_summ  
R-click "Minimum\_WUKey" and select Summarize  
Select a field to summarize: Min\_WUKey  
Choose one or more summary statistics to be included in the output table: none  
Specify output table: WU\_BRank\_summB2  
Summarize on the selected records only

### **## Join table back to WU\_BRank**

R-click WU\_BRank and select Joins and Relates / Joins  
What do you want to join to this layer: Join attributes from a table  
Choose the field in this layer that the join will be based on: WUKey  
Choose the table to join to this layer: WU\_BRank\_summB2  
Choose the field in the table to base the join on: Min\_WUKey  
Keep all records

### **## Select records with 4 or more elements and assign value to BConc**

Open attribute table of WU\_BRank with Join displayed  
SELECT \* FROM WU\_BRank\_WU\_BRank\_summB2 WHERE:  
    WU\_BRank\_summB2.Cnt\_Min\_WUKey > 3  
Field calculate BConc = "B2"

### **## Remove Join**

R-click WU\_BRank and select Joins and Relates / Remove Joins / Remove All Joins

### **## Rank B1 selection**

**## Select B-ranked occurrences of G1 elements and A- or B-ranked occurrences of G2 elements**

Open table WU\_BRank\_summ  
SELECT \* FROM WU\_BRank\_summ WHERE:  
    ("First\_Grank" = 'G1' AND "Max\_OQrankInt" = 3) OR  
    ("First\_Grank" = 'G2' AND "Max\_OQrankInt" IN (3,4))

Open table WU\_BRank\_summ  
R-click "Minimum\_WUKey" and select Summarize  
Select a field to summarize: Min\_WUKey  
Choose one or more summary statistics to be included in the output table: none  
Specify output table: WU\_BRank\_summB1  
Summarize on the selected records only

### **## Join table back to WU\_BRank**

R-click WU\_BRank and select Joins and Relates / Joins  
What do you want to join to this layer: Join attributes from a table  
Choose the field in this layer that the join will be based on: WUKey  
Choose the table to join to this layer: WU\_BRank\_summB1  
Choose the field in the table to base the join on: Min\_WUKey  
Keep all records

### **## Select records with 4 or more elements and assign value to BConc**

Open attribute table of WU\_BRank with Join displayed

SELECT \* FROM WU\_BRank\_WU\_BRank\_summB1 WHERE:  
WU\_BRank\_summB1.Cnt\_Min\_WUKey > 3  
Field calculate BConc = "B1"

### ## Remove Join

R-click WU\_BRank and select Joins and Relates / Remove Joins / Remove All Joins

### ## STEP 6: Calculate final Site Biodiversity Rank

Open attribute table of WU\_BRank  
SELECT \* FROM WU\_BRank WHERE: "BSing" = 'B6'  
R-click BRank and Field Calculate BRank = 'B6'

Open attribute table of WU\_BRank  
SELECT \* FROM WU\_BRank WHERE: "BSing" = 'B5' OR "BConc" = 'B5'  
R-click BRank and Field Calculate BRank = 'B5'

Open attribute table of WU\_BRank  
SELECT \* FROM WU\_BRank WHERE: "BSing" = 'B4' OR "BConc" = 'B4'  
R-click BRank and Field Calculate BRank = 'B4'

Open attribute table of WU\_BRank  
SELECT \* FROM WU\_BRank WHERE: "BSing" = 'B3' OR "BConc" = 'B3'  
R-click BRank and Field Calculate BRank = 'B3'

Open attribute table of WU\_BRank  
SELECT \* FROM WU\_BRank WHERE: "BSing" = 'B2' OR "BConc" = 'B2'  
R-click BRank and Field Calculate BRank = 'B2'

Open attribute table of WU\_BRank  
SELECT \* FROM WU\_BRank WHERE: "BSing" = 'B1' OR "BConc" = 'B1'  
R-click BRank and Field Calculate BRank = 'B1'

### ## Populate the “Null” BRank records with “none”

Open attribute table of WU\_BRank  
SELECT \* FROM WU\_BRank WHERE: "BRank" IS NULL

R-click BRank and Field Calculate BRank = "none"  
Clear all selections

### 5.6.4 BRankHUC: Watershed Biodiversity Rank

Version date: 2/26/2024

In 2024, this layer was prepared by Meryl Friedrich at WVDNR in cooperation with Elizabeth Byers. In the future, WVDNR's GIS office will prepare the layer for use in the WVWRAM GIS Tool. The next scheduled update will be in 2034 when the next State Wildlife Action Plan is written; however, it is worth checking around 2029 just in case there are interim updates. This layer can be easily updated by WVDNR whenever BRankInput is updated. BRankHUC uses all of the species, not just the wetland species, to rank watersheds in terms of their overall biodiversity.

Previous version(s): 6 October 2017

Strategy: 3/16/2017 EAB

GIS method: 10/6/2017 EAB; results verified 10/6/2017 EAB

Python code: 10/10/2017 YH

Final review by EAB: 10/10/2017

Purpose:

Input to Habitat / Landscape Opportunity (LandEco: Landscape Ecological Connectivity)

Description:

*Maximum 4 points*

Rationale: Landscape provides high biodiversity opportunity (maintenance and dispersal of native species richness, rare species, and natural communities)

GIS Method (no field method):

Select wetlands that intersect ranked HUC12 watersheds.

- 4 points: wetland intersects a B1-ranked 12-digit watershed (watershed provides habitat for good populations of critically globally imperiled species or natural communities (\_\_\_ out of 764 watersheds))
- 3 points: wetland intersects a B2-ranked 12-digit watershed (watershed provides habitat for good populations of globally imperiled species or natural communities) (\_\_\_ < 172 out of 764 watersheds)
- 2 points: wetland intersects a B3-ranked 12-digit watershed (watershed provides habitat for good populations of globally vulnerable or disjunct state critically imperiled species or natural habitats) (376 out of 764 watersheds)
- 1 point: wetland intersects a B4- or B5-ranked 12-digit watershed (watershed provides habitat for good populations of state imperiled species or natural habitats) (376 out of 764 watersheds)
- 0 points: none of the above criteria are met

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb
  - Feature Class: WU\_20150514
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceAsReceived\BRankHUC.shp

Method:

**## Create feature class to store results for BRankHUC and set initial value to zero**

R-click WU\_20150514 and select Data / Export / All Features  
Output feature class: WetlandFunction.gdb / WU\_BRankHUC

Open attribute table of WU\_BRankHUC  
Add field "BRankHUC" (short integer)  
Field calculate BRankHUC = 0

**## Select B4- or B5 ranked watersheds**

```
SELECT * FROM BRankHUC  
WHERE: "Brank" = 'B4' OR "Brank" = 'B5'
```

**## Select Wetland Units that intersect B3- or B4-ranked watershed**

Select by Location  
Selection method: select features from  
Target layer(s): WU\_BRankHUC  
Source layer: BRankHUC  
Check "Use selected features"  
Spatial selection method for target layer feature(s): intersect the source layer feature

**## Assign 1 point**

Open attribute table of WU\_BRankHUC  
Field Calculate BRankHUC = 1

**## Select B3- or B4-ranked watersheds**

```
SELECT * FROM BRankHUC  
WHERE: "Brank" = 'B3'
```

**## Select Wetland Units that intersect B3- or B4-ranked watershed**

Select by Location  
Selection method: select features from  
Target layer(s): WU\_BRankHUC  
Source layer: BRankHUC  
Check "Use selected features"  
Spatial selection method for target layer feature(s): intersect the source layer feature

### **## Assign 2 points**

Open attribute table of WU\_BRankHUC  
Field Calculate BRankHUC = 2

### **## Select B2-ranked watersheds**

```
SELECT * FROM BRankHUC  
WHERE: "Brank" = 'B2'
```

### **## Select Wetland Units that intersect B2-ranked watershed**

Select by Location  
Selection method: select features from  
Target layer(s): WU\_BRankHUC  
Source layer: BRankHUC  
Check "Use selected features"  
Spatial selection method for target layer feature(s): intersect the source layer feature

### **## Assign 3 points**

Open attribute table of WU\_BRankHUC  
Field Calculate BRankHUC = 3

### **## Select B1-ranked watersheds**

```
SELECT * FROM BRankHUC  
WHERE: "Brank" = 'B1'
```

### **## Select Wetland Units that intersect B1-ranked watershed**

Select by Location  
Selection method: select features from  
Target layer(s): WU\_BRankHUC  
Source layer: BRankHUC  
Check "Use selected features"  
Spatial selection method for target layer feature(s): intersect the source layer feature

### **## Assign 4 points and clear selections**

Open attribute table of WU\_BRankHUC  
Field Calculate BRankHUC = 4

Clear all selections



## 5.6.5 BufferContig: Contiguous 300m Buffer for Wildlife

Version date: 29 Septmeber 2017

Strategy: 3/16/2017 EAB

GIS method: 9/29/2017 EAB; results verified 9/29/2017 EAB

Python code: 10/3/2017 YH

Final review by EAB: 10/3/2017

Purpose:

Input to Habitat / Opportunity / BufferLand (Buffer and Landscape Integrity)

Description:

*Maximum 2 points*

Rationale: “A wider buffer has a greater capacity to serve as habitat for wetland edge-dependent species, to reduce the inputs of non-point source contaminants, to control erosion, and to generally protect the wetland from human activities.

The condition of a buffer is assessed according to the extent and quality of its vegetation cover, the overall condition of its substrate, and the amount of human visitation.

The condition or composition of the buffer, in addition to its width and extent around a wetland, determines the overall capacity of the buffer to perform its critical functions.” CWMW 2013

Strategy: *Note that the integrity of the 300m wetland buffer must be verified in the field, since GIS data may be out-of-date. This GIS metric is overwritten by field assessment.*

Calculate percent of contiguous 300m buffer not overlapping DisturbLand. Erase the DisturbedLand from the 300m buffer, then select the remaining buffer polygons that are contiguous (approximated as “share a line segment with”) with their corresponding Wetland Unit.

Assign points as follows:

- 2 points: >90% of buffer is undisturbed AND is contiguous with Wetland Unit
- 1 point: 60-90% of buffer is undisturbed AND is contiguous with Wetland Unit
- 0 points: neither of the above criteria are met

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb (WU\_20150514)
  - Feature Class: WU\_20150514
  - Feature Class: Buffer300m
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WaterQualityDatasets.gdb
  - Feature Class: DisturbedLand

**## Note that the procedure in this box should be performed when Wetland Units are first created**

**## Therefore, please do not include this procedure in the code for this metric**

**## Create 300m buffer around Wetland Unit**

ArcToolbox / Proximity / Buffer  
Input features WU\_20150514  
Output feature class: WetlandUnits.gdb\Buffer300m  
Distance [value or field]: Linear Unit: 300 Meters  
Side Type: OUTSIDE\_ONLY  
Dissolve Type: NONE

**## Add field to store buffer area**

Open attribute table of Buffer300m  
In attribute table of Buffer300m, add field "Buf300Area" (float)  
Field calculate Buf300Area = Shape\_Area

Method:

**## Erase the portions of the 300m buffer that overlap DisturbedLand**

ArcToolbox / Analysis Tools / Overlay / Erase  
Input features: Buffer300m  
Erase features: DisturbedLand  
Output feature class: Buffer300mUndist

**## The Erase tool produces multipart polygons. Change these to singlepart polygons.**

ArcToolbox / Data Management / Multipart to Singlepart  
Input: Buffer300mUndist  
Output: Buffer300mUndist\_sing

**## Add field to Buffer300mUndist\_sing to store area of contiguous singlepart polygons**

Open attribute field of Buffer300mUndist\_sing  
Add field "ContigSingArea" (float)

**## Select undisturbed buffer polygons that share a line segment with Wetland Units.**

*## This is a proxy for being contiguous to a Wetland Unit. When buffers of nearby wetland buffers*

*## do not overlap, it works perfectly. In the case of overlapping buffers, it is very unlikely that an*

*## overlapping buffer polygon from a nearby wetland would have the exact geometry to share a line*

*## segment with any Wetland Unit. Spot checks of the statewide output confirm this.*

Select by location  
Selection method: select features from  
Target layers(s): Buffer300mUndist\_sing  
Source layer: WU\_20150514  
Spatial selection method for target layer feature(s): share a line segment with the source layer feature

### **## Calculate area of contiguous singlepart polygons**

Open attribute field of Buffer300mUndist\_sing  
Field Calculate "ContigSingArea" = [Shape\_Area]

Clear selections  
SELECT \* FROM Buffer300mUndist\_sing WHERE: "ContigSingArea" IS NULL  
Field Calculate "ContigSingArea" = 0

### **## Dissolve undisturbed portion of wetland buffer by WUKey**

ArcToolbox / Data Management Tools / Generalization / Dissolve  
Input feature: Buffer300mUndist\_sing  
Output Feature Class: Buffer300mUndist\_diss  
Dissolve Fields: WUKey  
Statistics Fields: Buf300Area (Statistic Type = First)  
                  ContigSingArea (Statistic Type = Sum)  
Check box "Create multipart features" (default)

### **## Add field and calculate ratio of contiguous undisturbed area to total buffer area.**

Open attribute table of Buffer300mUndist\_diss  
Add field "ContigUndRat" (float)  
Field calculate ContigUndRat = [SUM\_ContigSingArea] / [FIRST\_Buf300Area]

### **## Create feature class to store intermediate results for BufferContig**

R-click "WU\_20150514" and Export Data  
Export: All features  
Output feature class: WetlandFunction.gdb\WU\_BufferContig1

### **## Join ratio of contiguous undisturbed buffer to Wetland Units**

ArcToolbox / Data Management Tools / Joins / Add Join  
Input table: WU\_BufferContig1  
Input Join Field: WUKey  
Join Table: Buffer300mUndist\_diss  
Output Join Field: WUKey

### **## Export joined data**

R-click WU\_BufferContig1 and select Data / Export Data  
Output feature class: WU\_BufferContig

### **## Remove Join**

R-click WU\_BufferContig1 and select Joins and Relates / Remove All Joins

### **## Set value of ContigUndRat to zero for null intersections**

Open attribute table of WU\_BufferContig  
SELECT \* FROM WU\_BufferContig WHERE: "ContigUndRat" IS NULL  
Field Calculate ContigUndRat = 0

### **## Add field BufferContig, set initial value to zero**

Open the attribute table to WU\_BufferContig  
Add field "BufferContig" (short integer) to attribute table  
Field Calculate "BufferContig" = 0

### **## Assign points**

SELECT \* FROM WU\_BufferContig WHERE: "ContigUndRat" > 0.6  
Field Calculate BufferContig = 1

SELECT \* FROM WU\_BufferContig WHERE: "ContigUndRat" > 0.9  
Field Calculate BufferContig = 2

## 5.6.6 BufferLand: Buffer and Landscape Integrity

Version date: 2 October 2017

Strategy: Completed 3/16/2017 EAB

GIS method: 10/2/2017 EAB; results verified 10/2/2017 EAB

Python coding: 10/3/2017 YH

Final review by EAB: 10/3/2017

Purpose:

Input to Habitat & Ecological Integrity / Landscape Opportunity

Max 7 points

Rationale: see rationale for each of the three component metrics.

Strategy: Sum the points for BufferPerim, BufferContig, and LandInteg.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandFunctionResults\WetlandFunction.gdb
  - Feature Class: WU\_BufferPerim
    - Field: BufferPerim
  - Feature Class: WU\_BufferContig
    - Field: BufferContig
  - Feature Class: WU\_LandInteg
    - Field: LandInteg

Method:

### **## Spatial join to merge BufferPerim and BufferContig into one attribute table**

ArcToolbox / Analysis Tools / Overlay / Spatial Join

Target Feature: WU\_BufferPerim

Join Feature: WU\_BufferContig

Output Feature Class: WU\_BufferLand1

Join operation: JOIN\_ONE\_TO\_ONE

Check box "Keep all target features"

Field Map of Join Features: retain the following:

WUKey

Shape\_Length

Shape\_Area

BufferPerim

BufferContig

Match option: CONTAINS

### **## Spatial join to merge LandInteg**

ArcToolbox / Analysis Tools / Overlay / Spatial Join

Target Feature: WU\_BufferLand1  
Join Feature: WU\_LandInteg  
Output Feature Class: WU\_BufferLand  
Join operation: JOIN\_ONE\_TO\_ONE  
Check box "Keep all target features"  
Field Map of Join Features: retain the following:  
WUKey  
    Shape\_Length  
Shape\_Area  
BufferPerim  
BufferContig  
LandInteg  
Match option: CONTAINS

**## Add BufferLand field to Wetland Units and set initial point value to zero.**

Open attribute table of WU\_BufferLand  
Add field "BufferLand" (short integer)  
R-click BufferLand and Field Calculate BufferLand = 0

**## Sum the points for BufferPerim, BufferContig, LandInteg**

R-click BufferLand and Field Calculate "BufferLand" = [BufferPerim] + [BufferContig] + [LandInteg]

### 5.6.7 BufferPerim: Wetland Perimeter with Natural Buffer

Version date: 24 January 2018

Strategy: 3/16/2017 EAB

GIS method: 9/28/2017 EAB; results verified 9/29/2017 EAB. 1/24/2018 EAB: Method updated to include mapped trails. Note that selection numbers are outdated as a result of this addition.

Python code: 10/3/2017 YH

Final review by EAB: 10/3/2017

Purpose:

Input to Habitat / Opportunity / BufferLand (Buffer and Landscape Integrity)

Description:

*Maximum 2 points*

Rationale: An intact perimeter, even with a narrow natural buffer, offers protection to the wetland habitat. The ability of buffers to protect a wetland increases with buffer extent along the wetland perimeter. For some kinds of stress, such as predation by feral pets or disruption of plant communities by cattle, small breaks in buffers may cause significant degradation of a wetland. However, for many stressors including trails and small unpaved roadways, small breaks in buffers probably do not significantly disrupt the buffer functions (CWMW 2013).

Strategy: *Note that the integrity of the wetland perimeter is best observed in the field. This GIS metric is overwritten by field assessment.*

Calculate the percent of the Wetland Unit perimeter (10m buffer around Wetland Unit) that intersects DisturbedLand. Identify the Wetland Units that are within 10 meters of linear disturbances (road, rail). Tiger line files have route type (RTTYP) codes as follows:

C = County (=DEP primary, local, other)

I = Interstate (=DEP interstate)

M = Common Name (=DEP interstate, primary, local, other)

O = Other (=DEP primary, local, other)

S = State recognized (=DEP primary, local, other)

U = U.S. (=DEP interstate, primary, local, other)

The DEP basemap has more accurate road attributes than the raw Tiger line files. Also the DEP railways layer appears to be more accurately and completely mapped than the tiger\_2013 rail layer. We do not have good GIS coverage of pipelines or transmission lines. Assign points as follows:

- 2 points: 10m buffer does not intersect DisturbedLand AND Wetland Unit is not within 10 meters of trails, roads or railways.
- Wetland Unit is within 10 meters of trail, Local Road, Other Road or Trail, but is not within 10 meters of railways or larger roads OR 10m buffer intersects trace-25% of DisturbedLand
- 0 points: Wetland Unit is within 10 meters of Interstate Highway, Primary Road, or Railway OR 10m buffer intersects >25% of DisturbedLand

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceAsReceived\trails\_Sep\_27\_2017\_webmercator.shp
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb
  - Feature Class: WU\_20150514
- M:\basemap\tiger\_2013\WV\_Transportation\_UTM.gdb
  - Feature Class: Interstates
  - Feature Class: Primary\_Roads
  - Feature Class: Local\_Roads
  - Feature Class: Other\_Roads & Trails
- M:\LayerFiles\arcsde\_backup.gdb
  - Feature Dataset: basemap\_cultural\_non\_replica
  - Feature Class: SDE\_railway\_tiger
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WaterQualityDatasets.gdb
  - Feature Class: DisturbedLand

**## Create 10m buffer around Wetland Unit**  
**## Note that this procedure should be performed when Wetland Units are first created**  
**## Therefore, please do not include this procedure in the code for this metric**

ArcToolbox / Proximity / Buffer  
 Input features WU\_20150514  
 Output feature class: WetlandUnits.gdb\Buffer10m  
 Distance [value or field]: Linear Unit: 10 Meters  
 Side Type: OUTSIDE\_ONLY  
 Dissolve Type: NONE

**## Add field to store buffer area**

Open attribute table of Buffer10m  
 In attribute table of Buffer10m, add field "Buf10Area" (float)  
 Field calculate Buf10Area = Shape\_Area

Method:

**## STEP 1 Roads and Railways**  
**## Create feature class to store intermediate results for BufferPerim**

R-click "WU\_20150514" and Export Data  
 Export: All features  
 Output feature class: WetlandFunction.gdb\WU\_BufferPerim1

**## Add field to store road and rail type**

Open attribute table of WU\_BufferPerim1



Add field RoadRailType (text, 10 characters)

**## Select Wetland Units that intersect or are within 10 meters of mapped trails**

Select by Location

Selection method: Select features from: WU\_BufferPerim1

Source layer: trails\_Sep\_27\_2017\_webmercator.shp

Spatial selection method for target layer feature(s): Intersect the source layer feature

Apply a search distance: 10 meters

(\_\_\_ Wetland Units selected)

R-click RoadRailType and Field Calculate RoadRailType: "Trail"

**## Select Wetland Units that intersect or are within 10 meters of other roads & trails**

Select by Location

Selection method: Select features from: WU\_BufferPerim1

Source layer: other roads & trails

Spatial selection method for target layer feature(s): Intersect the source layer feature

Apply a search distance: 10 meters

R-click RoadRailType and Field Calculate RoadRailType: "Other"

**## Select Wetland Units that intersect or are within 10 meters of local roads**

Select by Location

Selection method: Select features from: WU\_BufferPerim1

Source layer: local roads

Spatial selection method for target layer feature(s): Intersect the source layer feature

Apply a search distance: 10 meters

R-click RoadRailType and Field Calculate RoadRailType: "Local"

**## Select Wetland Units that intersect or are within 10 meters of railways**

Select by Location

Selection method: Select features from: WU\_BufferPerim1

Source layer: railways

Spatial selection method for target layer feature(s): Intersect the source layer feature

Apply a search distance: 10 meters

R-click RoadRailType and Field Calculate RoadRailType: "Rail"

**## Select Wetland Units that intersect or are within 10 meters of primary roads**

Select by Location

Selection method: Select features from: WU\_BufferPerim1  
Source layer: primary roads  
Spatial selection method for target layer feature(s): Intersect the source layer feature  
Apply a search distance: 10 meters

R-click RoadRailType and Field Calculate RoadRailType: "Primary"

### **## Select Wetland Units that intersect or are within 10 meters of interstate highways**

Select by Location  
Selection method: Select features from: WU\_BufferPerim1  
Source layer: interstates  
Spatial selection method for target layer feature(s): Intersect the source layer feature  
Apply a search distance: 10 meters

R-click RoadRailType and Field Calculate RoadRailType: "Interstate"

### **## STEP 2 DisturbedLand**

*## Note that much of this step is the same as the method for Disturb50m*

### **## Intersect the 10m buffers and the disturbed land uses.**

ArcToolbox / Analysis Tools / Overlay / Intersect  
Input features: Buffer10m  
DisturbedLand  
Output feature class: Buffer10mDist  
Join attributes: ALL  
Output type: INPUT

### **## Dissolve disturbed portion of wetland buffer by WUKey**

ArcToolbox / Data Management Tools / Generalization / Dissolve  
Input feature: Buffer10mDist  
Output Feature Class: Buffer10mDist\_diss  
Dissolve Fields: WUKey  
Statistics Fields: Buf10Area (Statistic Type = First)  
Check box "Create multipart features" (default)

### **## Add field and calculate ratio of disturbed area to total buffer area.**

Open attribute table of Buffer10mDist\_diss  
Add field "Dist10mRat" (float)  
Field calculate Dist10mRat = [Shape\_Area] / [FIRST\_Buf10Area]

### **## Join ratio of disturbed buffer to Wetland Units**

ArcToolbox / Data Management Tools / Joins / Add Join  
Input table: WU\_BufferPerim1  
Input Join Field: WUKey  
Join Table: Buffer10mDist\_diss  
Output Join Field: WUKey

### **## Export joined data**

R-click WU\_BufferPerim1 and select Data / Export Data  
Output feature class: WU\_BufferPerim

### **## Remove Join**

R-click WU\_BufferPerim1 and select Joins and Relates / Remove All Joins

### **## Set value of Dist10mRat to zero for null intersections**

Open attribute table of WU\_BufferPerim  
SELECT \* FROM WU\_BufferPerim WHERE: "Dist10mRat" IS NULL  
Field Calculate Dist10mRat = 0

### **## STEP 3**

#### **## Assign points**

#### **## Add field BufferPerim, set initial value to zero**

Open the attribute table to WU\_BufferPerim  
Add field "BufferPerim" (short integer) to attribute table  
Field Calculate "BufferPerim" = 0

#### **## Assign points**

SELECT \* FROM WU\_BufferPerim WHERE: "Dist10mRat" = 0 AND "RoadRailType" IS NULL  
Field Calculate BufferPerim = 2

SELECT \* FROM WU\_BufferPerim WHERE: "Dist10mRat" > 0 OR "RoadRailType" IN ('Trail', 'Local', 'Other')  
Field Calculate BufferPerim = 1

SELECT \* FROM WU\_BufferPerim WHERE: "Dist10mRat" > 0.25 OR "RoadRailType" IN ('Rail', 'Primary', 'Interstate')  
Field Calculate BufferPerim = 0

### 5.6.8 Chem Time: Time and space for Chemical Reactions to Occur

*i.e., Seasonal Ponding, Slope, and Wetland Upland Interface*

Version date: 14 March 2016

Strategy: completed 2/27/2016 EAB

GIS method: completed & verified 3/14/2016 EAB

Python code: started & completed 3/21/2016 MCA

Final review by EAB: 3/21/2016

Purpose:

Input to Water Quality

Maximum 3 points; groundwater wetlands only

Description:

Rationale: The area of the wetland that is seasonally ponded is an important characteristic in understanding how well it will remove nutrients, specifically nitrogen. The highest levels of nitrogen transformation occur in areas of the wetland that undergo a cyclic change between oxic (oxygen present) and anoxic (oxygen absent) conditions. The oxic regime (oxygen present) is needed so certain types of bacteria will change nitrogen that is in the form of ammonium ion (NH<sub>4</sub><sup>+</sup>) to nitrate, and the anoxic regime is needed for denitrification (changing nitrate to nitrogen gas) (Mitsch and Gosselink 1993). The area that is seasonally ponded is used as an indicator of the area in the wetland that undergoes this seasonal cycling. The soils are oxygenated when dry but become anoxic during the time they are flooded.

Water velocity increases with increasing slope. This decreases the retention time of surface water in the wetland and the potential for retaining sediments and associated toxic pollutants. The potential for sediment deposition and retention of toxics by burial decreases as the slope increases (Adamus et al. 1991).

Summary of strategy: Select wetlands that are not in a floodplain and have seasonal ponding. Then, filter the points so that wetlands with slope >5% do not receive any points, and wetlands with slopes 2-5% get a maximum of 2 points. Finally, wetlands can gain 1 additional point (regardless of slope) if they have a highly irregular upland/wetland boundary.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb (WU\_20150514)
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\EnhancedNWI\_20150511.gdb
  - Feature Class: EnhWVWetland

Input Variables:

- Floodplain (location in floodplain)
- SeasonPond (seasonal ponding)

- Slope (median percent slope)
- IrrEdge (irregular upland/wetland boundary edge)

Method:

**## Create feature class to store ChemTime factor**

R-click WU\_20150514 and select Data/Export Data  
Output feature class: WU\_ChemTime

**## Spatial join to add input variables to attribute table**

Spatial join (contains) to add the following to the WU\_ChemTime: Floodplain, SeasonPond, Slope, IrrEdge

**## Add field ChemTime to Wetland Units attribute table and set initial value to SeasonPond.**

Add field ChemTime (ShortInteger) to WU\_ChemTime attribute table.  
R-click ChemTime and Field Calculate “ChemTime” = [SeasonPond]

**## Filter Seasonal Ponding (SeasonPond) points based on Slope and Floodplain**

SELECT \* FROM WU\_ChemTime WHERE: "SLOPE" > 5 OR "Floodplain" = 'Y'  
R-click ChemTime and Field Calculate “ChemTime” = 0

SELECT \* FROM WU\_ChemTime WHERE: "SLOPE" > 2 AND "SLOPE" < 6 AND  
"ChemTime" > 2  
R-click ChemTime and Field Calculate “ChemTime” = 2

**## Add point for irregular edge (IrrEdge)**

SELECT \* FROM WU\_ChemTime WHERE: "IrrEdge" = 1 AND "Floodplain" = 'N' AND  
"ChemTime" < 3  
R-click ChemTime and Field Calculate “ChemTime” = [ChemTime] + 1

### 5.6.9 Clay: Clay near Surface

Version date: 4 October 2016

Strategy: completed 2/27/2016 EAB

GIS method: completed & verified 3/3/2016 EAB

Python code: Started 3/2/2016 MCA, Completed 3/3/2016 MCA

Final verification of result by EAB: 3/3/2016; 10/4/2016 EAB revised SsurgoClay layer to include clay < 8 cm instead of < 6 cm (better reading of Hraby 2012). This does not affect Python coding.

Purpose:

Input to Water Quality / Clay and Organic Soils Factor

Y/N

Description:

Clay near surface. Select Wetland Units that intersect with clay in the top 8 cm of the soil profile in Palustrine Plot or SSURGO datasets.

Note that SSURGO mapping is very uneven, with some counties heavily mapped in A-horizon clay (Wetzel, Tyler, Pleasants, Ritchie, Putnam, Cabell) and others with little or no A-horizon clay mapped (Hardy, Grant, Tucker, Preston, Webster, Roane, Calhoun, Lewis, Doddridge, Nicholas, and much of southwestern WV).

Definitions:

SSURGO soils data from NRCS has multiple non-spatial tables, which have one-to-many relationships with the `ssurgo_wv` table. We will access the component horizon table (`chorizon_all`) to extract the clay content, horizon, and top depth of the horizon.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb (WU\_20150514)
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandsGeodatasets.gdb
  - Feature Class: PalustrinePlots
- M:\basemap\ssurgo\ssurgo.gdb
  - Feature Class: `ssurgo_wv`
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SsurgoExports.gdb
  - Feature Class: SsurgoClay

**NOTE: ArcGIS related tables cannot be programmed in Python, so before this procedure is run, the input data layer must be created in ArcGIS, as shown below. Note that this layer should be re-exported as SSURGO is updated by NRCS.**

**## Open the related one-to-many SSURGO chorizon\_all table.**

Open attribute table for ssurgo\_wv

Click “Related Tables” (second icon from left).

Click “component to surgo: component\_all” to open the component\_all table. Note that a tab will appear at the bottom of the attribute table showing the tables that are open.

Click “Related Tables” (second icon from left).

Click “component to chorizon: chorizon\_all” to open the chorizon\_all table.

**## Select soils with clay > 27% in the top 8 cm of the soil profile.**

With the tab at the bottom of the attribute labelled “chorizon\_all” highlighted:

SELECT \* FROM chorizon\_all WHERE: "claytotal\_r" > 27 AND "hzdept\_r" < 8 (516 out of 28520 selected)

**## Relate this selection to the spatial data in the ssurgo\_wv tab.**

Click “Related Tables” again to get back to component\_all and then back to ssurgo\_wv (65525 out of 413438 selected). Note that the last step takes some time while all of the related tables open up.

**## Export data to new feature class**

R-click ssurgo\_wv / Data / Export Data

Export Selected Features

Output feature class: SsurgoExports\SsurgoClay

Input Variables:

None

Method:

**## Add field Clay to Wetland Units attribute table and set initial value to “no clay”.**

Add field Clay (Text, Length 2) to Wetland Units attribute table.

R-click Clay and Field Calculate “Clay” = ‘N’

**## PART 1: PALUSTRINE PLOTS**

**## Select Palustrine plots with clay near surface.**

```
SELECT * FROM PalustrinePlots WHERE: "Soil_Textu" LIKE '%clay%' AND "Depth_of_o"  
IN ( ' ', '0', '1', '2', '3', '4') (230 out of 1702 selected)
```

**## Select Wetland Units that intersect palustrine plots selection.**

Selected by location

Selection method: select features from

Target layer: WU\_20150514

Source layer: PalustrinePlots

Check “Use selected features”

Spatial selection method: intersect the source feature layer

**## Update the value for “Clay” based on Palustrine plots.**

Open Wetland Units attribute table.

R-click “Clay” and Field Calculate “Clay” = “Y”

Clear all selections.

**## Part 2: SSURGO**

**## Select Wetland Units that intersect with the SSURGO selection.**

Select by Location

Selection method: select features from

Target layer(s): WU\_21050514

Source layer: SsurgoClay

Spatial selection method: intersect the source layer feature

**## Update the value for “Clay” based on SSURGO.**

Open Wetland Units attribute table

R-click “Clay” and Field Calculate “Clay” = “Y”



### 5.6.10 Clay Organic: Clay and Organic Soils

Version date: 14 March 2016

Strategy: completed 2/27/2016 EAB

GIS method: completed 3/10/2016 EAB; verified 3/14/3016 EAB

Python code: started & completed 4/5/2016 MCA

Final review by EAB: 4/5/2016

Purpose:

Input to Water Quality

Maximum 3 points; groundwater wetlands only

Description:

Must be outside the area of permanent ponding.

Rationale: Clay soils and organic soils are good indicators that a wetland can remove a wide range of pollutants from surface water. The uptake of dissolved phosphorus and toxic compounds through adsorption to soil particles is highest when soils are high in clay or organic content (Mitsch and Gosselink 1993). Denitrification is also high in soils with high organic content (Fisher and Acreman 2004). We only consider the type of soil near the surface because this is where the soil actually has contact with the surface waters carrying the pollutants. This is where most of the chemical and biological reactions occur. We only consider the organic or clay soil horizon in areas that are not permanently ponded.

Summary of strategy: Select wetland units that have clay or organic soils AND are not in a floodplain. Assign points according to the area of seasonal ponding, as follows:

- SeaPondRatio = 70-100% cover: 3 points
- SeaPondRatio = 40-70% cover: 2 points
- SeaPondRatio = 10-40% cover: 1 point
- SeaPondRatio < 10% cover: 0 point

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb (WU\_20150514)

Input Variables:

- Clay (clay soil near surface)
- Organic (organic matter near surface)
- SeaPondRatio (ratio of seasonally ponded area to total Wetland Unit area)
- Floodplain (location in floodplain)

Method:

**## Create feature class to store ClayOrganic factor**

R-click WU\_20150514 and select Data/Export Data

Output feature class: WU\_ClayOrganic

**## Add ClayOrganic field to Wetland Units and set initial point value to zero.**

Open attribute table of WU\_ClayOrganic  
Add field "ClayOrganic" (short integer)  
R-click ClayOrganic and Field Calculate ClayOrganic = 0

**## Spatial join to add input variables to attribute table**

Spatial join (contains) to add the following to the WU\_ClayOrganic: Floodplain, Clay, Organic, SeaPondRatio

**## Assign points to Wetland Units not in floodplain with clay or organic soils and seasonal ponding**

```
SELECT * FROM WU_ClayOrganic WHERE: "Floodplain" = 'N' AND ("Clay" = 'Y' OR "Organic" = 'Y') AND "SeaPondRatio" > 0.1
```

Field Calculate ClayOrganic = 1

```
SELECT * FROM WU_ClayOrganic WHERE: "Floodplain" = 'N' AND ("Clay" = 'Y' OR "Organic" = 'Y') AND "SeaPondRatio" > 0.5
```

Field Calculate ClayOrganic = 2

```
SELECT * FROM WU_ClayOrganic WHERE: "Floodplain" = 'N' AND ("Clay" = 'Y' OR "Organic" = 'Y') AND "SeaPondRatio" > 0.9
```

Field Calculate ClayOrganic = 3

### 5.6.11 Connect FL: Connectivity to Historic Floodplain

Version date: 20 November 2016

Strategy: Completed 11/16/2016 EAB

GIS method: completed 11/20/2016 EAB, verified 12/19/2016 EAB

Python coding: Completed 12/22/2016 MCA

Final review by EAB: 12/30/2016

Purpose:

Input to Flood Attenuation / Opportunity

Max 2 points.

Rationale: Wetlands are more likely to receive flood waters if they are well-connected to their historic floodplain (Acreman and Holden 2013).

Summary of strategy: Sum the points for FloodArea and StreamEdge. Reduce to a maximum of 2 points.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb (WU\_20150514)

Input Variables:

- FloodArea (2 points)
- StreamEdge (2 points)

Method:

#### **## Spatial joins to add input variables to Wetland Units attribute table**

ArcToolbox / Analysis Tools / Overlay / Spatial Join

Target Feature: WU\_20150514

Join Feature: WU\_FloodArea

Output Feature Class: WU\_Connect1

Join operation: JOIN\_ONE\_TO\_ONE

Check box "Keep all target features"

Field Map of Join Features: retain the following:

Shape\_Length

Shape\_Area

FloodArea

Match option: CONTAINS

ArcToolbox / Analysis Tools / Overlay / Spatial Join

Target Feature: WU\_Connect1

Join Feature: WU\_StreamEdge

Output Feature Class: WU\_Connect

Join operation: JOIN\_ONE\_TO\_ONE  
Check box "Keep all target features"  
Field Map of Join Features: retain the following:  
Shape\_Length  
Shape\_Area  
FloodArea  
StreamEdge  
Match option: CONTAINS

**## Add ConnectFL field and set initial point value to zero.**

Open attribute table of WU\_Connect  
Add field "ConnectFL" (short integer)  
R-click ConnectFL and Field Calculate ConnectFL = 0

**## Sum the points for FloodArea and StreamEdge.**

Open attribute table of WU\_Connect  
R-click ConnectFL and Field Calculate "ConnectFL" = [FloodArea] + [StreamEdge]

**## Reduce the total points to a maximum of 2.**

Open attribute table of WU\_Connect  
SELECT \* FROM WU\_Connect WHERE: "ConnectFL" > 2  
Field Calculate (selection only) "ConnectFL" = 2

## 5.6.12 ConsFocus: WVDNR Conservation Focus Areas with Wetland Focus

Version date: 11 December 2018

Strategy: 3/16/2017 EAB

GIS method: 10/4/2017 EAB; results verified 10/4/2017 EAB; Updated to include amphibian and reptile focus area information from DNR on 12/10/2018 EAB; 12/11/2018 method verified by JSH

Python code: 10/9/2017 YH

Final review by EAB: 10/9/2017

Purpose:

Input to Habitat / Landscape Opportunity (LandEco: Landscape Ecological Connectivity)

Description:

*Maximum 2 points*

Rationale: WVDNR has identified Conservation Focus Areas (CFAs) as part of the State Wildlife Action Plan. Several of the CFAs have a specific wetland focus. In addition, Partners in Reptile and Amphibian Conservation (PARCA) is working with WVDNR, USFS, USFWS, Dr. Tom Pauley of Marshall U., and others to develop focus areas, some of which have a specific wetland focus. CFAs that include a wetland focus are:

1. Cacapon River and Patterson Creek (wetland odonates, Short Mtn wetland); note that this shares a boundary with much of the PARCA “Eastern Panhandle” focus area for amphibians and reptiles, including wetland species.
2. Central Reservoirs (wetland birds and odonates),
3. High Alleghenies (High Allegheny Wetlands, all taxa groups, largest and most intact wetland complex in WV),
4. Little Kanawha and Middle Island Creek (wetland odonates),
5. Lower Elk River (wetland odonates),
6. Meadow River Wetlands (oak-ash swamps in 2<sup>nd</sup> largest wetland complex in WV, birds, crayfish, plants),
7. Ohio River Corridor (wetland birds, amphibians, plants, Greenbottom Swamp, Ohio River Islands); note that the southern half of this area shares boundaries with the PARCA “Moth Man” focus area for amphibians and reptiles, including wetland species.
8. Shenandoah Valley (marl wetlands, Virginia Rail, spotted turtle); note that this include the PARCA “Altona” focus area for amphibians and reptiles, including wetland species.
9. Sleepy Creek and Back Creek (wetland turtles, amphibians, plants); note that this shares a boundary with the eastern portion of the PARCA “Eastern Panhandle” focus area for amphibians and reptiles, including wetland species.

PARCAs with at least a partial wetland focus:

1. Snot Otter: includes riverine wetlands
2. Gorges: includes riverine wetlands
3. General Davis: includes riverine wetlands

4. Cranberry: includes riverine wetlands
5. Eastern Panhandle: mostly focused on the 3 major wood turtle streams (Cacapon, Sleepy Creek, and Back Creek) and associated palustrine wetlands and tributaries to those waterways
6. Altona: incorporates the bulk of TNC property and easements along Mill Creek, west of Charles Town, so includes the stream and associated palustrine wetlands.
7. Moth Man: incorporates many of the wetlands, mainly palustrine, serving as habitat for amphibians, including rare species such as small-mouthed salamander, streamside salamander, Jefferson salamander, and Blanchard's cricket frog (if still extant in the state).

PARCAs that do not have a wetland focus are Panther, Wayne, Cow Knob, and Pauley's Plethodon. Pauley's Plethodon includes a large wetland acreage with significant overall biodiversity, but the wetland-affiliated amphibians and reptiles in that PARCA don't happen to be priority species. Pauley's Plethodon has priority species Cheat Mountain salamander, green salamander, and timber rattlesnake.

GIS Method (no field method):

Select wetlands that intersect CFAs and/or PARCAs. Assign points as follows:

- 2 points: Wetland Unit intersects CFA/PARCA with specific wetland focus
- 1 point: Wetland Unit intersects any CFA except the "General CFA" or any PARCA
- 0 points: None of the above criteria are met

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb
  - Feature Class: WU\_20150514
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceFunctionalAssessment\HabitatData.gdb
  - Feature Class: ConsFocusArea

Method:

**## Create feature class to store results for ConsFocus and set initial value to zero**

R-click WU\_20150514 and select Data / Export / All Features

Output feature class: WetlandFunction.gdb / WU\_ConsFocus

Open attribute table of WU\_ConsFocus

Add field "ConsFocus" (short integer)

Field calculate ConsFocus = 0

**## Select Wetland Units that intersect the selected CFAs**

Select by Location

Selection method: select features from

Target layer(s): WU\_ConsFocus

Source layer: ConsFocusArea

Spatial selection method for target layer feature(s): intersect the source layer feature

**## Assign 1 point**

Open attribute table of WU\_ConsFocus  
Field Calculate ConsFocus = 1

**## Select CFAs with wetland focus**

SELECT \* FROM ConsFocusArea WHERE: WetlFocus = 'yes'

**## Select Wetland Units that intersect CFAs with wetland focus**

Select by Location

Selection method: select features from

Target layer(s): WU\_ConsFocus

Source layer: ConsFocusArea

Check "Use selected features"

Spatial selection method for target layer feature(s): intersect the source layer feature

**## Assign 2 points**

Open attribute table of WU\_ConsFocus  
Field Calculate ConsFocus = 2

### 5.6.13 Creating Wetland Units from NWI Polygons

Version date: 26 January 2022

Purpose:

Wetland Units are contiguous, hydrologically connected wetland polygons. They are the basic units used for functional assessment in West Virginia.

Methods:

1. Run the NWI data verification tests on the input polygons and correct any errors.
  - a. Create a new feature class that contains all palustrine wetlands, vegetated riverine wetlands, and vegetated lacustrine wetlands. Select by attributes where: "ATTRIBUTE" LIKE 'P%' OR "ATTRIBUTE" LIKE 'R2AB%' OR "ATTRIBUTE" LIKE 'R3AB%' OR "ATTRIBUTE" LIKE 'R2US5%' OR "ATTRIBUTE" LIKE 'R3US5%' OR "ATTRIBUTE" LIKE 'R2EM%' OR "ATTRIBUTE" LIKE 'R3EM%' OR "ATTRIBUTE" LIKE 'R4SB7%' OR "ATTRIBUTE" LIKE 'L2AB%' OR "ATTRIBUTE" LIKE 'L2US5%' OR "ATTRIBUTE" LIKE 'L2EM%'
  - b. Create a new feature class with the selected data called WUWorkingDS.
2. Dissolve NWI polygons. ArcGIS Geoprocessing menu/Dissolve. Remember to uncheck “Create multipart features (optional)”. We do not want any multipart features.
3. Add unique ID field (Long Integer: WUKey) for Wetland Units
4. Run “Check Geometry” on the final output to check for errors.
5. Create the basic geometries used for assessment of Wetland Units
  - a. WUpoint
  - b. Buffer10m
  - c. Buffer50m
  - d. Buffer300m
  - e. Buffer1km
  - f. DrainageArea

#### **Buffer creation method**

##### **## Create 300m buffer around Wetland Unit**

ArcToolbox / Proximity / Buffer  
Input features WU\_20150514  
Output feature class: WetlandUnits.gdb\Buffer300m  
Distance [value or field]: Linear Unit: 300 Meters  
Side Type: OUTSIDE\_ONLY  
Dissolve Type: NONE

##### **## Add field to store buffer area**

Open attribute table of Buffer300m  
In attribute table of Buffer300m, add field “Buf300Area” (float)  
Field calculate Buf300Area = Shape\_Area



### 5.6.14 CSFunction: Carbon Sequestration

Version date: 3 February 2017

Strategy: completed 4/13/2016 EAB

GIS method: completed 4/13/2016 EAB; verified 4/15/2016 EAB

Python code: Please wait to do this roll-up of the function. Since there are just 4 points in this function, we will combine it with Habitat/Ecological Integrity.

Final review by EAB:

Purpose:

Carbon Sequestration

*4 points maximum – all wetlands*

Description:

Rationale: The intrinsic potential of a wetland to sequester carbon depends on the amount and stability of above-ground biomass (vegetation) and below-ground carbon (organic soils). The carbon sequestration function includes only the potential aspect, since the opportunity and value to society aspects are the same for all wetlands.

Summary of strategy: For each Wetland Unit, sum the points for all factors within the “Potential” aspect. If the total exceeds 4 points, reduce to 4.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb (WU\_20150514)

Input Variables:

- Histosol (3 points – all types)
- VegCS (3 points – all types)

Method:

#### **## Spatial join to add input variables to Wetland Units attribute table**

ArcToolbox / Analysis Tools / Overlay / Spatial Join

Target Feature: WU\_Histosol

Join Feature: WU\_VegCS

Output Feature Class: WU\_CSFunction

Join operation: JOIN\_ONE\_TO\_ONE

Check box “Keep all target features”

Field Map of Join Features: retain the following:

Shape\_Length

Shape\_Area

Histosol

VegCS

Match option: CONTAINS

**## Add CSFunction field to Wetland Units and set initial point value to zero.**

Open attribute table of WU\_CSFunction

Add field "CSFunction" (short integer)

R-click CSFunction and Field Calculate CSFunction = 0

**## Sum the factor points**

R-click CSFunction and Field Calculate CSFunction = [Histosol] + [VegCS]

**## Reduce any excess point scores to the maximum allowed.**

Clear all selections.

SELECT \* FROM WU\_CSFunction WHERE: "CSFunction" > 4

(235 out of 43214 selected)

Field Calculate (selection only) "CSFunction" = 4

### 5.6.15 Depressions: Surface Depressions

Version date: 22 March 2016

Strategy: Completed 2/27/2016 EAB

GIS method: Drafted 2/27/2016 EAB, verified 3/14/2016 EAB

Python code: Started 3/21/2016, completed 3/22/2016 MCA

Final review by EAB: 3/22/2016

Purpose:

Input to Water Quality

Max 5 points, floodplain wetlands only.

Description:

Rationale: Surface depressions in a wetland that receives overland flow can trap sediments during a flood event. Depressions in riverine wetlands will tend to accumulate sediment and the pollutants associated with sediment (phosphorus and some toxics) because they reduce water velocities (Fennessey and others 1994) when the river floods. Wetlands where a larger part of the total area has depressions are relatively better at removing pollutants associated with sediments than those that have no such depressions. We cannot calculate surface depressions directly with the DEMs we have, so we estimate it from interspersions of Cowardin polygons, low slope, and irregularity of the upland/wetland edge. This is a proxy for complex microtopography. During field assessment, surface depressions will be estimated directly.

Summary of strategy: Select floodplain wetlands only. Sum the points for Microtopo (2 max), LowSlope (2 max), and IrrEdge (1 max).

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb (WU\_20150514)

Input Variables:

- Floodplain (Floodplain Location)
- Microtopo (Microtopographic Complexity)
- LowSlope (Low Slope)
- IrrEdge (Irregular Edge of the Upland/Wetland Boundary)

Method:

**## Create feature class to store Depressions factor**

R-click WU\_20150514 and select Data/Export Data

Output feature class: WU\_Depressions

**## Spatial join to add input variables to attribute table**

Spatial join (contains) to add the following to the WU\_Depressions: Floodplain, Microtopo, LowSlope, IrrEdge

**## Add Depressions field to Wetland Units and set initial point value to zero.**

Open attribute table of WU\_Depressions

Add field "Depressions" (short integer)

R-click Depressions and Field Calculate Depressions = 0

**# Sum points for surface depressions (Depressions) in floodplain Wetland Units.**

Clear all selections.

SELECT \* FROM WU\_Depressions WHERE: "Floodplain" = 'Y'

Field Calculate "Depressions" = [Microtopo] + [LowSlope] + [IrrEdge]

### 5.6.16 Discharges: Discharges to wetland within 100 m of boundary

Version date: 21 February 2024

Previous version(s): 6 April 2016

Strategy: completed 3/11/2016 EAB

GIS method: completed 4/6/2016 EAB; verified 4/6/2016 EAB

Python coding: completed 6/9/2016 MCA

Final review by EAB: 10/3/2016; in 2024, EAB re-arranged the Source Data to show Septic as a source layer rather than as a variable.

Purpose:

Water Quality Function

Max 2 points

Description:

Rationale: Wetlands can receive polluted waters even if they have well-vegetated and large buffers. For example, a pipe can discharge directly into a wetland, or a stream that drains areas where pollutants are released far from the unit can pass through the wetland. Also, silt fences often do not prevent all the sediment from reaching the wetland during construction. Other sources of pollutants may be septic tanks, NPDES discharges, Hydrological Protection Units (mining impacts), Acid Mine Lands, Acid Mine Drainage sites, and other sources that we are not currently able to include such as pesticide spraying on golf courses, particulates in exhausts from airplanes or motor vehicles, pesticides used in mosquito or gypsy moth control, and atmospheric deposition of mercury or other contaminants.

Summary of strategy: Assign 1 point to Wetland Units within 100 meters a septic risk or low-certainty NPDES permit location (excluding deep injection sites). Assign 2 points to Wetland Units within 100 meters of NPDES outlets (excluding deep injection sites), Well pads permitted within the last 5 years, Hydrologic Protection Units, Acid Mine Lands, Acid Mine Drainage sites, Superfund sites, and National Priority List sites.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb (WU\_20150514)
- M:\wr\owrnpdes\_.shp (updated 2024)
- M:\wr\owrnpdes\_outlets.shp
- M:\mr\hpu.shp (updated 2024, filtered for attributes, 21416 records)
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WaterQualityDatasets.gdb
  - Feature Class: AMLAMDFeb2016 (data provided by James Summers, DEP)
  - Feature Class: WellPads\_20160325 (data provided by Laura Adkins, DEP)
  - Feature Class: NPL\_point\_20160406 (data provided by Peter Costello, DEP)
  - Feature Class: NPL\_Bndry\_20160406 (data provided by Peter Costello, DEP)
  - Feature Class: Septic (updated 2024)

Method:

**## Create feature class to store Discharges variable**

R-click WU\_20150514 and select Data/Export Data  
Output feature class: WU\_Discharges

**## Add Discharges field to Wetland Units and set initial point value to zero.**

Open attribute table of WU\_Discharges  
Add field “Discharges” (short integer)  
R-click Discharges and Field Calculate Discharges = 0

**## PART 1: Select the ownrpdes\_ records that are not deep injection points and not septic tanks.**

Select by Attributes from ownrpdes\_  
Method: Create a new selection  
SELECT \* FROM ownrpdes\_ WHERE: "perm\_type" = '401 Certification' OR "perm\_type" = 'Industrial' OR "perm\_type" = 'Sewage' OR "perm\_type" = 'UIC Sewage' OR "perm\_type" = 'UIC Stormwater Industrial'

**## Select Wetland Units within 100 m of Septic or selected NPDES records and assign 1 point.**

Select by location  
Selection method: select features from  
Target Layer: WU\_Discharges  
Source layer: Septic  
Spatial selection method: are within a distance of the source layer feature  
Apply a search distance: 100 meters

Select by location  
Selection method: add to the currently selected features in  
Target Layer: WU\_Discharges  
Source layer: ownrpdes\_  
Check box “Use selected features”  
Spatial selection method: are within a distance of the source layer feature  
Apply a search distance: 100 meters

In WU\_Discharges, R-click Discharges and Field Calculate Discharges = 1

**## PART 2: Select relevant records from ownrpdes\_outlets that are not deep injection.**

Select by Attributes from ownrpdes\_outlets  
Method: Create a new selection

```
SELECT * FROM ownrpdes_outlets WHERE: "perm_type" = 'Industrial' OR "perm_type" = 'Sewage' OR "perm_type" = 'UIC Sewage' OR "perm_type" = 'UIC Stormwater Industrial'
```

**## Select relevant records (outlets with open status) from Hydrologic Protection Units.**

Select by Attributes from hpu

Method: Create a new selection

```
SELECT * FROM hpu WHERE: "STATUS_FLA" = 'O' AND "INSPECTA_1" = 'OUTLT'
```

**## Select Wetland Units within 100 m of potential discharges and assign 2 points.**

Select by location

Selection method: select features from

Target layer: WU\_Discharges

Source layer: ownrpdes\_outlets

Check box “Use selected features”

Spatial selection method: are within a distance of the source layer feature

Apply a search distance: 100 meters

Select by location

Selection method: add to the currently selected features in

Target layer: WU\_Discharges

Source layer: hpu

Check box “Use selected features”

Spatial selection method: are within a distance of the source layer feature

Apply a search distance: 100 meters

Select by location

Selection method: add to the currently selected features in

Target layer: WU\_Discharges

Source layer: AMLAMDFeb2016

Spatial selection method: are within a distance of the source layer feature

Apply a search distance: 100 meters

Select by location

Selection method: add to the currently selected features in

Target layer: WU\_Discharges

Source layer: WellPads\_20160325

Spatial selection method: are within a distance of the source layer feature

Apply a search distance: 100 meters

Select by location

Selection method: add to the currently selected features in

Target layer: WU\_Discharges

Source layer: WV\_NPL\_point

Spatial selection method: are within a distance of the source layer feature

Apply a search distance: 100 meters

Select by location

Selection method: add to the currently selected features in

Target layer: WU\_Discharges

Source layer: WV\_NPL\_Bndry

Spatial selection method: are within a distance of the source layer feature

Apply a search distance: 100 meters

In WU\_Discharges, R-click Discharges and Field Calculate Discharges = 2



### 5.6.17 DrainageArea: Drainage Area of Wetland

Version date: 25 January 2018

Strategy: 1/25/2018 EAB with advice from Mike Shank

GIS method: 1/25/2018 EAB

Python code: Yibing Han, WV GIS Tech Center

Final review by EAB: 2/15/2018

Purpose:

This layer is a basic spatial input to multiple wetland function metrics within Water Quality, Flood Attenuation, and Habitat/Ecological Integrity.

Description:

Drainage Area or Contributing Watershed of a Wetland Unit, with 27-meter resolution.

This method creates a feature class containing the polygonal boundary of the watershed that contributes flow to a Wetland Unit, and the area of that watershed. This layer contains a linking field (WUKey) to relate it to the Wetland Unit layer (WU\_20150514 in WetlandUnits.gdb).

The DrainageArea layer was first developed and run statewide at 27-meter resolution by Mike Shank in 2016. Finer resolutions may be possible in the future but are extremely time-consuming (several weeks or more of server time).

For each new set of Wetland Unit polygons, the drainage area must be calculated. DrainageArea forms one of the basic input geometries for wetland functional assessment.

Source Data:

Flow direction model

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceFunctionalAssessment\Watershed.gdb  
Raster: hydrogrid\_16U\_flowdir\_27m

Wetland Units

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb  
Feature Class: WU\_20150514

*###Note that this method takes a very long time to run on large datasets.*

Strategy:

1. Create DrainageArea feature class to hold watershed polygon output in WetlandUnits.gdb
2. Begin LOOP: Note that Wetland Units must be processed one at a time because of overlapping watershed boundaries. For each Wetland Unit polygon:
  - a. Copy Wetland Unit polygon to a temporary feature class
    - i. Select by attributes where WUKey = 1
    - ii. Export polygon to feature class "temp"
    - iii. Go through all steps below

- iv. Next time through loop select WUKey = 2, and so on until all Wetland Units have been processed
  - b. Convert temporary feature class to a temporary grid
    - i. Use the same cell size as the flow direction grid: 27m
    - ii. Use the WUKey of the Wetland Unit polygon as the grid value, which will carry over to the output feature class. This allows you to associate the wetland polygon with its drainage area.
    - iii. Snap the Wetland Unit grid to the flow direction grid.
  - c. Run watershed command using temporary grid as input, and the processing extent set to the flow direction grid. Note that you can calculate drainage for areas. Points are often tougher to match up exactly to the stream channels on imperfect elevation models.
  - d. Convert watershed grid to a polygon
  - e. Append polygon to DrainageArea feature class
3. Return to beginning of LOOP until all Wetland Units have been processed
  4. Add field to DrainageArea feature class to store WUKey

Method:

**## Create feature class to hold watershed polygon output in WetlandUnits.gdb**

Create polygon feature class in WetlandUnits.gdb: DrainageArea

Add field: grid\_code (long integer)

**## BEGIN LOOP; start with WUKey = 1 and repeat until all Wetland Units are processed**

**## Copy Wetland Unit polygon to a temporary feature class**

In WetlandUnits.gdb, open attribute table of feature class WU\_20150514

Select by attributes where WUKey = 1 (*then 2,3,4,...n*)

Export selected features to feature class “temp”

**## Convert temporary feature class to a temporary grid**

Conversion Tools / To Raster / Polygon to Raster

Input features: temp

Value Field: WUKey

Output Raster Dataset: tempras

Cell assignment type: CELL\_CENTER

Priority Field: NONE

Cellsize: 27

Environment Settings / Processing Extent

Extent: Default

Snap raster: hydrogrid\_16U\_flowdir\_27m

*## In order to capture very thin or small Wetland Units, use Feature to Raster instead of Polygon to Raster; or Set WUKey field also as Priority field in Polygon to Raster.*

**## Run watershed command using temporary grid as input.**

Spatial Analyst Tools / Hydrology / Watershed  
Input flow direction raster: hydrogrid\_16U\_flowdir\_27m  
Input raster or feature pour point data: tempras  
Pour point field: VALUE  
Output raster: temprasout  
Environment Settings / Processing extent  
Extent: Same as layer hydrogrid\_16U\_flowdir\_27m  
Snap raster: blank

**## Convert watershed grid to a polygon**

Conversion Tools / From Raster / Raster to Polygon  
Input raster: temprasout  
Field: WUKey  
Output polygon features: temppolyout  
Do not check “simplify polygons”

**## Append polygon to DrainageArea feature class**

DrainageArea / Load data / Input data = temppolyout

**## RETURN TO BEGINNING OF LOOP**

**## END LOOP when all Wetland Units are processed**

**## All Wetland Units have now been added to DrainageArea feature class**

**## Add field to DrainageArea feature class to store WUKey**

Add field WUKey (long integer)  
Field calculate WUKey = grid\_code

**## DrainageArea is ready to be used for analysis**

**## End of procedure**

**5.6.17 Disturb50m: Land use disturbance within 50 meters of wetland boundary**

Version date: 26 October 2016

Strategy: completed 3/12/2016 EAB

GIS method: 10/26/2016 EAB; verified 10/26/2016

Python coding: Started 6/16/2016 & completed 1/25/2017 MCA. Note: This code needs to run on a server that has adequate memory and processing power.

Final review by EAB: 1/25/2017

Purpose:

Water Quality Function / Opportunity aspect

Max 3 points

Description:

Rationale: Farming, grazing, golf courses, residential areas, commercial land uses, urban areas, and developed areas in general, are major sources of pollutants (Sheldon et al. 2005). Tilled fields are a source of nutrients, pesticides, and sediment. Pastures are a source of nutrients and pathogenic bacteria, and clearcut areas are a source of sediment (Sheldon et al. 2005). A well-vegetated buffer of 50 meters will only remove 60-80% of some pollutants from surface runoff into a wetland. Thus, pollutants from such land uses will probably reach the wetland unit if they are within 50 meters of the wetland.

Summary of strategy: Calculate the ratio of disturbed area to total area within 50 meters of the Wetland Unit. Disturbed land uses include agricultural, pasture, golf course, residential, commercial, urban, or area that have been timbered within the last 5 years. Create 50 meter buffer around Wetland Unit. Merge the disturbed land use selections and assign points as follows:

- 1/10 to ¼ of buffer is covered by disturbed land uses → 1 point
- ¼ to ½ of buffer is covered by disturbed land uses → 2 points
- > ½ of buffer is covered by disturbed land uses → 3 points

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb
  - Feature Class: WU\_20150514
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WaterQualityDatasets.gdb
  - Feature Class: DisturbedLand

Input Variables:

None

Method:

### **## Add WUKey field to Wetland Units**

In attribute table of WU\_20150514, add field “WUKey” (long integer)  
Field calculate WUKey = OBJECTID

### **## Buffer Wetland Units by 50 meters.**

Analysis Tools / Proximity / Buffer

Input Features: WU\_20150514

Output Feature Class: Buffer50m  
Distance (Linear unit): 50 meters  
Side Type: OUTSIDE\_ONLY  
Dissolve Type: NONE

### **## Add field to store buffer area**

In attribute table of Buffer50m, add field "BufferArea" (float)  
Field calculate BufferArea = Shape\_Area

### **## Intersect the 50m buffers and the disturbed land uses.**

ArcToolbox / Analysis Tools / Overlay / Intersect  
Input features: Buffer50m  
DisturbedLand  
Output feature class: Buffer50mDist  
Join attributes: ALL  
Output type: INPUT

### **## Dissolve disturbed lands by wetland buffer**

ArcToolbox / Data Management Tools / Generalization / Dissolve  
Input feature: Buffer50mDist  
Output Feature Class: Buffer50mDist\_diss  
Dissolve Fields: WUKey  
Statistics Fields: BufferArea (Statistic Type = First)  
Check box "Create multipart features" (default)

### **## Add field and calculate ratio of disturbed area to total drainage area.**

Open attribute table of Buffer50mDist\_diss  
Add field "Dist50mRat" (float)  
Field calculate Dist50mRat = [Shape\_Area] / [FIRST\_BufferArea]

### **## Join ratio of disturbed land to Wetland Units**

ArcToolbox / Data Management Tools / Joins / Add Join  
Input table: WU\_20150514  
Input Join Field: WUKey  
Join Table: Buffer50mDist\_diss  
Output Join Field: WUKey

### **## Export joined data**

R-click WU\_20150514 and select Data / Export Data  
Output feature class: WU\_Disturb50m

**## Add field to Wetland Units and set initial point value to zero.**

Open attribute table of WU\_Disturb50m

Add field "Disturb50m" (short integer)

R-click Disturb50m and Field Calculate Disturb50m = 0

**## Assign points.**

SELECT \* FROM WU\_Disturb50m WHERE: "Dist50mRat" > 0.1

R-click Disturb50m and Field Calculate Disturb50m = 1

SELECT \* FROM WU\_Disturb50m WHERE: "Dist50mRat" > 0.25

R-click Disturb50m and Field Calculate Disturb50m = 2

SELECT \* FROM WU\_Disturb50m WHERE: "Dist50mRat" > 0.5

R-click Disturb50m and Field Calculate Disturb50m = 3

### 5.6.18 DisturbWshd: Land use disturbance within contributing watershed

Version date: 25 October 2016

Strategy: completed 3/12/2016 EAB

GIS method: 4/20/2016 EAB; verified 10/25/2016

Python coding: Started 5/27/2016 MCA & Completed 11/22/2016

Final review by EAB: 11/28/2016

Purpose:

Water Quality Function / Opportunity aspect

Max 1 point

Description:

Rationale: Farming, grazing, golf courses, residential areas, commercial land uses, urban areas, and developed areas in general, are major sources of pollutants (Sheldon et al. 2005). Tilled fields are a source of nutrients, pesticides, and sediment. Pastures are a source of nutrients and pathogenic bacteria, and clearcut areas are a source of sediment (Sheldon et al. 2005). The presence of these sources in the contributing watershed of a wetland is a good indicator that pollutants may be reaching the wetland.

Summary of strategy: Calculate the ratio of disturbed area to total area within the drainage areas of each Wetland Unit. Disturbed land uses include agricultural, pasture, golf course, residential, commercial, urban, or area that have been timbered within the last 5 years. Merge the disturbed land use selections and assign 1 point if more than 10% of the contributing watershed is disturbed.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb
  - Feature Class: WU\_20150514
  - Feature Class: DrainageArea27m
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WaterQualityDatasets.gdb
  - Feature Class: DisturbedLand

Input Variables:

None

Method:

**## Intersect the drainage areas and the disturbed land uses.**

ArcToolbox / Analysis Tools / Overlay / Intersect

Input features: DrainageArea27m

DisturbedLand

Output feature class: DrainAreaDist

Join attributes: ALL  
Output type: INPUT

### **## Dissolve disturbed lands by drainage area**

ArcToolbox / Data Management Tools / Generalization / Dissolve  
Input feature: DrainAreaDist  
Output Feature Class: DrainAreaDist\_diss  
Dissolve Fields: WUKey  
Statistics Fields: CntrWshd (Statistic Type = First)  
Check box “Create multipart features” (default)

### **## Add field to DrainAreaDist\_diss and calculate ratio of disturbed area to total drainage area.**

Open attribute table of DrainAreaDist\_diss  
Add field “DistWshdRat” (float)  
Field calculate DistWshdRat = [SHAPE\_Area] / [FIRST\_CntrWshd]

### **## Join ratio of disturbed land to Wetland Units**

ArcToolbox / Data Management Tools / Joins / Add Join  
Input table: WU\_20150514  
Input Join Field: WUKey  
Join Table: DrainAreaDist\_diss  
Output Join Field: WUKey

### **## Export joined data**

R-click WU\_20150514 and select Data / Export Data  
Output feature class: WU\_DisturbWshd

### **## Add field to Wetland Units and set initial point value to zero.**

Open attribute table of WU\_DisturbWshd  
Add field “DisturbWshd” (short integer)  
R-click DisturbWshd and Field Calculate DisturbWshd = 0

### **## Assign points.**

SELECT \* FROM WU\_DisturbWshd WHERE: DistWshdRat > 0.1  
R-click DisturbWshd and Field Calculate DisturbWshd = 1



## 5.6.19 EconRisk: Economically Valuable Flood Risk Area Downstream of Wetland

Version date: 9 November 2016

Strategy: 4/21/2016 EAB

GIS method: 4/22/2016 EAB: verified for Barbour and Berkeley counties, need TotalLossRP100 layer to set quintile thresholds. Layer created by MCA 11/9/16. Quintile thresholds set and method revised by EAB 11/9/16. Method verified EAB 11/9/16.

Python coding: Started 11/9/2016 MCA & Completed 11/10/2016 MCA

Final verification by EAB:

Purpose:

Flood Attenuation / Value to Society

Max 4 points (all wetland types)

Description:

Rationale: Wetlands upstream of economically valuable flood-prone infrastructure (structures, roads, developed lands, cropland) can reduce the costs and negative impacts of flood damages on society (WI GIS-RAM).

Strategy: Wetland Unit is located in or near a census block with significant predicted total losses during a 100-year flood (Hazus census block data). In West Virginia, wetlands tend to be in headwaters, while infrastructure is generally in the bottomlands. Therefore we will approximate “wetland upgradient of risk area” by using three levels of increasing distance: (a) co-location within a census block with predicted losses, (b) 1 km distance from a census block with predicted losses, and (c) co-location within a HUC12 watershed that contains predicted losses. This will approximately capture wetlands that are upgradient of census blocks with predicted flood losses. Assign points as follows:

- 4 points: WU intersects TotalLossRP100 > 1204 (top quintile or \$1,204,000-\$246,103,000)
- 3 points: WU intersects TotalLossRP100 = 200 – 1204 OR is within 1 km of top quintile
- 2 points: WU intersects TotalLossRP100 = 42 - 200 OR is within 1 km of fourth quintile
- 1 point: WU intersects TotalLossRP100 > 0 – 42 OR WU is in a HUC12 watershed with TotalLossRP100 > 0
- 0 point: WU is in a HUC12 watershed with TotalLossRP100 = 0 (bottom quintile)

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb
  - Feature Class: WU\_20150514
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\Floodplain\FloodplainData.gdb
  - Feature Class: TotalLossRP100
- M:\basemap\watersheds\_12digit.shp

Method:

**## Create new feature class to store EconRisk data.**

R-click WU\_20150514 and select Data / Export Data

Output feature class: WU\_EconRisk  
Open attribute table and add field EconRisk (short integer)  
Field calculate EconRisk = 0

**## Select Census blocks and assign points to Wetland Units.  
## Assign 1 point to wetlands within HUC12 with loss areas > 0.**

Select by attributes from TotalLossRP100  
Method: Create a new selection  
SELECT \* FROM TotalLossRP100 WHERE: "TotalLossRP100" > 0

Select by location  
Select Method: select features from  
Target layer: watersheds\_12digit  
Source layer: TotalLossRP100  
Check box "Use selected features"  
Spatial selection method: intersect the source layer feature

Select by location  
Select Method: select features from  
Target layer: WU\_EconRisk  
Source layer: watersheds\_12digit  
Check box "Use selected features"  
Spatial selection method: intersect the source layer feature

R-click WU\_EconRisk and open attribute table  
In WU\_EconRisk, Field Calculate EconRisk = 1

**## Assign 2 points to wetlands in middle quintile or within 1 km of second highest quintile.**

Select by attributes from TotalLossRP100  
Method: Create a new selection  
SELECT \* FROM TotalLossRP100 WHERE: "TotalLossRP100" > 42

Select by location  
Select Method: select features from  
Target layer: WU\_EconRisk  
Source layer: TotalLossRP100  
Check box "Use selected features"  
Spatial selection method: intersect the source layer feature

R-click WU\_EconRisk and open attribute table  
In WU\_EconRisk, Field Calculate EconRisk = 2

Select by attributes from TotalLossRP100

Method: Create a new selection

```
SELECT * FROM TotalLossRP100 WHERE: "TotalLossRP100" > 200
```

Select by location

Select Method: select features from

Target layer: WU\_EconRisk

Source layer: TotalLossRP100

Check box "Use selected features"

Spatial selection method: are within a distance of the source layer feature

Apply a search distance: 1000 meters

R-click WU\_EconRisk and open attribute table

In WU\_EconRisk, Field Calculate EconRisk = 2

**## Assign 3 points to wetlands in second highest quintile or within 1 km of highest quintile.**

Select by attributes from TotalLossRP100

Method: Create a new selection

```
SELECT * FROM TotalLossRP100 WHERE: "TotalLossRP100" > 200
```

Select by location

Select Method: select features from

Target layer: WU\_EconRisk

Source layer: TotalLossRP100

Check box "Use selected features"

Spatial selection method: intersect the source layer feature

R-click WU\_EconRisk and open attribute table

In WU\_EconRisk, Field Calculate EconRisk = 3

Select by attributes from TotalLossRP100

Method: Create a new selection

```
SELECT * FROM TotalLossRP100 WHERE: "TotalLossRP100" > 1204
```

Select by location

Select Method: select features from

Target layer: WU\_EconRisk

Source layer: TotalLossRP100

Check box "Use selected features"

Spatial selection method: are within a distance of the source layer feature

Apply a search distance: 1000 meters

R-click WU\_EconRisk and open attribute table

In WU\_EconRisk, Field Calculate EconRisk = 3

**## Assign 4 points to wetlands in highest quintile.**

Select by attributes from TotalLossRP100

Method: Create a new selection

```
SELECT * FROM TotalLossRP100 WHERE: "TotalLossRP100" > 1204
```

Select by location

Select Method: select features from

Target layer: WU\_EconRisk

Source layer: TotalLossRP100

Check box "Use selected features"

Spatial selection method: intersect the source layer feature

R-click WU\_EconRisk and open attribute table

In WU\_EconRisk, Field Calculate EconRisk = 4

## 5.6.20 FAFunction: Flood Attenuation

Version date: 7 March 2017

Strategy: completed 4/21/2016 EAB

GIS method: completed 4/22/2016 EAB; verified 3/7/2017 EAB

Python code: 3/13/2017 MCA

Final review by EAB: 6/20/2017 EAB

Purpose:

Flood Attenuation Function

Maximum 24 points (floodplain wetlands); 20 points (groundwater wetlands)

Description:

Rationale: The flood attenuation function is a measure of the effectiveness of a wetland in storing water or delaying the downgradient movement of water, thus potentially influencing the height, timing, duration, and frequency of flooding in downstream areas. Many wetlands are capable of slowing the downslope movement of water, regardless of whether they have significant storage capacity. Water that is slowed, or stored, in a wetland becomes potentially available for recharging baseflow of streams or aquifers, and supporting local food webs.

Strategy: For each Wetland Unit, sum the points for the three aspects (wetland potential to provide function, landscape offers opportunity to carry out function, and value to society)

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb
  - Feature Class: WU\_20150514

Input Variables:

- FAPotential (16 points max for floodplain wetlands; 14 points max for groundwater wetlands)
- FAOpportun (4 points max for floodplain wetlands; 2 points max for groundwater wetlands)
- FASociety (4 points max for all wetland types)

Method:

### **## Create feature class to store FAFunction**

R-click WU\_20150514 and select Data/Export Data

Output feature class: WU\_FAFunction

### **## Spatial join to bring in aspect values**

ArcToolbox / Analysis Tools / Overlay / Spatial join

Target Feature: WU\_FAPotential

Join Feature: WU\_Opportun

Output feature class: WU\_FAFunction1  
Join Operation: JOIN\_ONE\_TO\_ONE  
Field Map of Join Features: retain the following  
WUKey  
    Shape-Length  
Shape\_Area  
FAPotential  
FAOpportun  
Match Option: CONTAINS

ArcToolbox / Analysis Tools / Overlay / Spatial join  
Target Feature: WU\_FAFunction1  
Join Feature: WU\_FASociety  
Output feature class: WU\_FAFunction  
Join Operation: JOIN\_ONE\_TO\_ONE  
Field Map of Join Features: retain the following  
WUKey  
    Shape-Length  
Shape\_Area  
FAPotential  
FAOpportun  
FASociety  
Match Option: CONTAINS

**## Add FAFunction field to Wetland Units and set initial point value to zero.**

Open attribute table of WU\_FAFunction  
Add field "FAFunction" (short integer)  
R-click FAFunction and Field Calculate FAFunction = 0

**## Sum the points for each aspect of Water Quality Function for Wetland Units**

R-click FAFunction and Field Calculate FAFunction = [FAPotential] + [FAOpportun] + [FASociety]

### 5.6.21 FAOpportun: Flood Attenuation Opportunity

Version date: 7 March 2017

Strategy: completed 4/22/2016 EAB

GIS method: completed 11/20/2016 EAB; revised 12/19/2016 EAB; verified 3/17/2017

Python code:

Final check by EAB:

Purpose:

Flood Attenuation Function

Maximum 4 points (floodplain wetlands); Maximum 2 points (groundwater wetlands)

Description:

Rationale: Wetlands that are well-connected to their historic floodplains, are surrounded by runoff-producing areas, or have catchments with steep slopes, all tend to receive flood waters and have high opportunity to attenuate floods.

Strategy: For each Wetland Unit, sum the points for all factors within the “Opportunity” aspect. Restrict groundwater wetlands to a maximum of two points.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb
  - Feature Class: WU\_20150514

Input Variables:

- FloodIn (2 points max) (all wetlands) from WU\_FloodIn
- ConnectFL (2 points max) (all wetlands) from WU\_Connect
- Floodplain from WU\_Connect (or from WU\_Floodplain)

Method:

**## Bring together factor values and output feature class to store FAOpportun.**

ArcToolbox / Analysis Tools / Overlay / Spatial join

Target Feature: WU\_20150514

Join Feature: WU\_FloodIn

Output feature class: WU\_FAOpportun1

Join Operation: JOIN\_ONE\_TO\_ONE

Field Map of Join Features: retain the following

WUKey

Shape-Length

Shape\_Area

FloodIn

Match Option: CONTAINS

ArcToolbox / Analysis Tools / Overlay / Spatial join

Target Feature: WU\_FAOpportun1

Join Feature: WU\_Connect

Output feature class: WU\_FAOpportun2

Join Operation: JOIN\_ONE\_TO\_ONE

Field Map of Join Features: retain the following

WUKey

    Shape-Length

Shape\_Area

FloodIn

ConnectFL

Floodplain

Match Option: CONTAINS

**## Add FAOpportun field to Wetland Units and set initial point value to zero.**

Open attribute table of WU\_FAOpportun

Add field "FAOpportun" (short integer)

R-click FAOpportun and Field Calculate FAOpportun = 0

**## Sum the factor points.**

R-click FAOpportun and Field Calculate FAOpportun = [FloodIn] + [ConnectFL]

**## Reduce points for groundwater wetlands to a maximum of 2.**

Open attribute table of WU\_FAOpportun

SELECT \* FROM WU\_FAOpportun WHERE: "FAOpportun" > 2 AND "Floodplain" = 'N'  
(1369 out of 43124 selected)

Field Calculate (selection only) "FAOpportun" = 2



## 5.6.22 FAPotential: Flood Attenuation Potential

Version date: 1 September 2017

Strategy: completed 3/24/2016 EAB

GIS method: completed 3/24/2016 EAB; verified 12/20/2016 EAB; re-verified with revised  
Runoff values 1/9/2017 EAB

Python code: 12/22/2016 MCA; 1/10/2017 MCA (Re-ran Code)

Final review by EAB: 1/11/2017

Purpose:

Flood Attenuation Function

*17 points maximum FL*

*14 points maximum GW*

Description:

Rationale: The intrinsic potential of a wetland to attenuate floods depends on a number of factors, including its location in the watershed, slope, the structure and density of vegetation, soil infiltration capacity, microtopography, and the type of surface water outlet.

Summary of strategy: For each Wetland Unit, sum the points for all factors within the “Potential” aspect. Note that different point values for floodplain vs. groundwater wetlands are assigned at the factor level.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb (WU\_20150514)

Input Variables:

- Headwater (1 point – all types)
- LowSlope (2 points – all types)
- VegFA (9 points FL, 5 points GW)
- Runoff (5 points FL, 4 points GW)
- SWOutflow2 (2 points GW)

Method:

### **## Create feature class to store FAPotential**

R-click WU\_20150514 and select Data/Export Data

Output feature class: WU\_FAPotential

### **## Spatial join to bring in factor values**

Spatial join (contains) to add the following to the WU\_FAPotential table: Headwater, LowSlope, VegFA, Runoff, SWOutflow2

**## Add FAPotential field to Wetland Units and set initial point value to zero.**

Open attribute table of WU\_FAPotential

Add field "FAPotential" (short integer)

R-click FAPotential and Field Calculate FAPotential = 0

**## Sum the factor points**

R-click FAPotential and Field Calculate FAPotential = [Headwater] + [LowSlope] + [VegFA]  
+[Runoff] + [SWOutflow2]

### 5.6.23 FASociety: Flood Attenuation Value to Society

Version date: 10 November 2016

Strategy: completed 4/22/2016 EAB

GIS method: completed 4/22/2016 EAB; verified 11/10/2016 EAB

Python code: Started & completed 11/10/2016 MCA

Final check by EAB: 11/10/2016

Purpose:

Flood Attenuation Function

Maximum 4 points (all wetlands)

Description:

Rationale: Wetlands in regulatory floodways or upstream of economically valuable flood-prone areas can reduce the costs and negative impacts of flood damages to society.

Strategy: For each Wetland Unit, sum the points for all factors within the “Society” aspect. Reduce values that exceed the maximum allowable points for this aspect of flood attenuation function. Note that floodplain and groundwater wetlands are treated the same for this aspect.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb
  - Feature Class: WU\_20150514

Input Variables:

- Floodway (4 points max)
- EconRisk (4 points max)

Method:

#### **## Create feature class to store FASociety**

R-click WU\_20150514 and select Data/Export Data

Output feature class: WU\_FASociety1

#### **## Spatial joins to bring in factor values**

ArcToolbox / Analysis Tools / Overlay / Spatial join

Target Feature: WU\_FASociety1

Join Feature: WU\_Floodway

Output feature class: WU\_FASociety2

Join Operation: JOIN\_ONE\_TO\_ONE

Field Map of Join Features: retain the following

Shape-Length

Shape\_Area  
Floodway  
Match Option: CONTAINS

ArcToolbox / Analysis Tools / Overlay / Spatial join  
Target Feature: WU\_FASociety2  
Join Feature: WU\_EconRisk  
Output feature class: WU\_FASociety  
Join Operation: JOIN\_ONE\_TO\_ONE  
Field Map of Join Features: retain the following  
Shape-Length  
Shape\_Area  
Floodway  
EconRisk  
Match Option: CONTAINS

**## Add FASociety field to Wetland Units and set initial point value to zero.**

Open attribute table of WU\_FASociety  
Add field "FASociety" (short integer)  
R-click FASociety and Field Calculate FASociety = 0

**## Sum the factor points**

R-click FASociety and Field Calculate FASociety = [Floodway] + [EconRisk]

**## Reduce values that exceed the maximum allowable points**

Select by attributes  
Layer: WU\_Society  
Method: Create a new selection  
SELECT \* FROM WU\_FASociety WHERE: "FASociety" > 4  
(1184 out of 43124 selected)

R-click FASociety and Field Calculate FASociety = 4

## 5.6.24 Fisheries: Wetland discharges to economically important fisheries

Version date: 17 July 2016

Strategy: 2/14/2016 EAB

GIS method: 3/16/2016 EAB

Python coding: started and completed 3/16/2016

Final review by EAB:

Purpose:

Water Quality Function

Max 2 points

Description:

Rationale: Wetlands filter sediments and contaminants, and buffer pH. Wetlands in the contributing basin of an economically important fishery are of high economic and social value.

Summary of strategy: Approximated as Wetland Unit located within 1 km of an economically important fishery.

- Fishery. Wetland is in the contributing watershed of a high quality fishery, warmwater fishery stream, stocked trout stream, or a stream with year-round trout populations (1 point). Note that warmwater fisheries are generally included in the “high quality fishery” layer (they can also perhaps be approximated by all polygonal streams below 2000 feet elevation, according to Mike Shingleton (WVDNR), pers. comm. March 2015, but we will assume they are covered by the high quality fisheries data).
- Special Fishery. Wetland is in the contributing watershed of a catch-and-release area, children/Class Q fishing area, or fly-fishing-only stream (2 points).

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb (WU\_20150514)
  - M:\wr\WTRSHD\_BRANCH\TROUT\Trout\_Streams.shp
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\DNR\_Fishing\_20Aug2015\HighQualityStreamFisheriesWVDNR20150820.shp
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\DNR\_Fishing\_20Aug2015\TrStStreams.shp

Input Variables:

None

Method:

**## Create feature class to store Fisheries variable**

R-click WU\_20150514 and select Data/Export Data

Output feature class: WU\_Fisheries

**## Add field to Wetland Units and set initial point value to zero.**

Open attribute table of WU\_Fisheries  
Add field "Fisheries" (short integer)  
R-click Fisheries and Field Calculate Fisheries = 0

**## Select Wetland Units within 1 km of perennial trout streams.**

Select by location  
Selection method: select features from  
Target layer: WU\_Fisheries  
Source layer: Trout\_Streams.shp  
Spatial selection method: are within a distance of the source layer feature  
Apply a search distance: 1000 meters

**## Select Wetland Units within 1 km of high quality stream fisheries.**

Select by location  
Selection method: add to the currently selected features in  
Target layer: WU\_Fisheries  
Source layer: HighQualityStreamFisheriesWVDNR20150820.shp  
Spatial selection method: are within a distance of the source feature  
Apply a search distance: 1000 meters

**## Select Wetland Units within 1 km of stocked trout streams.**

Select by location  
Selection method: add to the currently selected features in  
Target layer: WU\_Fisheries  
Source layer: TrStStreams.shp  
Spatial selection method: are within a distance of the source feature  
Apply a search distance: 1000 meters

**## Assign 1 point to Wetland Units that discharge to economic fisheries.**

R-click "Fisheries" in WU\_Fisheries and Field Calculate Fisheries = 1

**## Select special fisheries**

Select by Attributes  
Layer: TrStStreams  
Method: Create a new selection  
SELECT \* FROM TrStStreams WHERE: "StockCode" NOT LIKE 'NS'

Select by Attributes  
Layer: TrStStreams

Method: Add to current selection

```
SELECT * FROM TrStStreams WHERE: "RegType" = 'Catch-and-Release' OR "RegType" =  
'Children and Class Q' OR "RegType" = 'Fly-fishing-Only'
```

**## Select Wetland Units within 1 km of special fisheries.**

Select by location

Selection method: select features from

Target layer: WU\_Fisheries

Source layer: TrStStreams

Check box "Use selected features"

Spatial selection method: are within a distance of the source layer feature

Apply a search distance: 1000 meters

**## Assign 2 points to Wetland Units within 1 km of special fisheries.**

R-click "Fisheries" in WU\_Fisheries and Field Calculate Fisheries = 2

### 5.6.25 FloodArea: Proportion of wetland area in floodplain, including the intermediate variable FloodRatio, and Floodplain (Y/N)

Version date: 8 March 2017

Strategy: Completed 4/13/2016 EAB

GIS method: Drafted 4/20/2016 EAB; Verified 12/5/2016; Revised 3/8/2017 EAB to include Floodplain

Python code: 12/21/2016 MCA; need revision

Final review by EAB: 12/22/2016; need re-check

Purpose:

Floodplain (Y/N): Input to numerous Water Quality and Flood Attenuation metrics

FloodArea: Input to Flood Attenuation / Opportunity

Max 2 points (all wetlands, but only Floodplain wetlands will score high enough to get points)

Description:

#### **Floodplain (Y/N)**

Rationale: Wetlands that receive overland flood flows sometimes have differing functions from those that are primarily groundwater-fed. “Floodplain” and “Groundwater” wetlands are therefore assessed using different variables in some cases. For example, surface depressions are important in holding floodwaters in a wetland, and woody vegetation physically slows flood flows and associated debris. Groundwater wetlands, with slower-moving subsurface flows, have water quality functions that are more dependent on the presence of organic soils, clay soils, or the irregularity of the upland-wetland edge.

Summary of strategy: Wetland Units with 10% or greater of their area in the FEMA floodplain or Active River Area Base Zone are considered floodplain wetlands unless they have known peat deposits, in which case they are put in the groundwater wetland group. This technique probably over-estimates the actual number of floodplain wetlands, but it is the best method we currently have.

#### **Proportion of wetland area in floodplain (FloodArea). Max 2 points.**

Rationale: Floodplain wetlands store and slow water movement during floods and storms. The amount of flood attenuation in a wetland is related to the amount of overbank flooding it receives, which in turn is related to its position in the floodplain. Wetlands that are entirely within the floodplain have more opportunity to attenuate floods than wetlands that are only partially in a floodplain.

Strategy: Calculate ratio of Wetland Unit area that lies in the floodplain (either FEMA or ARA). Peatlands are set to zero since they are primarily groundwater, not floodplain, wetlands.

Ratio > 0.5 = 2 points

Ratio 0.1-0.5 = 1 point

Ratio < 0.1 = 0 points.

*Note that only Floodplain wetlands will receive these points, since by definition they have a ratio > 0.1.*



Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb
  - Feature Class: WU\_20150514
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\Floodplain\FloodplainData.gdb
  - Feature Class: FloodplainARAFEMA
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandsGeodatasets.gdb
  - Feature Class: Peatlands\_20160228

Method:

**## Intersect floodplain and Wetland Units**

ArcToolbox / Analysis Tools / Overlay / Intersect

Input features: FloodplainARAFEMA  
WU\_20150514

Output feature class: WU\_FloodArea1

Join attributes: ONLY\_FID

Output type: INPUT

**## Add field to store floodplain area.**

Open attribute table of WU\_FloodArea1

Add field "FloodAreaAF" (float)

R-click "FloodAreaAF" and Calculate Geometry.

Property: Area

Coordinate System: Use coordinate system of the data source

Units: Square Meters [sq m]

**## Spatial Join floodplain selection to Wetland Units and sum floodplain area.**

Analysis Tools / Overlay / Spatial Join

Target Features: WU\_20150514

Join Features: WU\_FloodArea1

Output Feature Class: WU\_FloodArea

Join Operation: JOIN\_ONE\_TO\_ONE

Check box "Keep all target features"

Field Map of Join Features: retain the following

Shape\_Length

Shape\_Area

WUKey

FloodAreaAF (R-click and select "Merge Rule", "Sum")

Match Option: INTERSECT

**## Add fields to store Flood Area Ratio and Flood Area points.**

Open attribute table of WU\_FloodArea  
Add field FloodRatio (float) to WU\_FloodArea attribute table.  
Add field FloodArea (short integer) to WU\_FloodArea attribute table.  
Field calculate FloodArea = 0

**## Calculate the ratio of floodplain area to total Wetland Units area.**

Field calculate FloodRatio = [FloodAreaAF] / [Shape\_Area]

**## Assign points**

SELECT \* FROM WU\_FloodArea WHERE: FloodRatio > 0.1  
Field Calculate FloodArea = 1

SELECT \* FROM WU\_FloodArea WHERE: FloodRatio > 0.5  
Field Calculate FloodArea = 2

**## Select Wetland Units that contain peat deposits**

Clear selection.  
Select by Location  
Selection Method: Select features from  
Target Layer: WU\_FloodArea  
Source Layer: Peatlands\_20160228  
Spatial selection method: Intersect the source feature  
(277 out of 43124 selected)

**## Set FloodArea to zero for Wetland Units that contain peat deposits.**

R-click FloodArea and Field Calculate "FloodArea" = 0

*Add the following to compute "Floodplain" (Y/N)*

**## Add field Floodplain to Wetland Units attribute table and set initial value to "N".**

Add field Floodplain (Text, 2 characters) to WU\_Floodplain attribute table.  
R-click Floodplain and Field Calculate "Floodplain" = "N"

**## Select Wetland Units that have at least 10% of their area in a FEMA floodplain or Active River Area base zone.**

SELECT \* FROM WU\_FloodArea WHERE: FloodArea > 0

**Set Floodplain = "Yes" for selected Wetland Units.**

R-click Floodplain and Field Calculate "Floodplain" = "Y"

## 5.6.26 FloodIn: Floodwaters Delivered to Wetland

Version date: 7 March 2017

Strategy: Completed 11/20/2016 EAB

GIS method: completed 11/20/2016 EAB, verified 3/7/2017

Python coding: 3/7/2017 MCA

Final review by EAB: 3/7/2017 EAB

Purpose:

Input to Flood Attenuation / Potential

Max 2 points (all wetlands).

Rationale: Wetlands are more likely to receive flood waters if there are steep slopes in their contributing watershed, and if the land surrounding the wetland has high runoff potential.

Summary of strategy: Sum the points for SlopeWshd, Runoff50m, and RunoffWshd. Assign points as follows:

0 points: sum is (0,1,2).

1 point: sum is (3,4).

2 points: sum is (5,6).

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb (WU\_20150514)

Input Variables:

- SlopeWshd (2 points)
- Runoff50m (2 points)
- RunoffWshd (2 points)

Method:

**## Spatial joins to add input variables to Wetland Units attribute table**

ArcToolbox / Analysis Tools / Overlay / Spatial Join

Target Feature: WU\_20150514

Join Feature: WU\_SlopeWshd

Output Feature Class: WU\_FloodIn1

Join operation: JOIN\_ONE\_TO\_ONE

Check box "Keep all target features"

Field Map of Join Features: retain the following:

WUKey

Shape\_Length

Shape\_Area

SlopeWshd

Match option: CONTAINS

ArcToolbox / Analysis Tools / Overlay / Spatial Join

Target Feature: WU\_FloodIn1

Join Feature: WU\_Runoff50m

Output Feature Class: WU\_FloodIn2

Join operation: JOIN\_ONE\_TO\_ONE

Check box "Keep all target features"

Field Map of Join Features: retain the following:

WUKey

Shape\_Length

Shape\_Area

SlopeWshd

Runoff50m

Match option: CONTAINS

ArcToolbox / Analysis Tools / Overlay / Spatial Join

Target Feature: WU\_FloodIn2

Join Feature: WU\_RunoffWshd

Output Feature Class: WU\_FloodIn

Join operation: JOIN\_ONE\_TO\_ONE

Check box "Keep all target features"

Field Map of Join Features: retain the following:

WUKey

Shape\_Length

Shape\_Area

SlopeWshd

Runoff50m

RunoffWshd

Match option: CONTAINS

**## Add FloodIn field to Wetland Units and set initial point value to zero.**

Open attribute table of WU\_FloodIn

Add field "FloodIn" (short integer)

R-click FloodIn and Field Calculate FloodIn = 0

**## Calculate sum of SlopeWshd, Runoff50m, RunoffWshd and assign points to FloodIn.**

Open attribute table of WU\_FloodIn

Select \* from WU\_FloodIn where: ("RunoffWshd"+ "SlopeWshd"+ "Runoff50m") > 2

R-click FloodIn and Field Calculate "FloodIn" = 1

Select \* from WU\_FloodIn where: ("RunoffWshd"+ "SlopeWshd"+ "Runoff50m") > 4

R-click FloodIn and Field Calculate "FloodIn" = 2

### 5.6.27 Floodway: Wetland is in a FEMA Floodway

Version date: 21 April 2016

Strategy: 3/28/2016 EAB

GIS method: completed 4/21/2016 EAB; verified 4/21/EAB

Python code: started & completed 5/27/2016 MCA

Final review by EAB: 10/3/2016

Purpose:

Flood Attenuation Function / Value to Society

Maximum 4 points

Description:

Rationale: Regulatory floodways have been identified by FEMA as high priorities for flood control, with strict limits on development. Wetlands occurring in a regulatory floodway have a high value to society. FEMA: *A "Regulatory Floodway" means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height. Communities must regulate development in these floodways to ensure that there are no increases in upstream flood elevations.*

Strategy: Wetland intersects a mapped FEMA Regulatory Floodway. 4 points.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb
  - Feature Class: WU\_20150514
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\Floodplain\wvFloodHazardFeatures\_WVGISTC\_20130410\wvFloodHazardFeatures20130207.gdb
  - Feature Class: WV\_Floodway\_20130205\_wgs84wmA

Method:

#### **## Create feature class to store Floodway points and set initial value**

R-click WU\_20150514 and select Data / Export Data

Output feature class: WU\_Floodway

Add field to attribute table of WU\_Floodway: Floodway (short integer)

Field calculate Floodway = 0

#### **## Select Wetland Units that intersect a Floodway**

Select by Location

Selection method: select features from

Target layer: WU\_Floodway

Source layer: WV\_Floodway\_20130205\_wgs84wmA

Spatial selection method: intersect the source feature

**## Assign points**

In WU\_Floodway, Field calculate Floodway = 4

## 5.6.28 Function: Total Wetland Function

Version date: 5 November 2017

Strategy: completed 3/16/2017 EAB

GIS method: 10/20/2017 EAB; results verified 10/20/2017 EAB; re-verified with revised BRank 11/5/17

Python code: 10/30/2017 YH

Final review by EAB: 11/5/2017

Purpose:

Maximum 200 points

Description:

Rationale:

Strategy: Sum the scores for WQFunction, FAFunction, and HFunction

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandFunctionResults\WetlandFunction.gdb
  - Feature Class: WU\_WQFunction
  - Feature Class: WU\_FAFunction
  - Feature Class: WU\_HFunction

Method:

**## Spatial Join to merge metrics and create feature class to store Function**

ArcToolbox / Analysis Tools / Overlay / Spatial join

Target Feature: WU\_WQFunction

Join Feature: WU\_FAFunction

Output feature class: WetlandFunction.gdb \ WU\_Function1

Join Operation: JOIN\_ONE\_TO\_ONE

Field Map of Join Features: retain the following

WUKey

Shape-Length

Shape\_Area

WQFunction

FAFunction

Match Option: CONTAINS

ArcToolbox / Analysis Tools / Overlay / Spatial join

Target Feature: WU\_Function1

Join Feature: WU\_HFunction

Output feature class: WetlandFunction.gdb \ WU\_Function

Join Operation: JOIN\_ONE\_TO\_ONE

Field Map of Join Features: retain the following

WUKey  
    Shape-Length  
Shape\_Area  
WQFunction  
FAFunction  
HFunction  
Match Option: CONTAINS

**## Add Function and assign values**

Open attribute table of WU\_Function  
Add field "Function" (short integer)

R-click Function and Field Calculate Function = [WQFunction]+ [FAFunction]+ [HFunction]



### 5.6.29 Headwater: Headwater Location

Version date: 18 April 2016

Strategy: Completed 2/27/2016 EAB

GIS method: Completed 4/12/2016 EAB, verified 4/18/2016 EAB

Python coding: Started & Completed 6/15/2016 MCA

EAB 10/3/2016: re-run after WFlowPath and LandPos are updated; MCA 10/18/16 completed

Final review by EAB: 10/25/2016

Purpose:

Input to Water Quality (Potential) and Flood Attenuation (Potential) functions

Max 1 point.

Description:

Rationale: Headwater wetlands provide water quality and hydrologic stability benefits to waters downstream. Wetlands found in the headwaters of streams often do not store surface water to any great depth. They can, however, be important in reducing peak flows because they slow down and “desynchronize” the initial peak flows from a storm (Brassard and others 2000). Their importance in hydrologic functions is often under-rated. In the words of Michael Davis, Deputy Assistant of the Army, to the U.S. Senate: “The most recent data and scientific literature indicate that isolated and headwater wetlands often play an ecological role that is as important as other types of wetlands in protecting water quality, reducing flood flows, and providing habitat for many species of fish and wildlife” (Davis 1997).

Summary of strategy: Assign one point if the Wetland Unit has a Tiner Landscape Position (LandPos) with a headwater modifier.

Definitions:

Tiner (2011) defines lotic headwater wetlands as “wetlands along first- and second-order perennial streams in hilly terrain including all intermittent streams above these perennial streams”. He defines terrene headwater wetlands as “wetland is the source of a river or stream but this watercourse does not extend through the wetland”. These are coded in our database as “LandPos” = ‘LSH’ (lotic stream headwater wetlands and “LandPos” = ‘TEh’ (terrene headwater wetlands).

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb (WU\_20150514)

Input Variables:

- LandPos (Landscape Position)

Method:

**## Spatial join to add input variable to attribute table**

ArcToolbox / Analysis Tools / Overlay / Spatial join

Target Feature: WU\_20150514

Join Feature: WU\_LandPos

Output feature class: WU\_Headwater

Join Operation: JOIN\_ONE\_TO\_ONE

Field Map of Join Features: retain the following

Shape\_Length

Shape\_Area

LandPos

Match Option: CONTAINS

**## Add Headwater field to Wetland Units and set initial point value to zero.**

Open attribute table of WU\_Headwater

Add field "Headwater" (short integer)

R-click Headwater and Field Calculate Headwater = 0

**## Assign 1 point to Wetland Units with Landscape Position headwater modifier.**

Clear all selections.

SELECT \* FROM WU\_Headwater WHERE: "LandPos" LIKE '%h'

Field Calculate (selection only) "Headwater" = 1

### 5.6.30 HFuncNoBR: Habitat and Ecological Integrity Function without Site Biodiversity Rank

Version date: 19 October 2017

Strategy: completed 3/16/2017 EAB

GIS method: 10/16/2017 EAB; results verified 10/16/2017 EAB

Python code: 10/19/2017 YH

Final review by EAB: 10/19/2017

Purpose:

Input to Habitat and Ecological Integrity Function

Maximum 50 points

Description:

Rationale:

Strategy: For each Wetland Unit, sum the points for the three aspects (wetland potential to provide function, landscape offers opportunity to carry out function, and value to society).

- HPotential (30 points max)
- HOpportun (13 points max)
- HSociety (7 points max)

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandFunctionResults\WetlandFunction.gdb
  - Feature Class: WU\_HPotential
  - Feature Class: WU\_HOpportun
  - Feature Class: WU\_HSociety

Method:

**## Spatial Join to merge metrics and create feature class to store HFuncNoBR**

ArcToolbox / Analysis Tools / Overlay / Spatial join

Target Feature: WU\_HPotential

Join Feature: WU\_HOpportun

Output feature class: WetlandFunction.gdb \ WU\_HFuncNoBR1

Join Operation: JOIN\_ONE\_TO\_ONE

Field Map of Join Features: retain the following

WUKey

Shape-Length

Shape\_Area

HPotential

HOpportun

Match Option: CONTAINS

ArcToolbox / Analysis Tools / Overlay / Spatial join

Target Feature: WU\_HFuncNoBR1  
Join Feature: WU\_HSociety  
Output feature class: WetlandFunction.gdb \ WU\_HFuncNoBR  
Join Operation: JOIN\_ONE\_TO\_ONE  
Field Map of Join Features: retain the following  
WUKey  
    Shape-Length  
Shape\_Area  
HPotential  
HOportun  
HSociety  
Match Option: CONTAINS

**## Add HFuncNoBR field to Wetland Units and set initial point value to zero.**

Open attribute table of WU\_HFuncNoBR  
Add field "HFuncNoBRn" (short integer)  
R-click HFuncNoBR and Field Calculate HFuncNoBR = 0

**## Sum the points**

R-click HFuncNoBR and Field Calculate HFuncNoBR = [HPotential] + [HOportun] + [HSociety]

### 5.6.31 HFunction: Habitat and Ecological Integrity Function

Version date: 5 November 2017

Strategy: completed 3/16/2017 EAB

GIS method: 10/26/2017 EAB; results verified 10/26/2017 EAB; re-verified with new BRank 11/5/2017

Python code: 10/26/2017 YH

Final review by EAB: 10/30/2017 EAB

Purpose:

Maximum 150 points

Description:

Rationale:

Strategy: Incorporate the Site Biodiversity Rank (BRank) and HFuncNoBR into HFunction as follows:

- B1 Outstanding Global Biodiversity Significance: automatically assigned maximum points for habitat function x 3 (HFunction = 150 points)
- B2 High Global Biodiversity Significance: automatically assigned maximum points for habitat function x 2 (HFunction = 100 points)
- B3 Global Biodiversity Significance: automatically assigned maximum points for habitat function x 1.5 (HFunction = 75 points)
- B4 Outstanding State Biodiversity Significance: automatically assigned maximum points for habitat function (HFunction = 50 points)
- B5 State Biodiversity Significance: automatically assigned maximum points for “intrinsic potential” part of habitat function (HPotential = 30 points)
- B6 Local Biodiversity Significance: automatically awarded an additional 5 points toward the maximum of 30 for the “intrinsic potential” part of habitat function (HPotential)

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandFunctionResults\WetlandFunction.gdb
  - Feature Class: WU\_BRank
  - Feature Class: WU\_HFuncNoBR

Method:

**## Spatial Join to merge metrics and create feature class to store HFunction**

ArcToolbox / Analysis Tools / Overlay / Spatial join

Target Feature: WU\_BRank

Join Feature: WU\_HFuncNoBR

Output feature class: WetlandFunction.gdb \ WU\_HFunction

Join Operation: JOIN\_ONE\_TO\_ONE

Keep all target features

Field Map of Join Features: retain the following

WUKey

Shape-Length

Shape\_Area

HPotential

HOpportun

HSociety

HFuncNoBR

BRank

Match Option: CONTAINS

### **## Add fields to store intermediate value for B6 sites and results and set initial values**

Open attribute table of WU\_HFunction

Add field "HPotB6" (short integer)

Field calculate HPotB6 = 0

Add field "HFunction" (short integer)

Field Calculate HFunction = [HFuncNoBR]

### **## Select B6 wetlands**

Open attribute table of WU\_HFunction

SELECT \* FROM WU\_HFunction WHERE: "BRank" = 'B6'

### **## Add 5 points to HPotential for B6 wetlands, up to a maximum of 30 points**

Open attribute table of WU\_HFunction

Field calculate HPotB6 = [HPotential] + 5

SELECT \* FROM WU\_HFunction WHERE: "HPotB6" > 30

Field calculate HPotB6 = 30

### **## Select B6 wetlands and calculate HFunction**

Open attribute table of WU\_HFunction

SELECT \* FROM WU\_HFunction WHERE: "BRank" = 'B6'

Field Calculate HFunction = [HPotB6] + [HOpportun] + [HSociety]

### **## Select B5 wetlands and calculate HFunction**

Open attribute table of WU\_HFunction

SELECT \* FROM WU\_HFunction WHERE: "BRank" = 'B5'

Field Calculate HFunction = [HOpportun] + [HSociety] + 30

**## Select B4 wetlands and calculate HFunction**

Open attribute table of WU\_HFunction

```
SELECT * FROM WU_HFunction WHERE: "BRank" = 'B4'
```

Field Calculate HFunction = 50

**## Select B3 wetlands and calculate HFunction**

Open attribute table of WU\_HFunction

```
SELECT * FROM WU_HFunction WHERE: "BRank" = 'B3'
```

Field Calculate HFunction = 75

**## Select B2 wetlands and calculate HFunction**

Open attribute table of WU\_HFunction

```
SELECT * FROM WU_HFunction WHERE: "BRank" = 'B2'
```

Field Calculate HFunction = 100

**## Select B1 wetlands and calculate HFunction**

Open attribute table of WU\_HFunction

```
SELECT * FROM WU_HFunction WHERE: "BRank" = 'B1'
```

Field Calculate HFunction = 150

## 5.6.32 HInvest: Societal Investment in Habitat and Ecological Integrity

Version date: 20 October 2017

Strategy: 3/16/2017 EAB

GIS method: 10/16/2017 EAB; results verified 10/19/2017 EAB

Python code: 10/19/2017 YH

Final review by EAB: 10/19/2017 EAB

Purpose:

Input to Habitat / Value to Society

Description:

*Maximum 3 points*

Rationale: Society values wetland habitats by investing in them through management and conservation actions.

GIS and Field Method: Note that field data can overwrite the GIS determination of this metric.

Assign points according to the criteria met:

3 points: high investment. Award 3 points if any of the following criteria are met.

- Mitigation investment: wetland is all or part of a mitigation site used explicitly to offset impacts elsewhere.
- Conservation investment: wetland is part of or contiguous to lands which public or private organizational funds were spent to preserve, create, restore, or enhance habitat and not used explicitly to offset impacts elsewhere.
  - Conservation easement managed for biodiversity, i.e., Gap Status Code = 1 (TNC, some land trust holdings) *Check with DNR (or Michael Schwartz of Freshwater Institute) every two years to see if there are updates to: WV\_Protected\_Lands\_2015\_PUBLIC*
  - USDA
    - FSA Conservation Reserve Program (CRP)
    - NRCS Wetland Reserve Program
    - NRCS Emergency Watershed Protection easement
    - USFS Forest Legacy easement
    - USFS Special Botanical Area
    - USFS Wilderness Area
  - USFWS National Wildlife Refuge
  - USNPS National Park, Monument, or Scenic River
  - WVDNR State Natural Area

2 points: moderate investment in a general area including the wetland, with some focus on habitat and ecological integrity along with other functions. Assign 2 points if any of the following contain the Wetland Unit.

- USFS National Forest outside wilderness or special botanical areas



1 point: low investment: wetlands that are on public land where the primary focus is on functions (e.g., recreation, military operations) other than ecological conservation or restoration, but where wetlands are unlikely to be destroyed or severely adversely impacted.

- US Department of Defense lands
- WVDNR State Parks
- WVDNR Wildlife Management Areas (open access, Gap status 2)
- WVDOF State Forests (GAP status: managed for multiple uses, subject to extractive, e.g. mining or logging, or OHV use)
- City and County Parks (all are open access, GAP status code = “no known mandate”)
- Natural Streams Preservation Act (NSPA). Wetland is in the contributing watershed of a stream reach protected by the Natural Streams Preservation Act. These include (a) Greenbrier River from its confluence with Knapps Creek to its confluence with the New River, (b) Anthony Creek from its headwaters to its confluence with the Greenbrier River, (c) Cranberry River from its headwaters to its confluence with the Gauley River, (d) Birch River from the Cora Brown bridge in Nicholas county to the confluence of the river with the Elk River, and (e) New River from its confluence with the Gauley River to its confluence with the Greenbrier River.

0 points: no known investment

#### Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandFunctionResults\WetlandUnits.gdb
  - Feature Class: WU\_20150514
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceAsReceived
  - \Boundaries2017\countyCityParkBoundaries\_20107731\_utm83.gdb
    - Feature Class: countyCityParkBoundaries\_20170731\_utm83
  - \Boundaries2017\nationalForestOwnership\_USFWS\_20170803\_utm83.gdb
    - Feature Class: nationalForestOwnership\_USFWS\_20170803\_utm83
      - Field: Forest Service
  - \Boundaries2017\nationalParkBoundaries\_nationalParkService\_20170802.gdb
    - Feature Class: nationalParkBoundaries\_nationalParkService\_20170802
  - \Boundaries2017\nationalWildifeRefuge\_USFWS\_20170803\_utm83.gdb
    - Feature Class: nationalWildifeRefuge\_USFWS\_20170803
  - \Boundaries2017\wvdnrManagedLands\_wvdnr\_20170731\_utm83.gdb
    - Feature Class: wvdnrManagedLands\_wvdnr\_20170731\_utm83
  - \Boundaries2017\wvStateForestBoundaries\_wvdof\_20171003\_utm83.gdb
    - Feature Class: wvStateForestBoundaries\_wvdof\_20171003\_utm83
  - \Boundaries2017\stateParkBoundaries\_WVDNR\_20170927\_utm83
    - Feature Class: stateParkBoundaries\_WVDNR\_20170927\_utm83
  - \USFS\botanical\_areas\_MNF.shp
    - **Note: do not distribute this layer outside WVDEP - it is sensitive data!**
  - \WV\_Protected\_Lands\_v2013c\_Public\WV\_Protected\_Lands\_2015\_PUBLIC.shp
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceFunctionalAssessment\Watershed.gdb
  - Feature Class: NatStrPreAct\_HUC10
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandsGeodatasets.gdb
  - Feature Class: ILF\_banks
  - Feature Class: RestoredWetlands

Method:

**## Create feature class to store results for HInvest and set initial value to zero**

R-click WU\_20150514 and select Export Data / All features

Output feature class: WetlandFunction.gdb / WU\_HInvest

Open attribute table of WU\_HInvest

Add field "HInvest" (short integer)

Field calculate HInvest = 0

**## Low investment**

**## Select wetlands that intersect state or local public lands**

Select by Location

Select features from: WU\_HInvest

Source layer: stateParkBoundaries\_WVDNR\_20170927\_utm83

Spatial selection method for target layer feature(s): intersect the source feature

Select by Location

Add to the currently selected features in: WU\_HInvest

Source layer: wvdnrManagedLands\_wvdnr\_20170731\_utm83

Spatial selection method for target layer feature(s): intersect the source feature

Select by Location

Add to the currently selected features in: WU\_HInvest

Source layer: wvStateForestBoundaries\_wvdof\_20171003\_utm83

Spatial selection method for target layer feature(s): intersect the source feature

Select by Location

Add to the currently selected features in: WU\_HInvest

Source layer: countyCityParkBoundaries\_20170731\_utm83

Spatial selection method for target layer feature(s): intersect the source feature

**## Add wetlands that intersect Natural Streams Preservation Act watersheds to selection**

Select by Location

Add to the currently selected features in: WU\_HInvest

Source layer: NatStrPreAct\_HUC10

Spatial selection method for target layer feature(s): intersect the source feature

**## Add wetlands that intersect Department of Defense Lands to selection**

Open attribute table of WV\_Protected\_Lands\_2015\_PUBLIC

SELECT \* FROM WV\_Protected\_Lands\_2015\_PUBLIC WHERE: "OwnName" = 'Department of Defense (DOD)'

Select by Location

Add to the currently selected features in: WU\_HInvest

Source layer: WV\_Protected\_Lands\_2015\_PUBLIC

Use Selected Features

Spatial selection method for target layer feature(s): intersect the source feature

### **## Assign point and clear selections**

Open attribute table of WU\_HInvest

R-click HInvest and Field Calculate HInvest = 1

Clear all selections

### **## Moderate investment**

#### **## Select lands owned by USFS**

Open attribute table of nationalForestOwnership\_USFWS\_20170803\_utm83

SELECT \* FROM nationalForestOwnership\_USFWS\_20170803\_utm83 WHERE:

"Ownership" = 'Forest Service'

#### **## Select wetlands that intersect selected areas**

Select by Location

Select features from: WU\_HInvest

Source layer: nationalForestOwnership\_USFWS\_20170803\_utm83

Use Selected Features (1 Feature selected)

Spatial selection method for target layer feature(s): intersect the source feature

### **## Assign points and clear selections**

Open attribute table of WU\_HInvest

R-click HInvest and Field Calculate HInvest = 2

Clear all selections

### **## High investment**

#### **## Select Private Conservation Lands with Gap Status = 1 and USFS Wilderness Areas**

Open attribute table of WV\_Protected\_Lands\_2015\_PUBLIC

SELECT \* FROM WV\_Protected\_Lands\_2015\_PUBLIC WHERE: ("Mang\_Name" IN ('EWPP-FPE', 'WRP', 'CLRLT', 'Potomac Conservancy', 'The Nature Conservancy (TNC)', 'WVLT', 'Forest Legacy') OR "GAP\_Sts" = '1' OR "PdesTp" = 'Wilderness Area') AND ("PdesTp" <> 'Wild and Scenic River' AND "PdesTp" <> 'National Wildlife Refuge')

#### **## Select wetlands that intersect selected areas**

Select by Location

Select features from: WU\_HInvest

Source layer: WV\_Protected\_Lands\_2015\_PUBLIC

Use Selected Features

Spatial selection method for target layer feature(s): intersect the source feature

**## Add to Selection wetlands that intersect National Wildlife Refuges or National Parks**

Select by Location

Add to the currently selected features in: WU\_HInvest

Source layer: nationalWildlifeRefuge\_USFWS\_20170803

Spatial selection method for target layer feature(s): intersect the source feature

Select by Location

Add to the currently selected features in: WU\_HInvest

Source layer: nationalParkBoundaries\_nationalParkService\_20170802

Spatial selection method for target layer feature(s): intersect the source feature

**## Add to Selection wetlands that intersect special botanical areas**

Select by Location

Add to the currently selected features in: WU\_HInvest

Source layer: botanical\_areas\_MNF.shp

Spatial selection method for target layer feature(s): intersect the source feature

**## Add to Selection wetlands that intersect Mitigation Banks and In-Lieu Fee sites**

Select by Location

Add to the currently selected features in: WU\_HInvest

Source layer: ILF\_banks

Spatial selection method for target layer feature(s): are within a distance of the source layer feature

Apply a search distance: 100 meters

**## Add to Selection wetlands that intersect other restored, enhanced or created wetland sites**

Select by Location

Add to the currently selected features in: WU\_HInvest

Source layer: RestoredWetlands

Spatial selection method for target layer feature(s): intersect the source feature

**## Add to Selection wetlands in WVDNR State Natural Areas**

SELECT \* FROM stateParkBoundaries\_WVDNR\_20170927\_utm83 WHERE: "Unit\_Nm" IN ('Canaan Valley Resort State Park', 'Cathedral State Park', 'Beartown State Park')  
(3 out of 36 selected)

*## Hungry Beech State Natural Area is already selected in "Private Conservation Lands" above.*

*## There are currently (2017) no mapped wetlands in Hungry Beech.*

*## In case we ever need to generate State Natural Areas as a layer.*

*## SELECT \* FROM WV\_Protected\_Lands\_2015\_PUBLIC WHERE: "P\_Des\_Nm" = 'Hungry Beech'*

### **## Select wetlands that intersect selected areas**

Select by Location

Add to the currently selected features in: WU\_HInvest

Source layer: stateParkBoundaries\_WVDNR\_20170927\_utm83

Use Selected Features

Spatial selection method for target layer feature(s): intersect the source feature

### **## Assign points and clear selections**

Open attribute table of WU\_HInvest

R-click HInvest and Field Calculate HInvest = 3

### 5.6.33 Histosol: Deep Organic Soils

Version date: 14 February 2017

Strategy: completed 4/13/2016 EAB

GIS method: completed 4/14/2016 EAB; verified 4/14/2016 EAB

Python code: Started & Completed 2/7/2017 MCA

Final review by EAB: 2/7/2017

Purpose:

Input to Habitat and Ecological Integrity / Intrinsic Potential

Description:

Rationale: Deep organic soils provide important habitat to specialist plants and animals, including bog and fen species. Wetlands with deep organic soils store large amounts of carbon. It is important to keep carbon locked in the soil where it will not contribute to anthropogenic climate change.

Strategy:

*(Adapted from “Organic” variable – some code can be shared).*

Strategy: Determine presence of histosols and/or histic epipedons. *Note that this criterion can be measured much more accurately during rapid field assessment. For GIS assessment, we will note only the presence, not the cover, of histosols and histic epipedons.*

3 points: Histosols occur in Wetland Unit (NWI polygons with “g” modifier OR SSURGO/Palustrine plots organic depth OR peatlands layer).

2 points: Histic epipedons occur in Wetland Unit (SSURGO/palustrine plots organic depth).

0 points: Histosols and histic epipedons are not present.

Select Wetland Units that intersect with any of the following: Peatlands, NWI polygons with organic modifier, Palustrine Plots with muck or peat soils, or SSURGO chorizon with organic soils in the upper 5 cm.

SSURGO soils data from NRCS has multiple non-spatial tables, which have one-to-many relationships with the `ssurgo_wv` table. We will access the component horizon table (`chorizon_all`) to extract the organic content, horizon, and top depth of the horizon.

Note that SSURGO mapping is very uneven, with some counties heavily mapped with organic soils and others with few or no organic soils mapped.

Definitions:

For the purposes of this assessment, histosols and histic epipedons are defined as follows, simplified from NRCS 2014 Keys to Soil Taxonomy.

Histosol: Peat, mucky peat, or muck soil with at least 12-18% organic matter by weight and  $\geq 40$  cm deep within the upper 80 cm of soil profile.

Histic epipedon: Peat, mucky peat, or muck soil with at least 12-18% organic matter by weight and  $\geq 20$  cm thick (but  $< 40$  cm thick) as a surface horizon. Aquic conditions or artificial drainage is required.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb (WU\_20150514)
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\EnhancedNWI\_20150511.gdb
  - Feature Class: EnhWVWetland
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandsGeodatasets.gdb
  - Feature Class: Peatlands\_20160228 (update if more recent file is available)
  - Feature Class: PalustrinePlots
- M:\basemap\ssurgo\ssurgo.gdb
  - Feature Class: ssurgo\_wv
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SsurgoExports.gdb (see box below)
  - Feature Class: Histosol (created 4/14/2016)
  - Feature Class: HisticEpipedon (created 4/14/2016)

**NOTE: ArcGIS related tables cannot be programmed in Python, so before this procedure is run, the input data layers “Histosol” and “HisticEpipedon” must be created in ArcGIS, as shown below. Note that these layers should be re-exported annually or as SSURGO is updated by NRCS. These 2 layers (Histosol, HisticEpipedon) were created by EAB on 4/14/2016.**

**## Open the related one-to-many SSURGO chorizon\_all table.**

Open attribute table for ssurgo\_wv

Click “Related Tables” (second icon from left).

Click “component to surgo: component\_all” to open the component\_all table. Note that a tab will appear at the bottom of the attribute table showing the tables that are open.

Click “Related Tables” (second icon from left).

Click “component to chorizon: chorizon\_all” to open the chorizon\_all table.

**## Select histisols: organic material > 15% by weight with a thickness of at least 40 cm in the upper 80 centimeters of the soil profile.**

With the tab at the bottom of the attribute labelled “chorizon\_all” highlighted:

Select by attributes

```
SELECT * FROM chorizon_all WHERE: ("hzname" LIKE 'O%' OR "om_r" > 15) AND "hzdept_r" < 40 AND "hzthk_r" > 39
```

**## Relate this selection to the spatial data in the ssurgo\_wv tab.**

Click “Related Tables” again to get back to component\_all and then back to ssurgo\_wv

Note that the last step takes some time while all of the related tables open up.

**## Export data to new feature class**

R-click ssurgo\_wv / Data / Export Data

Export Selected Features

Output feature class: SSurgoExports.gdb\Histosol

**## Select histic epipedons: organic material > 15% by weight with a thickness of at least 20 cm in the upper 80 centimeters of the soil profile.**

Clear selections.

With the tab at the bottom of the attribute labelled "chorizon\_all" highlighted:

Select by Attributes.

```
SELECT * FROM chorizon_all WHERE: ("hzname" LIKE 'O%' OR "om_r" > 15) AND  
"hzdept_r" < 40 AND "hzthk_r" > 19 AND "hzthk_r" < 40
```

**## Relate this selection to the spatial data in the ssurgo\_wv tab.**

Click "Related Tables" again to get back to component\_all and then back to ssurgo\_wv

Note that the last step takes some time while all of the related tables open up.

**## Export data to new feature class**

R-click ssurgo\_wv / Data / Export Data

Export Selected Features

Output feature class: SSurgoExports.gdb\HisticEpipedon

Method:

**## Add field for Histosol to Wetland Units attribute table and set initial value to zero.**

R-click WU\_20150514 and select Data / Export Data

Output feature class: WU\_Histosol

Add field Histosol (Short Integer) to WU\_Histosol.

R-click Histosol and Field Calculate "Histosol" = 0

**## PART 1: Histic Epipedon**

**## Select Palustrine plots that have peat or muck soils (conservative assumption that these are histic epipedons) or organic soils 20-39 cm thick.**

```
SELECT * FROM PalustrinePlots WHERE: "Soil_Textu" LIKE '%peat%' OR "Soil_Textu"  
LIKE '%muck%' OR ("Depth_of_o" >19 AND "Depth_of_o" < 40)
```

**## Select Wetland Units that intersect palustrine plots with histic epipedons.**

Select by Location

Selection method: select features from

Target layer: WU\_Histosol

Source layer: PalustrinePlots

Check "Use selected features"



Spatial selection method: intersect the source layer feature

**## Update value for “Histosol” based on palustrine plots.**

Open WU\_Histosol attribute table

R-click “Histosol” and Field Calculate “Histosol” = 2

Clear all selections.

**## Select Wetland Units that intersect with the SSURGO histic epipedon selection.**

Select by Location

Selection method: select features from

Target layer(s): WU\_Histosol

Source layer: HisticEpipedon

Spatial selection method: intersect the source layer feature

**## Update value for “Histosol” based on ssurgo data.**

Open WU\_Histosol attribute table.

R-click “Histosol” and Field Calculate “Histosol” = 2

**## PART 2: Histosol**

**## Select Palustrine plots that have organic soils at least 40 cm thick.**

SELECT \* FROM PalustrinePlots WHERE: "Depth\_of\_o" > 39

**## Select Wetland Units that intersect palustrine plots with histosols.**

Select by Location

Selection method: select features from

Target layer: WU\_Histosol

Source layer: PalustrinePlots

Check “Use selected features”

Spatial selection method: intersect the source layer feature

**## Update value for “Histosol” based on palustrine plots.**

Open WU\_Histosol attribute table.

R-click “Histosol” and Field Calculate “Histosol” = 3

Clear all selections.

**## Select Wetland Units that intersect with the SSURGO histosol selection.**

Select by Location

Selection method: select features from  
Target layer(s): WU\_Histosol  
Source layer: Histosol  
Spatial selection method: intersect the source layer feature

**## Update value for “Histosol” based on ssurgo data.**

Open WU\_Histosol attribute table.  
R-click “Histosol” and Field Calculate “Histosol” = 3

**## PART 3: PEATLANDS**

**## Select Wetland Units that are peatlands.**

Select by Location  
Selection method: select features from  
Target layer: WU\_Histosol  
Source layer: Peatlands\_20160228 (or most recent version of Peatlands)  
Spatial selection method: intersect the source layer feature

**## Update value for “Histosol” based on peatlands.**

Open WU\_Histosol attribute table (277 out of 43124 selected).  
R-click “Histosol” and Field Calculate “Histosol” = 3  
Clear all selections.

**## PART 4: NWI ORGANIC MODIFIER**

**## Select polygons that have an organic modifier in the National Wetland Inventory.**

SELECT \* FROM EnhWVWetland WHERE: "ATTRIBUTE" LIKE '%g'

**## Select Wetland Units that intersect organic NWI polygons.**

Select by Location  
Selection method: select features from  
Target layer: WU\_Histosol  
Source layer: EnhWVWetland  
Check “Use selected features”  
Spatial selection method: intersect the source layer feature

**## Update value for “Histosol” based on NWI.**

Open WU\_Histosol attribute table.  
R-click “Histosol” and Field Calculate “Histosol” = “3”  
Clear all selections.

### 5.6.34 HOpportunity: Habitat and Ecological Integrity Landscape Opportunity

Version date: 6 October 2017

Strategy: completed 3/16/2017 EAB

GIS method: 10/6/2017 EAB; results verified 10/6/2017 EAB

Python code: 10/10/2017 YH

Final review by EAB: 10/10/2017

Purpose:

Habitat Function

Maximum 13 points (all wetlands)

Description:

Rationale: The landscape around a wetland, including its perimeter, buffer, and the connectivity of the hydrologic and ecologic setting, are important influences on habitat value and ecological integrity of the wetland.

Summary of strategy: For each Wetland Unit, sum the points for all factors within the “Opportunity” aspect.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandFunction.gdb
  - Feature Class: WU\_BufferLand
    - Field: BufferLand
  - Feature Class: WU\_LandHydro
    - Field: LandHydro
  - Feature Class: WU\_LandEco
    - Field: LandEco

Method:

**## Spatial joins to bring together factor values**

ArcToolbox / Analysis Tools / Overlay / Spatial join

Target Feature: WU\_BufferLand

Join Feature: WU\_LandHydro

Output feature class: WU\_HOpportun1

Join Operation: JOIN\_ONE\_TO\_ONE

Check box “Keep all target features”

Field Map of Join Features: retain the following

WUKey

Shape-Length

Shape\_Area

BufferLand

LandHydro

Match Option: CONTAINS

ArcToolbox / Analysis Tools / Overlay / Spatial join

Target Feature: WU\_HOpportun1

Join Feature: WU\_LandEco

Output feature class: WU\_HOpportun

Join Operation: JOIN\_ONE\_TO\_ONE

Check box "Keep all target features"

Field Map of Join Features: retain the following

WUKey

    Shape-Length

Shape\_Area

BufferLand

LandHydro

LandEco

Match Option: CONTAINS

**## Add HOpportun field and set initial point value to zero.**

Open attribute table of WU\_HOpportun

Add field "HOpportun" (short integer)

R-click HOpportun and Field Calculate HOpportun = 0

**## Sum the factor points**

R-click HOpportun and Field Calculate HOpportun = [BufferLand]+ [LandHydro]+ [LandEco]

### 5.6.35 HPotential: Habitat and Ecological Integrity Potential

Version date: 28 September 2017

Strategy: completed 3/16/2017 EAB

GIS method: 9/28/2017 EAB; results verified 9/28/2017 EAB

Python code: 9/28/2017 YH

Final review by EAB: 10/2/2017

Purpose:

Habitat Function

Maximum 30 points (all wetlands)

Description:

Rationale: Wetlands have an intrinsic potential to provide habitat for species, and wetlands benefit from high ecological integrity. This intrinsic capability is related to their vegetation, hydrology, soils, and physical structure.

Summary of strategy: For each Wetland Unit, sum the points for all factors within the “Potential” aspect.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandFunction.gdb
  - Feature Class: WU\_VegH
    - Field: VegH
  - Feature Class: WU\_HydroH
    - Field: HydroH
  - Feature Class: WU\_SoilH
    - Field: SoilH

Method:

**## Spatial joins to bring together factor values**

ArcToolbox / Analysis Tools / Overlay / Spatial join

Target Feature: WU\_VegH

Join Feature: WU\_HydroH

Output feature class: WU\_HPpotential1

Join Operation: JOIN\_ONE\_TO\_ONE

Check box “Keep all target features”

Field Map of Join Features: retain the following

WUKey

Shape-Length

Shape\_Area

VegH

HydroH

Match Option: CONTAINS

ArcToolbox / Analysis Tools / Overlay / Spatial join

Target Feature: WU\_HPOTENTIAL1

Join Feature: WU\_SoilH

Output feature class: WU\_HPOTENTIAL

Join Operation: JOIN\_ONE\_TO\_ONE

Check box "Keep all target features"

Field Map of Join Features: retain the following

WUKey

Shape-Length

Shape\_Area

VegH

HydroH

SoilH

Match Option: CONTAINS

**## Add HPOTENTIAL field and set initial point value to zero.**

Open attribute table of WU\_HPOTENTIAL

Add field "HPOTENTIAL" (short integer)

R-click HPOTENTIAL and Field Calculate HPOTENTIAL = 0

**## Sum the factor points**

R-click HPOTENTIAL and Field Calculate HPOTENTIAL = [VegH]+ [HydroH]+ [SoilH]

### 5.6.36 HSociety: Value to Society of Habitat and Ecological Integrity

Version date: 19 October 2017

Strategy: completed 3/16/2017 EAB

GIS method: 10/13/2017 EAB; results verified 10/19/2017 EAB; re-verified 11/6/2017 with new public lands layers for HInvest

Python code: 10/19/2017 YH

Final review by EAB: 10/19/2017

Purpose:

Habitat Function

Maximum 7 points (all wetland types)

Description:

Rationale: Societal investments in habitat and ecological integrity, along with public use and accessibility infrastructure, reflect the value to society of specific wetlands.

Strategy: Sum the points for HInvest and HUse.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandFunction.gdb
  - Feature Class: WU\_HInvest
    - Field: HInvest
  - Feature Class: WU\_HUse
    - Field: HUse

Method:

**## Spatial join to bring together metric values**

*## Note that this could also be done with a "Join" on the field "WUKey"*

ArcToolbox / Analysis Tools / Overlay / Spatial join

Target Feature: WU\_HInvest

Join Feature: WU\_HUse

Output feature class: WU\_HSociety

Join Operation: JOIN\_ONE\_TO\_ONE

Check box "Keep all target features"

Field Map of Join Features: retain the following

WUKey

Shape-Length

Shape\_Area

HInvest

HUse

Match Option: CONTAINS

**## Add HSociety field and set initial point value to zero.**

Open attribute table of WU\_HSociety

Add field "HSociety" (short integer)

R-click HSociety and Field Calculate HSociety = 0

**## Sum the factor points**

R-click HSociety and Field Calculate HSociety = [HInvest]+ [HUse]



## 5.6.37 HUC12WQ: Water quality issues in HUC12 watershed

Version date: 8 April 2019

Strategy: completed 3/16/2016 EAB

GIS method: completed and verified 3/17/2016 EAB

Python coding: started & completed 3/18/2016; EAB 4/8/2019 I'm not sure if the EPAOverlist layer was used for this metric. If yes, then please replace the ImpairedStreams and EPAOverlist shapefiles with the single updated ImpairedStreams, which combines both datasets.

Final review by EAB: 3/18/2016

Purpose:

Water Quality Function, Value to Society  
Max 1 point

Description:

Rationale: Wetland Unit is in a basin or sub-basin where water quality is an issue in some aquatic resource (303d list, eutrophic lakes, problems with nuisance and toxic algae, karst). Wetlands can mitigate the impacts of pollution even if they do not discharge directly to a polluted body of water. Wetlands can remove nitrogen from groundwater as well as surface water. They can also trap airborne pollutants. Thus wetlands can provide an ecosystem service and value to our society in any basin and sub-basin that has pollution problems. The removal of pollutants by wetlands is judged to be more valuable in basins where other aquatic resources are already polluted or have problems with eutrophication. Any further degradation of these resources by destroying the wetland could result in irreparable damage to the ecosystem. Karst systems lack natural filtering capacity and are vulnerable to pollution wherever they occur in the state; therefore wetlands occurring in karst areas get this point whether or not degradation has been documented.

Summary of strategy: Select HUC12 (12-digit) watersheds that contain an impaired stream reach, algal lake, algal stream, lake with power boat use, or karst. Assign 1 point to Wetland Units that intersect with these watersheds.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb (WU\_20150514)
- M:\basemap\watersheds\_12digit.shp
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\DNR\_Fishing\_20Aug2015\PublicFishingLakesWVD NR20150820.shp
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WaterQualityDatasets.gdb
  - Feature Class: AlgalStreams
  - Feature Class: AlgalLakes
- M:\wr\WTRSHD\_BRANCH\303D\_TMDL\_IMPAIRED\WV2016\_ImpairedStreams\_24KNHD.shp
- M:\basemap\geology\_shapefiles\type\geology-TYPE-limestone.shp
- M:\basemap\geology\_shapefiles\type\geology-TYPE-dolostone.shp

Input Variables:

None

Method:

**## Create feature class to store HUC12WQ variables**

R-click WU\_20150514 and select Data/Export Data

Output feature class: WU\_HUC12WQ

**## Add field to Wetland Units and set initial point value to zero.**

Open attribute table of WU\_HUC12WQ

Add field "HUC12WQ" (short integer)

R-click HUC12WQ and Field Calculate HUC12WQ = 0

**## Select lakes with power boat use**

Select \* FROM PublicFishingLakesWVDNR20150820 WHERE: "BoatType" NOT LIKE 'No%'

(86 out of 127 selected)

**## Select HUC12s that contain lakes with power boat use.**

Select by location

Selection method: select features from

Target layer: watersheds\_12digit.shp

Source layer: PublicFishingLakesWVDNR20150820.shp

Check box "Use selected features" (86 features selected)

Spatial selection method: Intersect the source layer feature

(102 out of 1205 selected)

**## Select HUC12s that contain algal lakes.**

Select by location

Selection method: add to the currently selected features in

Target layer: watersheds\_12digit.shp

Source layer: AlgalLakes

Spatial selection method: intersect the source layer feature

(107 out of 1205 selected)

**## Select HUC12s that contain algal streams.**

Select by location

Selection method: add to the currently selected features in

Target layer: watersheds\_12digit.shp

Source layer: AlgalStreams  
Spatial selection method: intersect the source layer feature  
(138 out of 1205 selected)

**## Select HUC12s that contain impaired stream reaches.**

Select by location  
Selection method: add to the currently selected features in  
Target layer: watersheds\_12digit.shp  
Source layer: WV2016\_ImpairedStreams\_24KNHD.shp  
Spatial selection method: intersect the source layer feature

**## Select HUC12s that contain karst.**

Select by location  
Selection method: add to the currently selected features in  
Target layer: watersheds\_12digit.shp  
Source layer: geology-TYPE-limestone.shp  
Spatial selection method: intersect the source layer feature

Select by location  
Selection method: add to the currently selected features in  
Target layer: watersheds\_12digit.shp  
Source layer: geology-TYPE-dolostone.shp  
Spatial selection method: intersect

**## Select Wetland Units in HUC12s with water quality issues.**

Select by location  
Selection method: select features from  
Target layer: WU\_HUC12WQ  
Source layer: watersheds\_12digit.shp  
Check box “Use selected features”  
Spatial selection method: intersect the source feature

**## Assign 1 point to Wetland Units in HUC12s with water quality issues.**

R-click “HUC12WQ” in WU\_HUC12WQ and Field Calculate HUC12WQ = 1

### 5.6.38 HUse: Public Use of Habitat and Ecological Integrity

Version date: 19 October 2017

Strategy: completed 3/16/2017 EAB

GIS method: 10/13/2017 EAB; results verified 10/19/2017 EAB

Python code: 10/18/2017 YH

Final review by EAB: 10/19/2017

Purpose:

Habitat Function / Value to Society

Maximum 4 points (all wetland types)

Description:

Rationale: Access, infrastructure, and habitat quality all impact public use of wetlands.

Strategy: Sum the points for OwnerAccess and PublicUse.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandFunction.gdb
  - Feature Class: WU\_OwnerAccess
    - Field: OwnerAccess
  - Feature Class: WU\_PublicUse
    - Field: PublicUse

Method:

**## Spatial join to bring together metric values**

*## Note that this could also be done with a "Join" on the field "WUKey"*

ArcToolbox / Analysis Tools / Overlay / Spatial join

Target Feature: WU\_OwnerAccess

Join Feature: WU\_PublicUse

Output feature class: WU\_HUse

Join Operation: JOIN\_ONE\_TO\_ONE

Check box "Keep all target features"

Field Map of Join Features: retain the following

WUKey

Shape-Length

Shape\_Area

OwnerAccess

PublicUse

Match Option: CONTAINS

**## Add HUse field and set initial point value to zero.**

Open attribute table of WU\_HUse  
Add field "HUse" (short integer)  
R-click HUse and Field Calculate HUse = 0

**## Sum the factor points**

R-click HUse and Field Calculate HUse = [OwnerAccess]+ [PublicUse]

### 5.6.39 HydIntact: Intactness of hydrologic regime

Version date: 24 September 2017

Strategy: Completed 3/16/2017 EAB

GIS method: 9/24/2017 EAB; results verified 9/24/2017 EAB

Python coding: 9/25/2017 YH

Final review by EAB: 9/26/2017

Purpose:

Input to Habitat & Ecological Integrity / Potential

Max 6 points

Description:

Rationale: Natural hydrologic processes vary greatly among different types of wetlands. Peatlands rely on precipitation and very slow groundwater movement to create deep organic soils and unique plant communities. Seepage swamps rely primarily on groundwater movement. Floodplain wetlands receive water from overland flooding in addition to groundwater and precipitation. Rather than specifying a particular hydrologic regime, this metric is rated based on the dominance of natural hydrologic processes and deviations from natural conditions. Hydroperiod is the characteristic frequency and duration of inundation or saturation of a wetland during a typical year. In most wetlands, plant recruitment and maintenance are dependent on hydroperiod. The interactions of hydroperiod and topography are major determinants of the distribution and abundance of native wetland plants and animals (Mitsch and Gosselink 2000, National Research Council 2001, CWMW 2013).

Strategy: Note that this metric is best assessed in the field. The field value will overwrite the GIS value. For GIS assessment, award points for low score for disturbances and discharges to the wetland (inverse of WQOpportun-5 pts- based on Discharges, ImpairedIn, RoadRail, Disturb50m, DisturbWshd); add an additional point for wetlands with higher scores (2,3) for Landscape Integrity.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\Tasks\Complete\WQOpportun.gdb
  - Feature Class: WU\_WQOpportun
    - Field: WQOpportun
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\Tasks\Complete\LandInteg.gdb
  - Feature Class: WU\_LandInteg
    - Field: LandInteg

Method:

*## Note that the Spatial Join could be replaced by a Join on WUKey if that is easier.*

**## Spatial join to merge WQOpportun and LandInteg into one attribute table**

ArcToolbox / Analysis Tools / Overlay / Spatial Join

Target Feature: WU\_WQOpportun

Join Feature: WU\_LandInteg

Output Feature Class: WU\_HydroH

Join operation: JOIN\_ONE\_TO\_ONE

Check box "Keep all target features"

Field Map of Join Features: retain the following:

WUKey

    Shape\_Length

Shape\_Area

WQOpportun

LandInteg

Match option: CONTAINS

### **## Add HydIntact field to Wetland Units and set initial point value to zero.**

Open attribute table of WU\_HydroH

Add field "HydIntact" (short integer)

R-click HydIntact and Field Calculate HydIntact = 0

### **## Assign points to HydIntact**

Open attribute table of WU\_HydroH

SELECT \* FROM WU\_HydroH WHERE: ("WQOpportun" = 5 AND "LandInteg" IN (2,3))

OR ("WQOpportun" = 4 AND "LandInteg" IN (0,1))

Field Calculate HydIntact = 1

SELECT \* FROM WU\_HydroH WHERE: ("WQOpportun" = 4 AND "LandInteg" IN (2,3))

OR ("WQOpportun" = 3 AND "LandInteg" IN (0,1))

Field Calculate HydIntact = 2

SELECT \* FROM WU\_HydroH WHERE: ("WQOpportun" = 3 AND "LandInteg" IN (2,3))

OR ("WQOpportun" = 2 AND "LandInteg" IN (0,1))

Field Calculate HydIntact = 3

SELECT \* FROM WU\_HydroH WHERE: ("WQOpportun" = 2 AND "LandInteg" IN (2,3))

OR ("WQOpportun" = 1 AND "LandInteg" IN (0,1))

Field Calculate HydIntact = 4

SELECT \* FROM WU\_HydroH WHERE: ("WQOpportun" = 1 AND "LandInteg" IN (2,3))

OR ("WQOpportun" = 0 AND "LandInteg" IN (0,1))

Field Calculate HydIntact = 5

SELECT \* FROM WU\_HydroH WHERE: "WQOpportun" = 0 AND "LandInteg" IN (2,3)

Field Calculate HydIntact = 6

#### 5.6.40 HydroH: Hydrologic regime for habitat

Version date: 27 September 2017

Strategy: Completed 3/16/2017 EAB

GIS method: 9/27/2017 EAB; results verified 9/27/2017 EAB

Python coding: 9/27/2017 YH

Final review by EAB: 9/28/2017

Purpose:

Input to Habitat & Ecological Integrity / Potential

Max 9 points

Description:

Rationale: Hydrology is the most important direct determinant of wetland functions (Mitsch and Gosselink 2007); however, it is not easy to accurately assess hydroperiod remotely or during a single field visit (Stein et al 2009, Mack 2001). Wetland hydrology varies greatly under natural conditions, from rainfed bogs to groundwater wetlands to wetlands fed by overbank flooding. All of these natural hydrologic regimes create conditions under which wetland plants and animals can thrive and wetlands can perform their intrinsic ecological, hydrological, and societal functions and services (CWMW 2013). Disturbances to hydrology are one of the main sources of degradation to wetlands (Mack 2001).

Strategy: Sum the points for the metrics HydIntact, ConnectFL, and HydSW.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandFunction[date & time].gdb
  - Feature Class: WU\_HydroH
    - Field: HydIntact
    - Field: HydSW
  - Feature Class: WU\_ConnectFL
    - Field: ConnectFL

Method:

*## Note that the step below could be done with a Spatial Join instead of a Join if that is easier to code.*

**## Add Join to merge fields into one attribute table**

ArcToolbox / Data Management Tools / Joins / Add Join

Layer Name or Table View: WU\_HydroH

Input Join Field: WUKey

Join Table: WU\_ConnectFL

Output Join Field: WUKey



Check “Keep All Target Features”

**## Add field to store ConnectFL**

Open attribute table of WU\_HydroH (Join is still active)

Add fields “ConnectFL1” (short integer)

Field Calculate ConnectFL1 = [WU\_ConnectFL.ConnectFL]

**## Remove Join**

R-click “WU\_HydroH” and select Joins and Relates / Remove All Joins

**## Add field to store HydroH and set initial value to zero**

Open attribute table of WU\_HydroH (Join is gone)

Add Field “HydroH” (short integer)

R-click HydroH and Field Calculate HydroH = 0

**## Assign points to HydroH**

Open attribute table of WU\_HydroH

Field Calculate HydroH = [HydIntact] + [HydSW] + [ConnectFL1]

### 5.6.41 HydSW: Available Surface Water

Version date: 24 Septmeber 2017

Strategy: completed 3/16/2017 EAB

GIS method: 9/24/2017 EAB; results verified 9/24/2017 EAB

Python code: 9/25/2017 YH

Final review by EAB: 9/26/2017

Purpose:

Input to Habitat & Ecological Integrity / Intrinsic Potential / Hydrology

Max 1 point.

Description:

Rationale: Seasonally or permanently available open water typically supports submerged macrophytes and provides important foraging and breeding habitat for birds, bats, and amphibians. The structural complexity provided by aquatic bed species increases habitat niches for a number of invertebrate and vertebrate species (Hruby 2012, Berglund and McEldowney 2008).

Summary of strategy: Select wetland polygons from the NWI that are attributed as palustrine aquatic bed, unconsolidated bottom, or unconsolidated shore AND are permanently flooded or intermittently exposed AND are not spoil. Also select Wetland Units that are contiguous to a non-impaired lake or stream. Assign points as follows:

- 1 point for PUB or PAB present OR NWI modifier [G,H] (Intermittently exposed/Permanently flooded) OR intersects/contiguous with non-impaired lake or stream (do not include impaired stream reaches or algal lakes/streams). Do not include polygons with the special modifier for spoil.
- 0 points: none of the above

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\Tasks\Complete\WU\_HydroH (this is created in HydIntact method)
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\EnhancedNWI\_20150511.gdb (EnhWVWetland)

Method:

**## Select the wetland polygons that are attributed as open water, including lakes, rivers, and open water palustrine (aquatic bed, unconsolidated bottom, unconsolidated shore) AND have a hydrologic regime that is (permanently flooded, semipermanently flooded, intermittently exposed) AND are not spoil.**

Clear all selections.

```
Select * FROM EnhWVWetland WHERE: ("ATTRIBUTE" LIKE 'L%' OR "ATTRIBUTE" LIKE 'R%' OR "ATTRIBUTE" LIKE 'PAB%' OR "ATTRIBUTE" LIKE 'PUB%' OR "ATTRIBUTE" LIKE 'PUS%') AND ("ATTRIBUTE" LIKE '%H%' OR "ATTRIBUTE" LIKE '%G%' OR "ATTRIBUTE" LIKE '%F%') AND "ATTRIBUTE" NOT LIKE '%s%'
```

### **## Create open water layer from selection**

R-click EnhWVWetland / Data / Export Data

Export: Selected features

Output feature class: M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\NWIExports.gdb

Feature Class: NWIOpenWater

### **## Add field to store HydSW and set initial value to zero**

In WU\_HydroH, add field: HydSW (short integer)

R-click HydSW and Field Calculate HydSW = 0

### **## Select the Wetland Units that intersect or touch NWIOpenWater**

Select By Location

Selection Method: select features from

Target Layer: WU\_HydroH

Source layer: NWIOpenWater

Spatial selection method for target layer feature(s): intersect the source layer feature

### **## Assign points to HydSW**

Open attribute table of WU\_HydroH

R-click HydSW, Field Calculate HydSW = 1

Clear all selections

## 5.6.42 ImpairedIn: Impaired waters impacting wetland

Version date: 8 April 2019

Strategy: completed 3/12/2016 EAB

GIS method: 4/18/2016 EAB; verified 4/18/2016 EAB; 2017 update included 2/22/2017 EAB

Python coding: started 6/9/2016 MCA, completed 6/10/2016 MCA; EAB 2/15/2017 see update to impaired streams layer below – please change code to use these 2 new layers. EAB 4/8/2019 please replace the ImpairedStreams and EPAOverlist shapefiles with the single updated ImpairedStreams, which combines both datasets.

Final review by EAB: 10/3/2016; need to review after 2017 update is completed

Purpose:

Water Quality Function, Opportunity Aspect  
Max 2 points

Description:

Impaired waters, algal blooms, or powerboat use impacting wetland (2 points max).

Rationale: Impaired waters are adjacent to wetland or are in the contributing watershed of a floodplain wetland. Impaired waters include the following:

- Power boat use. The presence of power boats in adjacent reservoirs or water bodies will increase the pollutants entering a fringe wetland. Toxic chemicals, oils, cleaners, and paint scrapings from boat maintenance can make their way into the water (Asplund 2000). In addition, older two stroke engines still found on many recreational boats and jet skis were purposely designed to discharge the exhaust that contains unburned gasoline and oil into the water. The landscape potential to improve water quality for a wetland unit along a shore is higher if the water body itself is directly receiving pollutants from power boats.
- Algal blooms and blooms or larger plants such as milfoil in open water are an indication of excessive nutrients (Schindler and Fee 1974, Smith et al. 1999). The increased levels of nutrients in the water body increase the amount of nutrients that the wetland plants absorb (Venterink and others 2002) and thus also increase the level of function within the wetland unit.
- Impaired streams.

Summary of Strategy: Select floodplain Wetland Units whose contributing watershed contains impaired waters, algal blooms, or powerboat use (1 point). Select all (floodplain and groundwater) Wetland Units within 5 meters' distance of impaired waters, algal blooms, or powerboat use (2 points).

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb
  - Feature Class: WU\_20150514
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\DNR\_Fishing\_20Aug2015\PublicFishingLakesWVD NR20150820.shp
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WaterQualityDatasets.gdb
  - Feature Class: AlgalStreams
  - Feature Class: AlgalLakes
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb

- Feature Class: DrainageArea27m
- M:\wr\WTRSHD\_BRANCH\303D\_TMDL\_IMPAIRED\WV2016\_ImpairedStreams\_24KNHD.shp

Input Variables:

- Floodplain

Method:

**## Create feature class to store ImpairedIn variables**

R-click WU\_Floodplain and select Data/Export Data

Output feature class: WU\_ImpairedIn

**## Add field to Wetland Units and set initial point value to zero.**

Open attribute table of WU\_ImpairedIn

Add field “ImpairedIn” (short integer)

R-click ImpairedIn and Field Calculate ImpairedIn = 0

**## Add field to DrainageArea27m and set initial value to “No”**

Open attribute table of DrainageArea27m

Add field “ImpairSrc” (text, 2 characters)

R-click ImpairSrc and Field Calculate ImpairSrc = “N”

**## Select lakes with power boat use**

Select \* FROM PublicFishingLakesWVDNR20150820 WHERE: "BoatType" NOT LIKE 'No%'

**## Select Drainage Areas with power boat use.**

Select by Location

Selection method: select features from

Target layers: DrainageArea27m

Source layer: PublicFishingLakesWVDNR20150820

Check box “Use Selected Features”

Spatial selection method: intersect the source layer feature

**## Select (add) Drainage Areas with algal lakes.**

Select by Location

Selection method: add to the currently selected features in

Target layers: DrainageArea27m

Source layer: AlgalLakes

Spatial selection method: intersect the source layer feature

**## Select (add) Drainage Areas with algal streams.**

Select by Location

Selection method: add to the currently selected features in

Target layers: DrainageArea27m

Source layer: AlgalStreams

Spatial selection method: intersect the source layer feature

**## Select (add) Drainage Areas with impaired streams.**

Select by Location

Selection method: add to the currently selected features in

Target layers: DrainageArea27m

Source layer: WV2016\_ImpairedStreams\_24KNHD

Spatial selection method: intersect the source layer feature

**## Set ImpairSrc to yes for Drainage Areas with an impaired water source.**

In DrainageArea27m feature class, Field calculate ImpairSrc = "Y"

Clear selections.

**## Join Drainage Area attribute to Wetland Units.**

ArcToolbox / Data Management Tools / Joins / Join Field

Input table: WU\_ImpairedIn

Input Join Field: OBJECTID\_1

Join Table: DrainageArea27m

Output Join Field: WUKey

Join Fields: WUKey, ImpairSrc

**## Assign 1 point to floodplain Wetland Units with impaired waters in their Drainage Area.**

SELECT \* FROM WU\_ImpairedIn WHERE: "Floodplain" = 'Y' AND "ImpairSrc" = 'Y'

R-click "ImpairedIn" in WU\_ImpairedIn and Field Calculate ImpairedIn = 1

Clear selections.

**## Select lakes with power boat use**

Select \* FROM PublicFishingLakesWVDNR20150820 WHERE: "BoatType" NOT LIKE 'No%'

**## Select Wetland Units adjacent to lakes with power boat use**

Select by location  
Selection method: select features from  
Target layers: WU\_ImpairedIn  
Source layer: PublicFishingLakesWVDNR20150820  
Check box "Use selected features"  
Spatial selection method: are within a distance of the source layer feature  
Apply a search distance: 5 meters

### **## Select Wetland Units adjacent to algal lakes**

Select by location  
Selection method: add to the currently selected features in  
Target layers: WU\_ImpairedIn  
Source layer: AlgalLakes  
Spatial selection method: are within a distance of the source layer feature  
Apply a search distance: 5 meters

### **## Select Wetland Units adjacent to algal streams**

Select by location  
Selection method: add to the currently selected features in  
Target layers: WU\_ImpairedIn  
Source layer: AlgalStreams  
Spatial selection method: are within a distance of the source layer feature  
Apply a search distance: 5 meters

### **## Select Wetland Units adjacent to impaired streams**

Select by location  
Selection method: add to the currently selected features in  
Target layers: WU\_ImpairedIn  
Source layer: WV2016\_ImpairedStreams\_24KNHD  
Spatial selection method: are within a distance of the source layer feature  
Apply a search distance: 5 meters

### **## Assign 2 points to Wetland Units adjacent to impaired waters.**

R-click "ImpairedIn" in WU\_ImpairedIn and Field Calculate ImpairedIn = 2

### 5.6.43 ImpairedOut: Wetland Discharges to Impaired Waters

Version date: 8 April 2019

Strategy: completed 3/12/2016 EAB

GIS method: completed and verified 3/17/2016 EAB

Python coding: started 3/16/2016 MCA, completed 3/18/2016 MCA; EAB 2/15/2017 please replace old "impaired streams" layer with 2 new ones, as highlighted below  
Changes finished 3/13/2017 MCA; EAB 4/8/2019 please replace the ImpairedStreams and EPAOverlist shapefiles with the single updated ImpairedStreams, which combines both datasets.

Final check by EAB: 3/18/2016

Purpose:

Water Quality Function

Max 1 point

Description:

Rationale: Wetland discharges to (<1 km above) a stream, river, or lake that is on the 303d list, or a water body that is impacted by chronic algal blooms or power boat use. The term, "303(d) list," is short for the list of impaired waters (stream segments, lakes) that the Clean Water Act requires all states to submit to the Environmental Protection Agency (EPA) every two years. Wetlands that discharge directly to these polluted waters are judged to be more valuable than those that discharge to unpolluted bodies of water because their role at cleaning up the pollution is critical for reducing further degradation of water quality. The WVDEP list is at:

[http://www.dep.wv.gov/WWE/watershed/IR/Pages/303d\\_305b.aspx](http://www.dep.wv.gov/WWE/watershed/IR/Pages/303d_305b.aspx)

Karst systems lack natural filtering capacity and are vulnerable to pollution wherever they occur in the state; therefore wetlands discharging to karst areas get this point whether or not degradation has been documented.

Summary of strategy: Select Wetland Units within 1 km of an impaired reach, algal lake, algal stream, or lake with power boat use AND Wetland Units that occur on karst. This is a coarse approximation (since it does not follow flowlines) that selects slightly over half of the state's wetlands.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb (WU\_20150514)
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\DNR\_Fishing\_20Aug2015\PublicFishingLakesWVDNR20150820.shp
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WaterQualityDatasets.gdb
  - Feature Class: AlgalStreams
  - Feature Class: AlgalLakes
- M:\wr\WTRSHD\_BRANCH\303D\_TMDL\_IMPAIRED\WV2016\_ImpairedStreams\_24KNHD.shp
- M:\basemap\geology\_shapefiles\type\geology-TYPE-limestone.shp
- M:\basemap\geology\_shapefiles\type\geology-TYPE-dolostone.shp



Input Variables:

None

Method:

**## Create feature class to store ImpairedOut variables**

R-click WU\_20150514 and select Data/Export Data

Output feature class: WU\_ImpairedOut

**## Add field to Wetland Units and set initial point value to zero.**

Open attribute table of WU\_ImpairedOut

Add field "ImpairedOut" (short integer)

R-click ImpairedOut and Field Calculate ImpairedOut = 0

**## Select lakes with power boat use**

Select \* FROM PublicFishingLakesWVDNR20150820 WHERE: "BoatType" NOT LIKE 'No%'

**## Select Wetland Units < 1 km from lakes with power boat use.**

Select by location

Selection method: select features from

Target layer: WU\_ImpairedOut

Source layer: PublicFishingLakesWVDNR20150820.shp

Check box "Use selected features"

Spatial selection method: are within a distance of the source feature

Apply a search distance: 1000 meters

**## Select Wetland Units < 1 km from algal lakes.**

Select by location

Selection method: add to the currently selected features in

Target layer: WU\_ImpairedOut

Source layer: AlgalLakes

Spatial selection method: are within a distance of the source feature

Apply a search distance: 1000 meters

**## Select Wetland Units < 1 km from algal streams.**

Select by location

Selection method: add to the currently selected features in

Target layer: WU\_ImpairedOut

Source layer: AlgalStreams

Spatial selection method: are within a distance of the source feature  
Apply a search distance: 1000 meters

**## Select Wetland Units < 1 km from impaired stream reaches.**

Select by location

Selection method: add to the currently selected features in

Target layer: WU\_ImpairedOut

Source layer: WV2016\_ImpairedStreams\_24KNHD

Spatial selection method: are within a distance of the source feature

Apply a search distance: 1000 meters

**## Select Wetland Units on karst.**

Select by location

Selection method: add to the currently selected features in

Target layer: WU\_ImpairedOut

Source layer: geology-TYPE-limestone.shp

Spatial selection method: intersect the source layer feature

(27668 out of 43124 selected)

Select by location

Selection method: add to the currently selected features in

Target layer: WU\_ImpairedOut

Source layer: geology-TYPE-dolostone.shp

Spatial selection method: intersect

(27683 out of 43124 selected)

**## Assign 1 point to Wetland Units that discharge to impaired waters.**

R-click "ImpairedOut" in WU\_ImpairedOut and Field Calculate ImpairedOut = 1

#### 5.6.44 IrrEdge: Irregularity of the Upland/Wetland Edge

Version date: 8 March 2016

Strategy: Completed 2/17/2016 EAB

GIS method: Completed 3/8/2016 EAB JCC, Verified 3/8/2016 EAB

Python code: Completed 3/14/2016 MCA

Final result verified by EAB: 3/14/2016

Purpose:

Input to Water Quality/Surface Depressions

Max 1 point.

Nitrite removal is aided by upland/wetland contact (Adamus et al. 2010).

Note that GIS determination of surface depressions and the detailed perimeter (edge) of the wetland is not currently within our analysis reach. We are instead using the proxy of mapped perimeter/sqrt(area) to estimate this value. The perimeter will be much more accurately measured during rapid field assessment.

Summary of strategy: Calculate the perimeter of wetland unit that is NOT adjacent to open water divided by the square root of the area of wetland unit. Add 1 point if > 6.

Definitions:

N/A

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb (WU\_20150514)
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\EnhancedNWI\_20150511.gdb (EnhWVWetland)

Input Variables:

- Shape\_Length (perimeter of Wetland Unit in meters)
- Shape\_Area (Area of Wetland Unit in m<sup>2</sup>)

Method:

**## Add field to the Wetland Units feature class.**

Add numeric field to WU\_20150514 attribute table: IrrEdgeRat (irregular edge ratio, float)

**## Calculate initial value of IrrEdgeRat for all Wetland Units.**

R-click IrrEdgeRat and Field Calculate = [Shape\_Length] / ([Shape\_Area] ^ 0.5)

**## Select the rivers and lakes from the National Wetlands Inventory.**

Clear all selections.

Select \* FROM EnhWVWetland WHERE: "ATTRIBUTE" LIKE 'R%' OR "ATTRIBUTE" LIKE 'L%'

### ## Export the rivers and lakes.

R-click EnhWVWetland  
Data / Export Data  
Export: Selected features  
Output feature class: RiversLakes

### ## Select the Wetland Units that border a river or lake.

Select by Location  
Selection method: select features from  
Target layer: WU20150514  
Source layer: RiversLakes  
Spatial selection method: intersect the source layer feature

### ## Export the intersecting Wetland Units

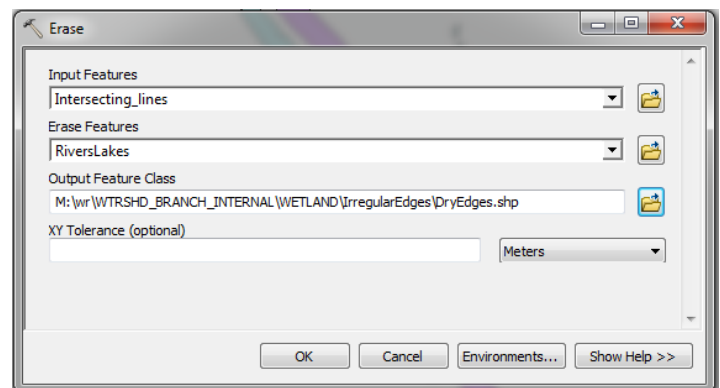
R-click WU\_20150514  
Data / Export Data  
Export: Selected features  
Output feature class: WURiversLakes

### ## Convert Wetland polygons to lines

Data Management Tools / Features / Polygon to Line  
Input Features: WU\_RiversLakes  
Output Feature Class: Intersecting\_lines  
Do not check box “Identify and store polygon...”

### ## Erase the wet perimeter lines

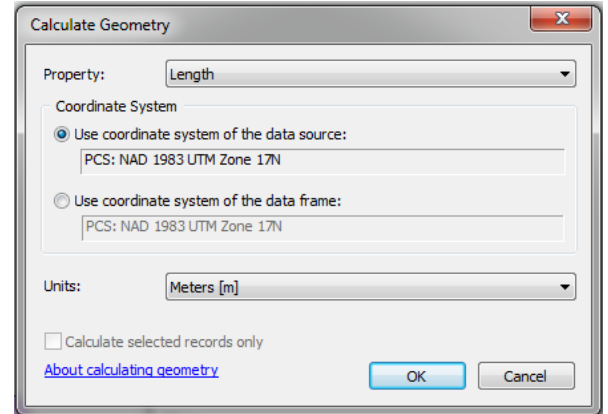
Analysis Tools / Overlay / Erase  
Input features: Intersecting\_lines  
Erase features: RiversLakes  
Output feature class: DryEdges



## ## Add field and calculate dry perimeter in DryEdges

In DryEdges, add field “DryPerim” (float)

Right click DryPerim attribute field and Field Calculate  
“DryPerim” = [Shape\_Length]



## ## Reset to NULL records from DryEdges with length < 26. These are mapping or computational errors.

Clear all selections.

SELECT \* FROM DryEdges WHERE: “DryPerim” < 26

R-click DryPerim and Field Calculate “DryPerim” = NULL

## ## Join Wetland Units to DryEdges

Clear all selections.

Analysis Tools / Overlay / Spatial Join

Target Features: WU\_20150514

Join Features: DryEdges

Output Feature Class: WU\_IrrEdge

Join operation: Join\_one\_to\_one

Check box “Keep all target features”

Field map of join features: (retain the following)

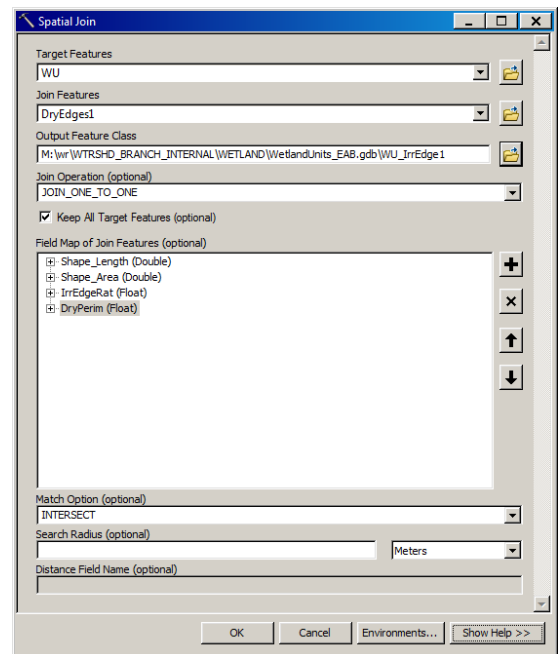
Shape\_Length

Shape\_Area

IrrEdgeRat

DryPerim

Match Option: Intersect



**## Select the Wetland Units fronting rivers and lakes**

SELECT \* FROM WU\_IrrEdge WHERE: "DryPerim" > 0

**## Update the value of IrrEdgeRat for the selected records.**

Open attribute table of WU\_IrrEdge

R-click IrrEdgeRat and Field Calculate: [DryPerim] / ([Shape\_Area] ^ 0.5)

Clear all Selections.

**## Add IrrEdge point field and set initial value to zero.**

In WU\_IrrEdge, add field IrrEdge (short integer)

Field Calculate IrrEdge = 0

**## Assign 1 point if IrrEdgeRat > 6.**

SELECT \* FROM WU\_IrrEdge WHERE: IrrEdgeRat > 6

Field Calculate IrrEdge = 1

## 5.6.45 Karst: limestone/dolomite bedrock or calcareous soil

Version date: 18 September 2017

Strategy: Completed 3/16/2017 EAB

GIS method: 9/15/2017 EAB; results verified 9/18/2017 EAB

Python code:

Final review by EAB:

Purpose:

Input to Habitat / Potential / Vegetation / Floristic Quality

Max 3 points

Description:

Rationale: A rich and distinctive flora and fauna are characteristic of calcareous wetlands.

Summary of strategy: Karst area (limestone/dolomite bedrock geology or SSURGO karst/calcareous soils) > 0.67 of total wetland area = 3 points; karst 0.33-0.67 = 2 points; > 0.1 = 1 point

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb
  - Feature Class: WU\_20150514
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WaterQualityDatasets.gdb
  - Feature Class: KarstComposite

Method:

### ## Intersect karst and Wetland Units

ArcToolbox / Analysis Tools / Overlay / Intersect

Input features: KarstComposite

WU\_20150514

Output feature class: WU\_Karst1

Join attributes: ONLY\_FID

Output type: INPUT

### ## Add field to store karst area.

Open attribute table of WU\_Karst1

Add field "KarstArea" (float)

R-click "Karst" and Field Calculate: KarstArea = [Shape\_Area]

### ## Spatial Join karst selection to Wetland Units and sum karst area.

Analysis Tools / Overlay / Spatial Join

Target Features: WU\_20150514  
Join Features: WU\_Karst1  
Output Feature Class: WU\_Karst  
Join Operation: JOIN\_ONE\_TO\_ONE  
Check box “Keep all target features”  
Field Map of Join Features: retain the following  
Shape\_Length  
Shape\_Area  
WUKey  
    KarstArea (R-click and select “Merge Rule”, “Sum”)  
Match Option: CONTAINS

*Note: if the Spatial Join doesn't work because of difficulties opening the “WU\_Karst1” feature class, then export “WU\_Karst1” to a shapefile and re-run the Spatial Join.*

### **## Add fields to store KarstRatio and Karst.**

Open attribute table of WU\_Karst  
Add field KarstRatio (float) to WU\_Karst attribute table.  
Add field Karst (short integer) to WU\_Karst attribute table.  
Field calculate Karst = 0

### **## Calculate the ratio of karst area to total Wetland Unit area.**

Field calculate KarstRatio = [KarstArea] / [Shape\_Area]

### **## Assign points**

SELECT \* FROM WU\_Karst WHERE: KarstRatio > 0.1  
Field Calculate Karst = 1

SELECT \* FROM WU\_Karst WHERE: KarstRatio > 0.33  
Field Calculate Karst = 2

SELECT \* FROM WU\_Karst WHERE: KarstRatio > 0.67  
Field Calculate Karst = 3



## 5.6.46 LandEco: Landscape-level Ecological Connectivity

Version date: 6 October 2017

Strategy: 3/16/2017 EAB

GIS method: 10/6/2017 EAB; results verified 10/6/2017 EAB

Python code: 10/10/2017 YH

Final review by EAB: 10/10/2017

Purpose:

Input to Habitat / Landscape Opportunity

Description:

*Maximum 3 points*

Rationale: Landscape-level ecological connectivity provides high opportunities for maintenance and dispersal of native species, rare species, and natural communities.

GIS Method (no field method):

Sum the values of the metrics below.

BRankHUC (4 max)

WshdUniq (2 max)

ConsFocus (2 max)

WetldBird (3 max)

Assign points as follows:

3 points: Sum of metrics = 8-11

2 points: Sum of metrics = 5-7

1 point: Sum of metrics = 2-4

0 points: Sum of metrics = 0-1

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandFunctionResults\WetlandFunction.gdb
  - Feature Class: WU\_BRankHUC
    - Field: BRankHuc
  - Feature Class: WU\_WshdUniq
    - Field: WshdUniq
  - Feature Class: WU\_ConsFocus
    - Field: ConsFocus
  - Feature Class: WU\_WetlandBird
    - Field: WetldBird

Method:

**## Spatial Join to merge attributes into one table**

*## Note that this could also be done with a Join on WUKey if that is easier*

ArcToolbox / Analysis Tools / Overlay / Spatial Join

Target Feature: WU\_BRankHUC

Join Feature: WU\_WshdUniq

Output Feature Class: WU\_LandEco1

Join operation: JOIN\_ONE\_TO\_ONE

Check box "Keep all target features"

Field Map of Join Features: retain the following:

WUKey

Shape\_Length

Shape\_Area

BRankHUC

WshdUniq

Match option: CONTAINS

ArcToolbox / Analysis Tools / Overlay / Spatial Join

Target Feature: WU\_LandEco1

Join Feature: WU\_ConsFocus

Output Feature Class: WU\_LandEco2

Join operation: JOIN\_ONE\_TO\_ONE

Check box "Keep all target features"

Field Map of Join Features: retain the following:

WUKey

Shape\_Length

Shape\_Area

BRankHUC

WshdUniq

ConsFocus

Match option: CONTAINS

ArcToolbox / Analysis Tools / Overlay / Spatial Join

Target Feature: WU\_LandEco2

Join Feature: WU\_WetlandBird

Output Feature Class: WU\_LandEco

Join operation: JOIN\_ONE\_TO\_ONE

Check box "Keep all target features"

Field Map of Join Features: retain the following:

WUKey

Shape\_Length

Shape\_Area

BRankHUC

WshdUniq

ConsFocus

WetldBird

Match option: CONTAINS

**## Create feature class to store results for LandEco and set initial value to zero**

Open attribute table of WU\_LandEco  
Add field "LandEco" (short integer)  
Field calculate LandEco = 0

**## Sum the metrics and assign points:**

Open attribute table of WU\_LandEco  
SELECT \* FROM WU\_LandEco WHERE: ("ConsFocus" + "WetldBird" + "BRankHUC" +  
"WshdUniq") > 1

Field Calculate LandEco = 1

SELECT \* FROM WU\_LandEco WHERE: ("ConsFocus" + "WetldBird" + "BRankHUC" +  
"WshdUniq") > 4

Field Calculate LandEco = 2

SELECT \* FROM WU\_LandEco WHERE: ("ConsFocus" + "WetldBird" + "BRankHUC" +  
"WshdUniq") > 7

Field Calculate LandEco = 3

Clear all selections

### 5.6.47 LandHydro: Landscape-level Hydrologic Connectivity

Version date: 3 October 2017

Strategy: Completed 3/16/2017 EAB

GIS method: 10/3/2017 EAB; results verified 10/3/2017 EAB

Python coding:

Final review by EAB:

Purpose:

Input to Habitat & Ecological Integrity / Landscape Opportunity

Max 3 points

Rationale: Landscape-level hydrologic conductivity is a key component of ecological integrity.

See WshdPos and AquaAbund metrics for additional information on rationale.

Strategy: Sum the points for WshdPos and AquaAbund.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandFunctionResults\WetlandFunction.gdb
  - Feature Class: WU\_WshdPos
    - Field: WshdPos
  - Feature Class: WU\_AquaAbund
    - Field: AquaAbund

Method:

*Note that the Spatial Joins could be replaced by Joins on WUKey if that is easier.*

#### **## Spatial join to merge WshdPos and AquaAbund into one attribute table**

ArcToolbox / Analysis Tools / Overlay / Spatial Join

Target Feature: WU\_WshdPos

Join Feature: WU\_AquaAbund

Output Feature Class: WU\_LandHydro

Join operation: JOIN\_ONE\_TO\_ONE

Check box “Keep all target features”

Field Map of Join Features: retain the following:

WUKey

Shape\_Length

Shape\_Area

WshdPos

AquaAbund

Match option: CONTAINS

#### **## Add LandHydro field to Wetland Units and set initial point value to zero.**

Open attribute table of WU\_LandHydro

Add field “LandHydro” (short integer)

R-click LandHydro and Field Calculate LandHydro = 0

**## Sum the points for WshdPos and AquaAbund**

R-click LandHydro and Field Calculate “LandHydro” = [WshdPos] + [AquaAbund]

## 5.6.48 LandInteg: Landscape Integrity Index

Version date: 3 December 2018

Strategy: 3/16/2017 EAB

GIS method: 9/19/2017 EAB; revised 9/22/2017 EAB; revised to include IEI (UMass) data 11/27/2018 EAB

Python code: 9/25/2017 YH

Final review by EAB: 9/26/2017

Purpose:

Input to Habitat / Potential (VegFQ, HydIntact) and Habitat/Opportunity (Buffer and Landscape Integrity)

Description:

*Maximum 3 points*

Rationale: Landscape Integrity is a good measure of overall habitat value, including a positive correlation with Floristic Quality.

Strategy:

Sum the following four weighted measures of landscape integrity. Then calculate a weighted average for a maximum of 3 points.

**LandIntegDNR:** DNR 2008 Landscape Integrity model: mean value for wetland.

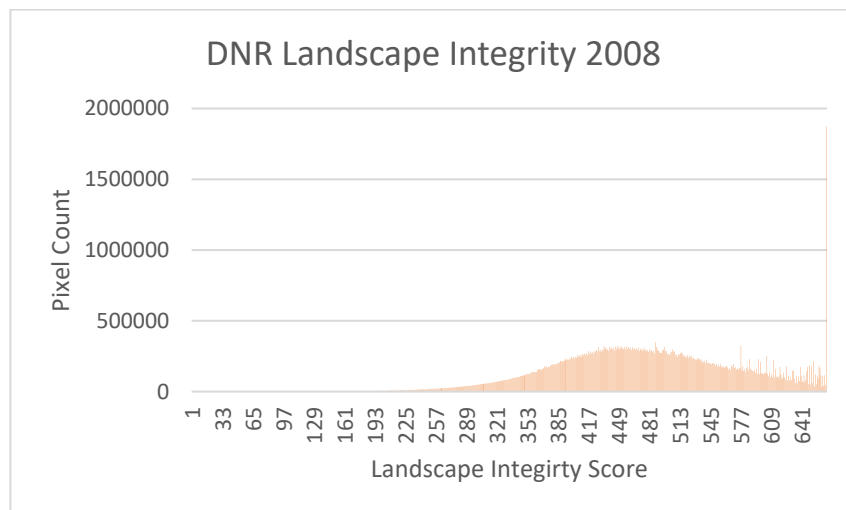
LandIntegDNR is calculated as the mean value of pixels within a Wetland Unit. For Wetland Units that are smaller or narrower than a single pixel (30m x 30m), LandInteg is calculated from the (contained) centroid of the polygon. Point thresholds were set by E. Byers after comparing a large number of known landscapes to point distributions.

3 points:  $\geq 800$

2 points: 700-800

1 point: 600-700

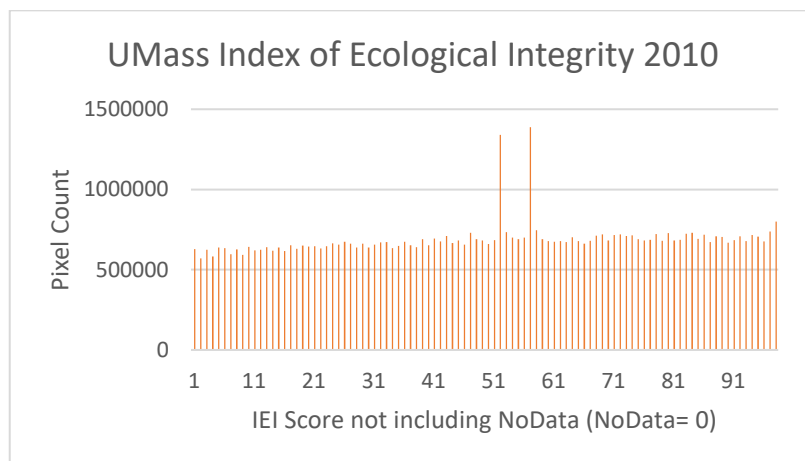
0 points:  $< 600$



**IEI:** Index of Ecological Integrity from the Conservation and Prioritization System (UMass 2010 with some 2018 updates). This layer is very similar to the LandIntegDNR layer. It has finer resolution and does a better job of capturing roads and other detailed features. However, its treatment of pipelines and powerlines as higher-integrity areas than surrounding wetlands is problematic.

IEI is calculated as the mean value of pixels within a Wetland Unit. For Wetland Units that are smaller or narrower than a single pixel (30m x 30m), IEI is calculated from the (contained) centroid of the polygon. Pixels with “NoData” are all in highly developed areas and we therefore set these pixels equal to 0. Point thresholds were set to approximately mimic the proportions of land in each category of the LandIntegDNR layer, with slightly more land in the lower categories since this layer has finer resolution and picks up fragmentation better (except for the pipelines).

- 3 points: 70
- 2 points: 45 – 70
- 1 point: 15 – 45
- 0 points: < 15



**LandResil:** TNC 2016 Resilient and Connected Landscapes model: most common value for wetland. Note that this layer has a small percentage of null pixel values.

LandResil is calculated as the most common value of pixels within a Wetland Unit. For Wetland Units that are smaller or narrower than a single pixel (30m x 30m), LandResil is calculated from the (contained) centroid of the polygon.

- 3 points: wetland intersects resilient land with confirmed diversity: Value IN (11,12,112)
- 2 points: wetland intersects resilient land with connectivity: Value IN (2,4,11,12,13,14,33,112)
- 1 point: wetland intersects resilient land: Value IN (2,3,4,11,12,13,14,33,112)
- 0 points: wetland does not meet above criteria

Definition of Value codes:

- 0 Vulnerable
- 2 Climate Corridor (resilient)
- 3 Resilient only (unsecured)
- 4 Climate Corridor (vulnerable)

- 11 Climate Corridor with confirmed diversity
- 12 Resilient Area with confirmed diversity
- 13 Climate Corridor
- 14 Climate Flow Zone
- 33 Resilient only (secured)
- 112 Climate Flow Zone with confirmed diversity

**ForestPatch:** Forest tract proximity and extent based on TNC 2014 forest patches mapping. Note that this layer has a few small gaps, e.g. no forest patches mapped north of Cranberry Glades.

- 3 points: wetland intersects forest patch  $\geq 1000$  ha (2470 acres) in size
- 2 points: wetland intersects forest patch  $\geq 100$  ha (247 acres) in size (i.e., is contiguous with a forest patch  $\geq 100$  ha in size OR wetland itself contains  $\geq 100$  ha of forest)
- 1 point: wetland intersects a forest patch  $\geq 20$  ha (50 acres) in size OR wetland is within 30 m of a forest patch  $\geq 100$  ha in size
- 0 points: wetland does not meet above criteria

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb (WU\_20150514)
  - Feature Class: WU\_20150514
  - Feature Class: WUpoint
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\landscapeIntegrityIndex\_WVDNR\_2008\_utm83\_img\
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\ContributedRawData\Resilient\_and\_Connected\_Landscapes\Resilient\_and\_Connected\_Data.gdb
  - Raster: Resilient\_and\_Connected
    - Field: Value
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\ContributedRawData\forest\_patches\_over50acres\_WVplus10mi.shp
  - Field: Acreage
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceFunctionalAssessment\HabitatData.gdb
  - Raster: IEIUMa2010v32

Method:

**## STEP 1**  
**## Calculate the intermediate metric LandIntegDNR**  
**## Summarize the DNR Landscape Integrity raster values for each Wetland Unit**

Spatial Analyst Tools/Zonal/Zonal Statistics as Table

Input feature zone data: WU\_20150514

Zone field: WUKey

Input Value raster: landscapeIntegrityIndex\_WVDNR\_2008\_utm83.img

Output table: LandInteg\_zonal

Check Ignore No Data



Statistics Type: MEAN

*## Note the null returns are for polygons that are too small to contain an entire pixel. For these polygons, we need to calculate the centroid of the (very small) wetland, and use the centroid to obtain the Landscape Integrity Index value.*

**## Convert Wetland Unit polygons to points**

**## Note that this step should be moved to “Creating Wetland Units from NWI Polygons”**

Data Management Tools / Features / Feature to Point

Input Features: WU\_20150514

Output Feature Class:

M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb\WUpoint

Check “Inside”

**## Extract the DNR Landscape Integrity raster values for each Wetland Unit centroid**

Spatial Analyst Tools / Extraction / Extract Values to Points

Input point features: WUpoint

Input raster: landscapeIntegrityIndex\_WVDNR\_2008\_utm83.img

Output point features: WUpoint\_LandInteg

**## Delete the “Count” field from the LandInteg\_zonal table since “Count” is a restricted word**

**## and may interfere with the join in the next step**

R-click table “LandInteg\_zonal” to open the table.

R-click the “Count” field and delete field.

**## Join Wetland Units to the LandInteg\_zonal table**

Right-click WU\_20151514 in TOC

Click Joins and Related

Click “Join...”

This will display the “Join Data pop-up window”

Select “Join attributes from a table”

“Choose the field...” = WUKey

“Choose the table to join...” = LandInteg\_zonal

“Choose the field in the table...” = WUKey

Check “Keep all records”

**## Export the joined data to a Feature Class**

Conversion Tools/To Geodatabase/Feature Class to FeatureClass

Input Features: WU\_20150514

Output Feature Class: WU\_LandInteg1

### **## Remove Join from Wetland Units**

R-click WU\_20150514 / Joins and Relates / Remove Joins / Remove all joins

### **## Join WU\_LandInteg1 to WUpoint\_LandInteg**

Right-click WU\_LandInteg1 in TOC  
Click Joins and Related  
Click "Join..."

This will display the "Join Data pop-up window"  
Select "Join attributes from a table"  
"Choose the field..." = WUKey (choose the first listing of WUKey)  
"Choose the table to join..." = WUpoint\_LandInteg  
"Choose the field in the table..." = WUKey  
Check "Keep all records"

### **## Export joined data to feature class**

Conversion Tools/To Geodatabase/Feature Class to FeatureClass  
Input Features: WU\_LandInteg1  
Output Feature Class: WU\_LandIntegDNR

### **## Replace NULL values of MEAN with centroid values of Landscape Integrity**

Open attribute table of WU\_LandIntegDNR  
Select by attributes  
SELECT \* FROM WU\_LandIntegDNR WHERE: "MEAN" IS NULL  
R-click MEAN and Field Calculate MEAN = [RASTERVALU]  
Clear Selection

### **## Add field LandIntegDNR, set initial value to zero**

Open the attribute table to WU\_LandInteg  
Add field "LandIntegDNR" (short integer) to attribute table  
Field Calculate "LandIntegDNR" = 0

### **## Assign points**

SELECT \* FROM WU\_LandInteg WHERE: MEAN > 600  
Field Calculate LandIntegDNR = 1

SELECT \* FROM WU\_LandInteg WHERE: MEAN > 700  
Field Calculate LandIntegDNR = 2

SELECT \* FROM WU\_LandInteg WHERE: MEAN > 800  
Field Calculate LandIntegDNR = 3

**## STEP 2**

**## Note that method is nearly identical to STEP 1 except for field names and final points**

**## Changes from STEP 1 are noted in green highlight.**

**## Calculate the intermediate metric IEI**

**## Summarize the IEI raster values for each Wetland Unit**

Spatial Analyst Tools/Zonal/Zonal Statistics as Table

Input feature zone data: WU\_20150514

Zone field: WUKey

Input Value raster: IEIUMa2010v32

Output table: IEI\_zonal

Check Ignore No Data

Statistics Type: MEAN

*## The null returns are for polygons that are too small to contain an entire pixel. For these polygons, we need to calculate the centroid of the (very small) wetland, and use the centroid to obtain the IEI value.*

**## Extract the IEI raster values for each Wetland Unit centroid**

Spatial Analyst Tools / Extraction / Extract Values to Points

Input point features: WUpoint

Input raster: IEIUMa2010v32

Output point features: WUpoint\_IEI

**## Delete the “Count” field from the IEI\_zonal table since “Count” is a restricted word**

**## and may interfere with the join in the next step**

R-click table “IEI\_zonal” to open the table.

R-click the “Count” field and delete field.

**## Join Wetland Units to the IEI\_zonal table**

Right-click WU\_20151514 in TOC

Click Joins and Related

Click “Join...”

This will display the “Join Data pop-up window”

Select “Join attributes from a table”

“Choose the field...” = WUKey

“Choose the table to join...” = IEI\_zonal

“Choose the field in the table...” = WUKey

Check “Keep all records”

### **## Export the joined data to a Feature Class**

Conversion Tools/To Geodatabase/Feature Class to Feature Class

Input Features: WU\_20150514

Output Feature Class: WU\_IEI1

### **## Remove Join from Wetland Units**

R-click WU\_20150514 / Joins and Relates / Remove Joins / Remove all joins

### **## Join WU\_IEI1 to WUpoint\_IEI**

Right-click WU\_IEI1 in TOC

Click Joins and Related

Click “Join...”

This will display the “Join Data pop-up window”

Select “Join attributes from a table”

“Choose the field...” = WUKey (choose the first listing of WUKey)

“Choose the table to join...” = WUpoint\_IEI

“Choose the field in the table...” = WUKey

Check “Keep all records”

### **## Export joined data to feature class**

Conversion Tools/To Geodatabase/Feature Class to FeatureClass

Input Features: WU\_IEI1

Output Feature Class: WU\_IEI

### **## Replace NULL values of MEAN with centroid values of IEI**

Open attribute table of WU\_IEI

Select by attributes

SELECT \* FROM WU\_IEI WHERE: "MEAN" IS NULL

R-click MEAN and Field Calculate MEAN = [RASTERVALU]

Clear Selection

### **## Add field IEI, set initial value to zero**

Open the attribute table to WU\_IEI

Add field “IEI” (short integer) to attribute table

Field Calculate “IEI” = 0

### **## Assign points**

SELECT \* FROM WU\_IEI WHERE: MEAN > 15  
Field Calculate IEI = 1

SELECT \* FROM WU\_IEI WHERE: MEAN > 45  
Field Calculate IEI = 2

SELECT \* FROM WU\_IEI WHERE: MEAN > 70  
Field Calculate IEI = 3

### **## STEP 3**

**## Note that method is nearly identical to STEP 1 except for field names, MAJORITY, and final points**

**## Calculate the intermediate metric LandResil**

**## Summarize the Resilient\_and\_Connected raster values for each Wetland Unit**

Spatial Analyst Tools/Zonal/Zonal Statistics as Table

Input feature zone data: WU\_20150514

Zone field: WUKey

Input Value raster: Resilient\_and\_Connected

Output table: LandResil\_zonal

Check Ignore No Data

Statistics Type: MAJORITY

**## Extract the Resilient\_and\_Connected raster values for each Wetland Unit centroid**

Spatial Analyst Tools / Extraction / Extract Values to Points

Input point features: WUpoint

Input raster: Resilient\_and\_Connected

Output point features: WUpoint\_LandResil

*## Note the null returns are for polygons that are too small to contain an entire pixel. For these polygons, we need to calculate the centroid of the (very small) wetland, and use the centroid to obtain the Resilient\_and\_Connected value.*

**## Delete the “Count” field from the LandResil\_zonal table since “Count” is a restricted word**

**## and may interfere with the join in the next step**

R-click table “LandResil\_zonal” to open the table.

R-click the “Count” field and delete field.

**## Join Wetland Units to the LandResil\_zonal table**

Right-click WU\_20151514 in TOC  
Click Joins and Related  
Click "Join..."

This will display the "Join Data" pop-up window  
Select "Join attributes from a table"  
"Choose the field..." = WUKey  
"Choose the table to join..." = LandResil\_zonal  
"Choose the field in the table..." = WUKey  
Check "Keep all records"

### **## Export the joined data to a Feature Class**

Conversion Tools/To Geodatabase/Feature Class to FeatureClass  
Input Features: WU\_20150514  
Output Feature Class: WU\_LandResil1

### **## Remove Join from Wetland Units**

R-click WU\_20150514 / Joins and Relates / Remove Joins / Remove all joins

### **## Join WU\_LandResil1 to WUpoint\_LandResil**

Right-click WU\_LandResil1 in TOC  
Click Joins and Related  
Click "Join..."

This will display the "Join Data" pop-up window  
Select "Join attributes from a table"  
"Choose the field..." = WUKey (choose the first listing of WUKey)  
"Choose the table to join..." = WUpoint\_LandResil  
"Choose the field in the table..." = WUKey  
Check "Keep all records"

### **## Export joined data to feature class**

Conversion Tools/To Geodatabase/Feature Class to FeatureClass  
Input Features: WU\_LandResil1  
Output Feature Class: WU\_LandResil

### **## Replace NULL values of MAJORITY with centroid values of Resilient\_and\_Connected**

Open attribute table of WU\_LandResil  
Select by attributes  
SELECT \* FROM WU\_LandResil WHERE: "MAJORITY" IS NULL  
R-click MAJORITY and Field Calculate MAJORITY = [RASTERVALU]

Clear Selection

**## Add field LandResil, set initial value to zero**

Open the attribute table to WU\_LandResil  
Add field "LandResil" (short integer) to attribute table  
Field Calculate "LandResil" = 0

**## Assign points**

SELECT \* FROM WU\_LandResil WHERE: MAJORITY IN (2,3,4,11,12,13,14,33,112)  
Field Calculate LandResil = 1

SELECT \* FROM WU\_LandResil WHERE: MAJORITY IN (2,4,11,12,13,14,33,112)  
Field Calculate LandResil = 2

SELECT \* FROM WU\_LandResil WHERE: MAJORITY IN (11,12,112)  
Field Calculate LandResil = 3

**## STEP 4**

**## Calculate the intermediate metric ForestPatch**

**## Spatial Join Wetland Units and Forest Patches, selecting for the largest forest patch  
## that is intersected by the Wetland Unit**

ArcToolbox/ Spatial Join  
Target Features: WU\_LandResil  
Join Features: forest\_patches\_over50acres\_WVplus10mi.shp  
Output Feature Class: WU\_ForestPatch  
Join Operation: JOIN\_ONE\_TO\_ONE  
Check "Keep all target features"  
Field Map of Join Features:  
WUKey  
Shape\_Length  
Shape\_Area  
LandResil  
Acreage (R-click, Merge Rule = Maximum)  
Match Option: Intersect

**## Add field ForestPatch, set initial value to zero**

Open the attribute table to WU\_ForestPatch  
Add field "ForestPatch" (short integer) to attribute table  
Field Calculate "ForestPatch" = 0

**## Assign points**

SELECT \* FROM WU\_ForestPatch WHERE: "ACREAGE" >= 50  
Field Calculate ForestPatch = 1

SELECT \* FROM WU\_ForestPatch WHERE: "ACREAGE" >= 247  
Field Calculate ForestPatch = 2

SELECT \* FROM WU\_ForestPatch WHERE: "ACREAGE" >= 2470  
Field Calculate ForestPatch = 3

## ## STEP 5

### ## Spatial Join LandIntegDNR metric to the other three metrics

## Note that this can also be done with a "Join" on WUKey.

ArcToolbox/ Spatial Join

Target Features: Output Feature Class: WU\_LandInteg1

Join Operation: JOIN\_ONE\_TO\_ONE

Check "Keep all target features"

Field Map of Join Features:

WUKey

Shape\_Length

Shape\_Area

LandResil

ForestPatch

LandIntegDNR

Match Option: Contains

ArcToolbox/ Spatial Join

Target Features: WU\_LandInteg1

Join Features: WU\_IEI

Output Feature Class: WU\_LandInteg

Join Operation: JOIN\_ONE\_TO\_ONE

Check "Keep all target features"

Field Map of Join Features:

WUKey

Shape\_Length

Shape\_Area

LandResil

ForestPatch

LandIntegDNR

IEI

Match Option: Contains

### ## Add field LandInteg, set initial value to zero

Open the attribute table to WU\_LandInteg



Add field "LandInteg" (short integer) to attribute table  
Field Calculate "LandInteg" = 0

**## Assign points**

SELECT \* FROM WU\_LandInteg WHERE: ("LandIntegDNR" + "IEI" + "LandResil" +  
"ForestPatch") / 4 >= 0.5

Field Calculate LandInteg = 1

SELECT \* FROM WU\_LandInteg WHERE: ("LandIntegDNR" + "IEI" + "LandResil" +  
"ForestPatch") / 4 >= 1.5

Field Calculate LandInteg = 2

SELECT \* FROM WU\_LandInteg WHERE: ("LandIntegDNR" + "IEI" + "LandResil" +  
"ForestPatch") / 4 >= 2.5

Field Calculate LandInteg = 3

## 5.6.49 LandPos: Landscape Position

Version date: 11 October 2016

Strategy: completed 2/17/2016 EAB

GIS method: drafted 4/12/2016 EAB; verified 4/18/2016 EAB

Python code: Started 6/14/2016 MCA & Completed 6/15/2016 MCA w/Problems

EAB 10/3/2016: need to re-run this after WFlowPath is updated. Right now the Python code generates too few headwater stream (7667 instead of 9336 LSh) and not enough Terrene (zero instead of 315 TE) wetlands.

EAB 10/11/2016: see bottom of file for method to calculate "PropWshd".

MCA 10/11/2016 this has been fixed and some changes have had to be made as indicated below.

Final review by EAB: 10/25/2016

Purpose:

Basic functional variable, used in several functional equations

Input to Water Quality/Headwater Location

Strategy:

1. Assign Lotic Stream Landscape Position to wetlands in an active floodplain but not within 200m of a wide river. Add headwater modifier to wetlands that intersect first- or second-order streams, are outflow wetlands, or have only intermittent flow. *Note: I experimented with adding wetlands that have a small (<40 acres) contributing watershed (Paybins 2003), or make up a large proportion (>5%) of their contributing watershed, but these were generally identified by the earlier criteria, and additions tended to be along streams with very small contributing watersheds perpendicular to the stream – not headwater wetlands.*
2. Assign Lotic River Landscape Position to wetlands in an active floodplain within 200m of a wide river.
3. Assign Lentic Landscape Position to wetlands within 25 meters of a lake.
4. Assign Terrene Landscape Position to all remaining unassigned wetlands. Add headwater modifier to wetlands that intersect first- or second-order streams, are outflow wetlands, have only intermittent flow, have a small (<40 acres) contributing watershed (Paybins 2003), or make up a large proportion (>5%) of their contributing watershed.

Definitions:

Tiner wetland classification is based on Tiner (2011) which describes and classifies wetlands by landscape position, landform, water flow path, and waterbody type (LLWW).

Tiner's landscape position characterizes wetlands based on their location within or outside the active floodplain of a waterbody (stream, river, lake). The basic landscape position types in West Virginia wetlands are:

Code	Landscape Position	Description
------	--------------------	-------------

LR	Lotic River	Wetland Unit is located in a river (including in-river ponds and shallow lakes), within its banks, or on its active floodplain and is periodically flooded by the river. River is defined as a broad channel mapped as a polygon or 2-lined watercourse on a 1:24,000 U.S. Geological Survey topographic map.
LS	Lotic Stream	Wetland Unit is located in a stream (including in-stream ponds and shallow lakes), within its banks, or on its active floodplain and is periodically flooded by the stream. Stream is defined as a linear or single-line watercourse on a 1:24,000 U.S. Geological Survey topographic map.
LSh	Lotic Stream - headwater	Wetland Unit is located in a stream (including in-stream ponds and shallow lakes), within its banks, or on its active floodplain and is periodically flooded by the stream. Stream is defined as a linear or single-line watercourse on a 1:24,000 U.S. Geological Survey topographic map.  <i>Modifier:</i> Headwater (wetlands along first- and second-order perennial streams in hilly terrain including all intermittent streams above these perennial streams).
LSc	<i>Lotic Stream - channelized</i>	<i>Not yet used in WV, but may be part of future development.</i> Wetland Unit is located in a stream (including in-stream ponds and shallow lakes), within its banks, or on its active floodplain and is periodically flooded by the stream. Stream is defined as a linear or single-line watercourse on a 1:24,000 U.S. Geological Survey topographic map.  <i>Modifier:</i> Channelized (excavated stream course).
LE	Lentic	Wetland Unit is located in or along a lake or reservoir (permanent waterbody where standing water is typically much deeper than 6.6 feet at low water but including large shallow lakes >20 acres), including streamside wetlands in a lake basin (the depression containing the lake). Wetlands contiguous to the lake but at higher elevations and not in the lake basin should NOT be classified as lentic; these wetlands should be treated as terrene outflow types in most cases. This is especially common where lakes are artificially created by diking and/or excavation.
TE	Terrene	Wetland Unit is completely surrounded by upland (non-hydric soils or filled lands that are now upland development). Terrene wetlands may occur: (1) on a slope or flat, or in a depression (including ponds)

		lacking a stream but may be contiguous to a river or stream, (2) on a historic (inactive) floodplain, (3) in a landscape position crossed by a stream (e.g., an entrenched stream), but where the stream does not periodically inundate the wetland, (4) in a headwater, outflow only, position as the source of a stream.
TEh	Terrene - headwater	Wetland Unit is completely surrounded by upland (non-hydric soils or filled lands that are now upland development). Terrene wetlands (headwater) may occur in a headwater, outflow only, position as the source of a stream.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb
  - Feature Class: WU\_20150514
  - Feature Class: DrainageArea27m
- M:\basemap\national\_hydrology\_dataset\wb-rivers.shp
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\EnhancedNWI\_20150511.gdb (EnhWVWetland)
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WaterQualityDatasets.gdb
  - Feature Class: FirstSecondOrderFlowlines

Input Variables:

- Wetland in Floodplain (Floodplain)
- Water Flow Path (WFlowPath)
- Contributing Watershed Area (CntrWshd) in DrainageArea27m

Method:

**## Joins to add variables to new Landscape Position feature class.**

ArcToolbox / Analysis Tools / Overlay / Spatial join

Target Feature: WU\_Floodplain

Join Feature: WU\_WFlowPath

Output feature class: WU\_LandPos1

Join Operation: JOIN\_ONE\_TO\_ONE

Field Map of Join Features: retain the following

Shape\_Length

Shape\_Area

Floodplain

WFlowPath

Match Option: CONTAINS

ArcToolbox / Data Management Tools / Joins / Join Field

Input table: WU\_LandPos1

Input join field: OBJECTID  
Join table: DrainageArea27m  
Output Join Field: WUKey  
Join Fields: WUKey, CntrWshd

### **## Export join to feature class**

R-click WU\_LandPos1 and select Data / Export Data  
Output feature class: WU\_LandPos

### **## Add text field to the Wetland Units feature class.**

Add text field (length=5) to WU\_LandPos attribute table: LandPos.

### **## Assign Lotic Stream Landscape Position.**

Clear all selections.  
Select by attributes from WU\_LandPos  
SELECT \* FROM WU\_LandPos WHERE "Floodplain" = 'Y'

Field Calculate selected records LandPos = "LS"  
Clear all selections

### **## Assign Lotic River Landscape Position.**

Add temporary text field to WU\_LandPos attribute table: River (text, 2 characters)

Select by location  
Selection method: select features from  
Target layer: WU\_LandPos  
Source layer: wb-rivers  
Spatial selection method: are within a distance of the source layer feature  
Apply a search distance: 200 meters

Field Calculate selected records River = "Y"

Select by attributes  
SELECT \* FROM WU\_LandPos WHERE: "LandPos" = 'LS' AND "River" = 'Y'

Field Calculate selected records LandPos = "LR".  
Clear all selections

**## Assign headwater modifier to Lotic Stream Landscape Position for wetlands intersecting first and second order streams, outflow wetlands, and wetlands with intermittent flow. Include isolated wetlands for now since almost all of these are actually**

**outflow wetlands, but the streams flowing from them are too small to show up on the NHD.**

Add temporary text field to WU\_LandPos attribute table: FSOSTream (text, 2 characters)

Select by location

Selection method: select features from

Target layer: WU\_LandPos

Source layer: FirstSecondOrderFlowlines

Spatial selection method: intersect the source layer feature

Field Calculate selected records FSOSTream = "Y"

Select by attributes

```
SELECT * FROM WU_LandPos WHERE: "LandPos" = 'LS' AND ("FSOSTream" = 'Y' OR "WFlowPath" LIKE '%O%' OR "WFlowPath" LIKE '%I%')
```

*The above select only works when using select by attribute from the Selection menu in ArcMap. Using the above select in Python and with the toolbox Select Attribute by yields a different selection. To fix this, the select below must be used.*

```
SELECT * FROM WU_LandPos WHERE: LandPos = 'LS' AND ((POSITION('O' IN WFlowPath) > 0) OR (POSITION('I' IN WFlowPath) > 0) OR (FSOSTream = 'Y'))
```

Field Calculate selected records LandPos = "LSh"

### **## Assign Lentic Landscape Position.**

Clear all selections

Select by attributes in EnhWVWetland

Method: Create a new selection

```
SELECT * FROM EnhWVWetland WHERE: "WETLAND_TYPE" = 'Lake'
```

Select by location

Selection method: select features from

Target layer: WU\_LandPos

Source layer is EnhWVWetland

Check box "use selected features"

Spatial selection method: are within a distance of the source layer feature

Apply a search distance: 25 meters

Field Calculate selected records: LANDPOS = "LE"

### **## Assign Terrene Landscape Position**

Clear selections

SELECT \* FROM WU\_LandPos WHERE: "LandPos" IS NULL

Field Calculate selected records LandPos = "TE"

**## Assign headwater modifier to Terrene Landscape Position for wetlands that intersect first and second order streams, are outflow wetlands, or have intermittent flow. Include isolated wetlands for now since almost all of these are actually headwater wetlands – the streams are just too small to show up on the National Hydrography Dataset.**

Select by attributes

SELECT \* FROM WU\_LandPos WHERE: "LandPos" = 'TE' AND ("FSOStream" = 'Y' OR "WFlowPath" LIKE '%O%' OR "WFlowPath" LIKE '%I%')

Use the following select for the same reason as indicated above:

SELECT \* FROM WU\_LandPos WHERE: LandPos = 'TE' AND ((POSITION('O' IN WFlowPath) > 0) OR (POSITION('I' IN WFlowPath) > 0) OR (FSOStream = 'Y'))

Field Calculate selected records LandPos = "TEh"

**## Assign headwater modifier to Terrene Landscape Position for wetlands with small contributing watershed.**

Select by attributes.

SELECT \* FROM WU\_LandPos WHERE: "LandPos" = 'TE' AND "CntrWshd" < 161874

Field Calculate selected records LandPos = "TEh"

**## Assign headwater modifier to Terrene Landscape Position for wetlands that occupy a large percentage of their contributing watershed**

Add field to WU\_LandPos: "PropWshd" (double)

Field calculate PropWshd = ShapeArea / CntrWshd

Select by attributes.

SELECT \* FROM WU\_LandPos WHERE: "LandPos" = 'TE' AND "PropWshd" > 0.05

Field Calculate selected records LandPos = "TEh"

### 5.6.50 LowSlope: Low Slope

Version date: 16 Novmeber 2016

Strategy: 2/27/2016 EAB

GIS method: completed 2/27/2016 EAB;

Python code: started & finished 3/3/2016 MCA;

Final review by EAB: 3/3/2016;

Purpose:

Water Quality Function / Potential / Surface Depressions Factor (Max 2 points)

Flood Attenuation Function / Potential

Description:

Rationale: Flat-lying wetlands are more effective at storing and slowing the velocity of flood waters and trapping sediments than sloping wetlands.

Strategy for LowSlope: For Wetland Units in Floodplains, LowSlope (maximum 2 points) is calculated as the median percent slope (SLOPE)

- Slope < 2% (2 points)
- Slope = 2-5% (1 point)
- Slope > 5% (0 points)

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb (WU\_20150514)

Input Variables:

Median percent slope (SLOPE)

Method:

**## Create feature class to store LowSlope**

R-click WU\_SLOPE and select Data/Export Data

Output feature class: WU\_LowSlope

**## Add LowSlope fields to store points and set initial point value to zero.**

Add field "LowSlope" (short integer) to attribute table of WU\_LowSlope.

Field Calculate "LowSlope" = 0

**## Select Wetland Units and assign points to LowSlope.**

SELECT \* FROM WU\_LowSlope WHERE: "SLOPE" < 2

R-click "LowSlope" field, and Field Calculate "LowSlope" = 2



SELECT \* FROM WU\_LowSlope WHERE: "SLOPE" > 1 AND "SLOPE" < 6  
R-click "LowSlope" field, and Field Calculate "LowSlope" = 1

## 5.6.51 MarlPEM: Emergent Wetland on Marl Deposits

Version date: 18 Septmeber 2017

Strategy: Completed 3/16/2017 EAB

GIS method: 9/15/2017 EAB; results verified 9/18/2017 EAB

Python code:

Final review by EAB:

Purpose:

Input to Habitat / Potential / Vegetation / Floristic Quality

Max 3 points

Description:

Rationale: Emergent wetlands on marl substrates provide habitat for a large number of rare species and comprise a globally rare and imperilled habitat.

Summary of strategy: Overlay emergent wetland (PEM) on marl soils and calculate area and ratio of area to total wetland area.

3 points: PEM on marl > 1 ha in extent

2 points: PEM on marl comprises > 50% of wetland

1 point: PEM on marl > 200 m<sup>2</sup> in extent

0 points: none of the above criteria are met

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb
  - Feature Class: WU\_20150514
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SurgoExports.gdb
  - Feature Class: MarlSoils
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\EnhancedNWI\_20150511.gdb
  - Feature Dataset: CONUS\_WVWetlandsProj
  - Feature Class: EnhWVWetland
    - Field: Attribute

Method:

### ## Select emergent wetlands and export feature class

SELECT \* FROM EnhWVWetland WHERE: "ATTRIBUTE" LIKE 'PEM%'  
R-click EnhWVWetland and export selected records as “VegPEM” feature class.

### ## Intersect MarlSoils and emergent wetlands (PEM)

ArcToolbox / Analysis Tools / Overlay / Intersect

Input features: MarlSoils

VegPEM

Output feature class: WU\_MarlPEM1  
Join attributes: ONLY\_FID  
Output type: INPUT

**## Add field to store emergent wetland/marl area.**

Open attribute table of WU\_MarlPEM1  
Add field "MarlPEMAre" (float)  
R-click "MarlPEMAre" and Field Calculate: MarlPEMAre = [Shape\_Area]

**## Spatial Join MarlPEM to Wetland Units and sum MarlPEM area.**

Analysis Tools / Overlay / Spatial Join  
Target Features: WU\_20150514  
Join Features: WU\_MarlPEM1  
Output Feature Class: WU\_MarlPEM  
Join Operation: JOIN\_ONE\_TO\_ONE  
Check box "Keep all target features"  
Field Map of Join Features: retain the following  
Shape\_Length  
Shape\_Area  
WUKey  
    MarlPEMAre (R-click and select "Merge Rule", "Sum")  
Match Option: CONTAINS

*Note: if the Spatial Join fails because of difficulty opening the "WU\_MarlPEM1" feature class, then export the feature class to a shapefile and re-run the Spatial Join.*

**## Add fields to store MarlPEMRat and MarlPEM, and set initial value of MarlPEM = 0.**

Open attribute table of WU\_MarlPEM  
Add field MarlPEMRat (float) to WU\_MarlPEM attribute table.  
Add field MarlPEM (short integer) to WU\_MarlPEM attribute table.  
Field calculate MarlPEM = 0

**## Calculate the ratio of MarlPEM area to total Wetland Unit area.**

Field calculate MarlPEMRat = [MarlPEMAre] / [Shape\_Area]

**## Assign points**

SELECT \* FROM WU\_MarlPEM WHERE: MarlPEMAre > 200  
Field Calculate MarlPEM = 1

SELECT \* FROM WU\_MarlPEM WHERE: MarlPEMRat > 0.5  
Field Calculate MarlPEM = 2

```
SELECT * FROM WU_MarlPEM WHERE: MarlPEMAre > 10000  
Field Calculate MarlPEM = 3
```

## 5.6.52 Microtopo: Microtopographic Complexity

Version date: 7 March 2016

Strategy: Completed 3/1/2016 EAB

GIS method: Completed 3/2/2016 EAB & JCC, Verified 3/7/2016 EAB

Python code: Started 3/3/2016 MCA

Final review by EAB:

Purpose:

Input to Water Quality/Surface Depressions

Max 2 points. Floodplain wetlands only.

Description:

Strategy: Perimeter of summed NWI palustrine polygon perimeters divided by the square root of the Wetland Unit area.

Note that GIS determination of surface depressions and actual microtopography is not currently within our analysis reach. We are instead using the proxy of interspersed Cowardin types (along with low slope and irregularity of the upland edge, which are calculated elsewhere) to estimate these values. The values will be much more accurately measured during rapid field assessment.

Definitions:

The National Wetlands Inventory is comprised of polygons attributed with the wetland classification system developed by Cowardin et al (1979) and updated by the National Wetlands Inventory (2016). The source data "EnhWVWetland" is a slightly enhanced version of the National Wetlands Inventory with updates for a small percentage of the polygons in West Virginia.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb (WU\_20150514)
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\EnhancedNWI\_20150511.gdb (EnhWVWetland)

Input Variables:

- Shape\_Length (EnhWVWetland), Shape\_Area (Wetland Units): these should already be in the attribute tables

Method:

**## Create a new layer from the palustrine polygons in the National Wetlands Inventory.**

```
SELECT * FROM EnhWVWetland WHERE: "WETLAND_TYPE" IN ('PEM', 'PFOPSS', 'Pond') (57945 out of 59959 selected)
```

R-click EnhWVWetland / Data / Export Data

Export Selected features  
Output feature class: NWIpalustrine

**## Sum the perimeters of the palustrine polygons that make up each Wetland Unit.**

Analysis Tools / Overlay / Spatial Join  
Target Features: WU\_20150514  
Join Features: NWIpalustrine  
Output Feature Class: WU\_Microtopo  
Join Operation: JOIN\_ONE\_TO\_ONE  
Check box: "Keep all target features"  
Field Map of Join Features:  
R-click SHAPE\_Length\_1 and select "Merge Rule", "Sum"  
Retain the following features (the rest can be deleted):  
    Shape\_Area  
    Shape\_Length  
    SHAPE\_Area\_1  
    SHAPE\_Length\_1  
Match Option: INTERSECT

**## Add fields to WU\_Microtopo.**

Add numeric fields to WU\_Microtopo attribute table: MicroRatio (float), Microtopo (short integer)

**# Divide the summed perimeters of palustrine polygons by the square root of the Wetland Unit area.**

Field Calculate MicroRatio = [SHAPE\_Length\_1] / ([Shape\_Area] ^ 0.5)

**# Assign points to Wetland Units.**

Field Calculate Microtopo = 0

SELECT \* FROM WU\_Microtopo WHERE: "MicroRatio" > 8  
Field Calculate Microtopo = 1

SELECT \* FROM WU\_Microtopo WHERE: "MicroRatio" > 15  
Field Calculate Microtopo = 2

### 5.6.53 Organic: Organic Matter near Surface

Version date: 4 October 2016

Strategy: completed 2/29/2016 EAB

GIS method: completed & verified 3/3/2016 EAB

Python code: 4/5/2016 MCA

Final review by EAB: 4/5/2016; 10/4/16 EAB revised SsurgoOrganic layer to depth < 8 cm instead of < 6 cm (closer reading of Hrubby 2012) – this does not affect the Python coding, nor does it change the number of Wetland Units with Organic = “Y”.

Purpose:

Input to Water Quality / Clay and Organic Soils Factor

Description:

Organic Soil near surface (Y/N).

Summary of strategy:

Select Wetland Units that intersect with any of the following: Peatlands, NWI polygons with organic modifier, Palustrine Plots with muck or peat soils, or SSURGO chorizon with organic soils in the upper 5 cm.

Note that SSURGO mapping is very uneven, with some counties heavily mapped with organic soils and others with little or no organic soils mapped.

Definitions:

SSURGO soils data from NRCS has multiple non-spatial tables, which have one-to-many relationships with the `ssurgo_wv` table. We will access the component horizon table (`chorizon_all`) to extract the organic content, horizon, and top depth of the horizon.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb (WU\_20150514)
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\EnhancedNWI\_20150511.gdb
  - Feature Class: EnhWVWetland
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandsGeodatasets.gdb
  - Feature Class: Peatlands\_20160228 (update if more recent file is available)
  - Feature Class: PalustrinePlots
- M:\basemap\ssurgo\ssurgo.gdb
  - Feature Class: `ssurgo_wv`
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SsurgoExports.gdb
  - Feature Class: SsurgoOrganic

**NOTE: ArcGIS related tables cannot be programmed in Python, so before this procedure is run, the input data layer must be created in ArcGIS, as shown below. Note that this layer should be re-exported as SSURGO is updated by NRCS.**

**## Open the related one-to-many SSURGO chorizon\_all table.**

Open attribute table for ssurgo\_wv

Click “Related Tables” (second icon from left).

Click “component to surgo: component\_all” to open the component\_all table. Note that a tab will appear at the bottom of the attribute table showing the tables that are open.

Click “Related Tables” (second icon from left).

Click “component to chorizon: chorizon\_all” to open the chorizon\_all table.

**## Select soils with organic matter in the upper 8 centimeters of the soil profile with a thickness of at least 2 cm.**

With the tab at the bottom of the attribute labelled “chorizon\_all” highlighted:

```
SELECT * FROM chorizon_all WHERE: ("hzname" LIKE 'O%' OR "om_r" > 30) AND
```

```
"hzdept_r" < 8 AND "hzthk_r" > 1
```

(1488 out of 28520 selected)

**## Relate this selection to the spatial data in the ssurgo\_wv tab.**

Click “Related Tables” again to get back to component\_all and then back to ssurgo\_wv (146911 out of 413438 selected). Note that the last step takes some time while all of the related tables open up.

**## Export data to new feature class**

R-click ssurgo\_wv / Data / Export Data

Export Selected Features

Output feature class: SSurgoExports.gdb\SsurgoOrganic

Input Variables:

None

Method:

**## Add field Organic to Wetland Units attribute table and set initial value to “no organic”.**

Add field Organic (Text, Length 2) to Wetland Units attribute table.

R-click Organic and Field Calculate “Organic” = ‘N’



## **## PART 1: PEATLANDS**

### **## Select Wetland Units that are peatlands.**

Select by Location

Selection method: select features from

Target layer: WU\_20150514

Source layer: Peatlands\_20160228 (or most recent version of Peatlands)

Spatial selection method: intersect the source layer feature

### **## Update value for “Organic” based on peatlands.**

Open Wetland Units attribute table (277 out of 43124 selected).

R-click “Organic” and Field Calculate “Organic” = “Y”

Clear all selections.

## **## PART 2: NWI ORGANIC MODIFIER**

### **## Select polygons that have an organic modifier in the National Wetland Inventory.**

SELECT \* FROM EnhWVWetland WHERE: "ATTRIBUTE" LIKE '%g' (143 out of 59959 selected)

### **## Select Wetland Units that intersect organic NWI polygons.**

Select by Location

Selection method: select features from

Target layer: WU\_20150514

Source layer: EnhWVWetland

Check “Use selected features” (143 features selected)

Spatial selection method: intersect the source layer feature

### **## Update value for “Organic” based on NWI.**

Open Wetland Units attribute table (68 out of 43124 selected).

R-click “Organic” and Field Calculate “Organic” = “Y”

Clear all selections.

## **## PART 3: PALUSTRINE PLOTS**

### **## Select Palustrine plots that have peat or muck soils.**

SELECT \* FROM PalustrinePlots WHERE: "Soil\_Textu" LIKE '%peat%' OR "Soil\_Textu" LIKE '%muck%' OR "Depth\_of\_o" NOT IN (' ', '0', '1')

### **## Select Wetland Units that intersect palustrine plots with organic soils.**

Select by Location

Selection method: select features from

Target layer: WU\_20150514

Source layer: PalustrinePlots

Check “Use selected features”

Spatial selection method: intersect the source layer feature

**## Update value for “Organic” based on palustrine plots.**

Open Wetland Units attribute table.

R-click “Organic” and Field Calculate “Organic” = “Y”

Clear all selections.

**## PART 4: SSURGO SELECTION**

**## Select Wetland Units that intersect with the SSURGO selection.**

Select by Location

Selection method: select features from

Target layer(s): WU\_21050514

Source layer: SsurgoOrganic

Spatial selection method: intersect the source layer feature

**## Update value for “Organic” based on ssurgo.**

Open Wetland Units attribute table.

R-click “Organic” and Field Calculate “Organic” = “Y”

### 5.6.54 OwnerAccess: Land Ownership and Accessibility

Version date: 16 October 2017

Strategy: 3/16/2017 EAB

GIS method: 10/16/2017 EAB; Results verified 10/16/2017 EAB

Python code: 10/18/2017 YH

Final review by EAB: 10/19/2017

Purpose:

Input to Habitat / Value to Society / HUse

Description:

*Maximum 2 points*

Rationale: Accessible wetlands and wetlands on public land are more likely to be used and/or appreciated by the public.

GIS Method: public lands layers, plus a few additions from known private preserves with public assess.

- 2 points: public land (except for U.S. Navy and Air National Guard), or private land with permanent unrestricted public access to the edge of the wetland (e.g., WV Botanical Garden, TNC Cranesville Swamp Preserve, Brush Creek, Brooklyn Heights, Eidolon, Greenland Gap, Hungry Beech, Murphy Preserve, Pike Knob, Slaty Mountain, Yankauer Preserve, TNC Mt. Porte Crayon, Stauffer's Marsh, Williamstown, Camp Dawson Wetland Boardwalk, Core Arboretum)
- 1 point: private land with seasonal, partial, or case-by-case public access (e.g., Harewood Marsh, Ice Mountain, Upper Shavers, Tygart Valley Mitigation Bank, Wetlands of Winfield, New River Birding & Nature Center, Ward Hollow, John Gottshcal Boardwalk in Boy Scout Camp, Page Jackson Elementary School Wetland)
- 0 points: private land without public access

Source Data:

Note on Source Data: new public land boundaries are available for 2017 (except for Department of Defense), but have not yet been aggregated into a public lands layers. Once they are aggregated, they can replace the separate files below.

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandFunctionResults\WetlandUnits.gdb
  - Feature Class: WU\_20150514
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceAsReceived
  - \Boundaries2017\countyCityParkBoundaries\_20107731\_utm83.gdb
    - Feature Class: countyCityParkBoundaries\_20170731\_utm83
  - \Boundaries2017\nationalForestOwnership\_USFWS\_20170803\_utm83.gdb
    - Feature Class: nationalForestOwnership\_USFWS\_20170803\_utm83
      - Field: Forest Service

- \Boundaries2017\nationalParkBoundaries\_nationalParkService\_20170802.gdb
  - Feature Class: nationalParkBoundaries\_nationalParkService\_20170802
- \Boundaries2017\nationalWildifeRefuge\_USFWS\_20170803\_utm83.gdb
  - \Boundaries2017nationalWildifeRefuge\_USFWS\_20170803
- \Boundaries2017\wvdnrManagedLands\_wvdnr\_20170731\_utm83.gdb
  - Feature Class: wvdnrManagedLands\_wvdnr\_20170731\_utm83
- \Boundaries2017\wvStateForestBoundaries\_wvdof\_20171003\_utm83.gdb
  - Feature Class: wvStateForestBoundaries\_wvdof\_20171003\_utm83
- \Boundaries2017\stateParkBoundaries\_WVDNR\_20170927\_utm83
  - Feature Class: stateParkBoundaries\_WVDNR\_20170927\_utm83
- \WV\_Protected\_Lands\_2015\_PUBLIC\WV\_Protected\_Lands\_2015\_PUBLIC.shp
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandsGeodatasets.gdb
  - Feature Class: RIBITS\_banks\_ILF\_20171007
  - Feature Class: InfrastructureWetlands

Method:

**## STEP 1: Create feature class and add field to store results; set initial value to zero**

R-click WU\_20150514 and select Export Data / All features

Output feature class: WetlandFunction.gdb / WU\_OwnerAccess

Open attribute table of WU\_OwnerAccess

Add field "OwnerAccess" (short integer)

Field calculate OwnerAccess = 0

**## STEP 2: Private lands with seasonal, partial, or case-by-case public access**

**## Select wetlands that intersect partial-access Protected Lands**

Open attribute table of WV\_Protected\_Lands\_2015\_PUBLIC.shp

SELECT \* FROM WV\_Protected\_Lands\_2015\_PUBLIC WHERE: "P\_Des\_Nm" IN ('Harewood (Washington)', 'Ice Mountain (Riverbirch Inc.)', 'Upper Shavers Fork')

Select by Location

Select features from: WU\_OwnerAccess

Source layer: WV\_Protected\_Lands\_2015\_PUBLIC

Use Selected Features

Spatial selection method for target layer feature(s): intersect the source feature

**## Add wetlands that intersect InfrastructureWetlands, all of which have at least partial access**

Select by Location

Add to the currently selected features in: WU\_OwnerAccess

Source layer: InfrastructureWetlands

Spatial selection method for target layer feature(s): intersect the source feature

### **## Assign point and clear selections**

Open attribute table of WU\_OwnerAccess  
R-click OwnerAccess and Field Calculate OwnerAccess = 1  
Clear all selections

### **## STEP 3: Public Ownership**

#### **## Select wetlands that intersect state or local public lands**

*## This step is very similar to that used in the metric HInvest*

Select by Location

Select features from: WU\_OwnerAccess  
Source layer: stateParkBoundaries\_WVDNR\_20170927\_utm83  
Spatial selection method for target layer feature(s): intersect the source feature

Select by Location

Add to the currently selected features in: WU\_OwnerAccess  
Source layer: wvdnrManagedLands\_wvdnr\_20170731\_utm83  
Spatial selection method for target layer feature(s): intersect the source feature

Select by Location

Add to the currently selected features in: WU\_OwnerAccess  
Source layer: wvStateForestBoundaries\_wvdof\_20171003\_utm83  
Spatial selection method for target layer feature(s): intersect the source feature

Select by Location

Add to the currently selected features in: WU\_OwnerAccess  
Source layer: countyCityParkBoundaries\_20170731\_utm83  
Spatial selection method for target layer feature(s): intersect the source feature

#### **## Add National Parks and Wildlife Refuges to selection**

Select by Location

Add to the currently selected features in: WU\_OwnerAccess  
Source layer: nationalParkBoundaries\_nationalParkService\_20170802  
Spatial selection method for target layer feature(s): intersect the source feature

Select by Location

Add to the currently selected features in: WU\_OwnerAccess  
Source layer: nationalWildlifeRefuge\_USFWS\_20170803  
Spatial selection method for target layer feature(s): intersect the source feature

#### **## Add U.S. Army Corps of Engineers lands to selection**

Open attribute table of WV\_Protected\_Lands\_2015\_PUBLIC  
SELECT \* FROM WV\_Protected\_Lands\_2015\_PUBLIC WHERE: "Mang\_Name" = 'US  
Army Corps of Engineers'

Select by Location

Select features from: WU\_OwnerAccess

Source layer: WV\_Protected\_Lands\_2015\_PUBLIC

Use Selected Features

Spatial selection method for target layer feature(s): intersect the source feature

### **## Add National Forests to selection**

Open attribute table of nationalForestOwnership\_USFWS\_20170803\_utm83  
SELECT \* FROM nationalForestOwnership\_USFWS\_20170803\_utm83 WHERE:  
"Ownership" = 'Forest Service'

Select by Location

Select features from: WU\_OwnerAccess

Source layer: nationalForestOwnership\_USFWS\_20170803\_utm83

Use Selected Features

Spatial selection method for target layer feature(s): intersect the source feature

### **## Assign points and clear selections**

Open attribute table of WU\_OwnerAccess

R-click OwnerAccess and Field Calculate OwnerAccess = 2

Clear all selections

### **## STEP 4: Select private lands with permanent public access**

*## Note that TNC Charlotte Ryde Preserve is contained within Cheat Canyon WMA*

*## Note that Mt Porte Crayon Preserve is called "Canaan/Dolly Sods (Moshein)*

*## Note that WV Botanical Garden is included in the county park layer*

Open attribute table of WV\_Protected\_Lands\_2015\_PUBLIC  
SELECT \* FROM WV\_Protected\_Lands\_2015\_PUBLIC WHERE: "P\_Des\_Nm" IN ('Brush  
Creek (McPherson/Robertson)', 'Bear Rocks Lake Wildlife Management Area', 'Brooklyn  
Heights (Hills)', 'Cranesville Swamp Preserve', 'Eidolon Nature Preserve', 'Greenland Gap  
(Amendment)(Greenland Lodge Inc)', 'Hungry Beech', 'Murphy Preserve', 'Pike Knob', 'Pike  
Knob (Smith)', 'Slaty Mountain (Westvaco)', 'Yankauer Nature Preserve', 'Canaan Valley/Dolly  
Sods (Moshein)', 'Core Arboretum' ) OR "Comments" = 'Stauffer's Marsh (PVAS)'

### **## Select wetlands that intersect selected areas**

Select by Location

Select features from: WU\_OwnerAccess

Source layer: WV\_Protected\_Lands\_2015\_PUBLIC

Use Selected Features

Spatial selection method for target layer feature(s): intersect the source feature

**## Select open-access wetlands from the InfrastructureWetlands feature class**

Open attribute table of InfrastructureWetlands

SELECT \* FROM InfrastructureWetlands WHERE: "Access" = 'public'

**## Select wetlands that intersect selected areas**

Select by Location

Add to the currently selected features in: WU\_OwnerAccess

Source layer: InfrastructureWetlands

Use Selected Features

Spatial selection method for target layer feature(s): intersect the source feature

**## Assign points and clear selections**

Open attribute table of WU\_OwnerAccess

R-click OwnerAccess and Field Calculate OwnerAccess = 2

Clear all selections

## 5.6.55 PublicUse: Public Use and Research

Version date: 19 October 2017

Strategy: 3/16/2017 EAB

GIS method: 10/16/2017 EAB; Results verified 10/19/2017 EAB

Python code: 10/18/2017 YH

Final review by EAB: 10/19/2017

Purpose:

Input to Habitat / Value to Society / HUse

Description:

*Maximum 2 points*

Rationale: Wetlands that are used and/or appreciated by the public, or are of importance to long-term scientific research, have a high value to society.

### Strategy

This metric is adjusted based on the field assessment. Assign points as follows:

2 points: high public use, or built infrastructure offers potential for high public use; assign points if any of the following criteria are met. Areas included are National Wildlife Refuges and selected other public and private lands. Even though parts of NWRs are closed to the public, they still offer outstanding opportunities to experience wetlands. Individual wetlands with infrastructure, public use, or sustained scientific use are also included.

- Infrastructure
  - Maintained parking area: paved and/or big enough for a schoolbus
  - Boardwalk
  - Informational kiosk (e.g., Williamstown wetland, WV Botanical Garden)
  - Maintained road within 30 m of wetland with views of wetland (field only)
  - Maintained trail within 10 m of wetland
  - Boat access to wetland
  - Known wetlands with infrastructure, organized by source data include:
    - Wildlife Refuges: Canaan Valley & Ohio River Islands
    - State Parks: Canaan Valley, Blackwater Falls
    - WMAs: Greenbottom, Little Canaan, McClintic, Short Mountain, Valley Bend Wetlands
    - County Parks: Meadowood, WV Botanical Garden, McDonough Wildlife Refuge, Johnson T. Janes Nature Preserve and Conservation Park
    - Exemplary wetlands: Alder Run Bog, Cranberry Glades, Cranesville Swamp, Harewood Marsh, Winfield
    - Infrastructure: New River Birding and Nature Center, Williamstown, Tea Creek Interpretive Trail, Stauffer's Marsh
    - Unknown data source: John Gottschal Boardwalk and Causeway at the Summit Bechtel Reserve, Camp Dawson wetland boardwalk, Page Jackson Trail, Gardens, and Wetlands
- Sustained scientific use



- Long-term research sites: known sites include CVNWR Research Natural Area and Monongahela National Forest special botanical areas
  - Plants, animals, or water in the wetland have been monitored for >2 years, unrelated to any regulatory requirements, and data are available to the public.
- Birding Hotspot (Brooks Bird Club, WVDNR, Audubon, and citizen birding organization hotspot lists for WV). Initial list combines eBird download of birding hotspots and main wetland sites from Eddy 2009.
  - Download ebird hotspots from:
    - <https://confluence.cornell.edu/display/CLOISAPI/eBird-1.1-HotSpotsByRegion>
 and select wetlands within 100 meters of these hotspots
  - Select wetlands that intersect main birding wetlands areas from Eddy 2009:
    - National Wildlife Refuges: Canaan Valley, Ohio River Islands
    - Wildlife Management Areas: Fairfax Pond / Rehe, Meadow River, Pleasant Creek
    - State Parks: Canaan Valley, Blackwater Falls, Cathedral
    - Exemplary Wetlands: Altona, Cranberry Glades, Dolly Sods: Alder Run, Bear Rocks, Spruce Knob Lake, Winfield, McClintic, Greenbottom, Cranesville
    - Within 10m of trail: Stauffer's Marsh

**Combined list of high public use wetlands by source data:**

- Any Wetland Unit that is within 10 m of a mapped trail or a public fishing access point
- National Wildlife Refuges
  - Canaan Valley
  - Ohio River Islands
- National Forest
  - Monongahela NF botanical areas
- State Parks
  - Canaan Valley
  - Blackwater Falls
  - Cathedral
- County Parks
  - Meadowood
  - WV Botanical Garden
  - McDonough Wildlife Refuge
  - Johnson T. Janes Nature Preserve and Conservation Park
- Wildlife Management Areas
  - Fairfax Pond / Rehe
  - Meadow River
  - Pleasant Creek
  - Greenbottom
  - Little Canaan
  - McClintic
  - Short Mountain
  - Valley Bend Wetlands
- Exemplary Wetlands (no need to include wetlands already selected in the categories above)
  - Altona

- Cranesville Swamp
- Dolly Sods: Alder Run, Bear Rocks
- Harewood Marsh
- Spruce Knob Lake
- Winfield
- Infrastructure wetlands
  - New River Birding and Nature Center
  - ~~Williamstown~~
  - Tea Creek Interpretive Trail
  - Ward Hollow
  - Camp Dawson wetland boardwalk
  - John Gottschal Boardwalk and Causeway at the Summit Bechtel Reserve
  - Page Jackson Elementary School Trail, Gardens, and Wetlands
- Any Wetland Unit that is within 100 m of an eBird birding hotspot

1 point: Assign point if any of the following criteria are met.

Hunting or trapping area identified by WVDNR as having species that occur in wetlands. This includes WMAs and State Forests with populations of waterfowl, grouse, woodcock, beaver, mink, muskrat, deer, or bear. Also include wetland edge species (Keith Krantz, WVDNR, pers comm 20171010): rabbit, bobcat, coyote, red fox, raccoon, opossum. Keith Krantz writes: “Depending on your location, marsh/swamp/cottontail rabbits are routinely found along the edges of the drier PEM wetlands, anywhere standing cattails and frozen/dry ground can be found. My trapping friends routinely catch bobcats/coyotes/red fox in the winter in these same wetland settings, likely hunting the aforementioned rabbits and rodents. Raccoons and opossums are typically found around water as well foraging for whatever they can find.”

0 points: None of the above criteria are met.

Source Data:

Note on Source Data: new public land boundaries are available for 2017 (except for Department of Defense), but have not yet been aggregated into a public lands layers. Once they are aggregated, they can replace the separate files below. The Birding Hotspots can be expanded to include birding destinations identified in “Birding Guide to West Virginia”, compiled by Greg Eddy 2009, Brooks Bird Club.

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandFunctionResults\WetlandUnits.gdb
  - Feature Class: WU\_20150514
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceAsReceived
  - \Boundaries2017\countyCityParkBoundaries\_20107731\_utm83.gdb
    - Feature Class: countyCityParkBoundaries\_20170731\_utm83
  - \Boundaries2017\nationalWildifeRefuge\_USFWS\_20170803\_utm83.gdb
    - Feature Class: nationalWildifeRefuge\_USFWS\_20170803
  - \Boundaries2017\wvdnrManagedLands\_wvdnr\_20170731\_utm83.gdb
    - Feature Class: wvdnrManagedLands\_wvdnr\_20170731\_utm83
  - \Boundaries2017\stateParkBoundaries\_WVDNR\_20170927\_utm83
    - Feature Class: stateParkBoundaries\_WVDNR\_20170927\_utm83

- \DNR\_Fishing\PublicFishingAccessSites\_2017\_10.shp
- \USFS\botanical\_areas\_MNF.shp (*do not share this layer – sensitive data*)
- \201710\_WVDNR\_property\_boundary.gdb
  - Feature Class: PropertyBoundaries\_WVDNR\_20171011
- trails\_Sep\_27\_2017\_webmercator.shp
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceFunctionalAssessment\HabitatData.gdb
  - Feature Class: eBirdHotspots
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandsGeodatasets.gdb
  - Feature Class: InfrastructureWetlands
  - Feature Class: ExemplaryOrBrankedWetlands31Mar2015

Method:

**## STEP 1: Create feature class and add field to store results; set initial value to zero**

R-click WU\_20150514 and select Export Data / All features  
 Output feature class: WetlandFunction.gdb / WU\_PublicUse

Open attribute table of WU\_PublicUse  
 Add field “PublicUse” (short integer)  
 Field calculate PublicUse = 0

**## STEP 2: Moderate public use**

**## Select WMAs and State Forests identified as hunting/trapping areas for wetland species**

Open attribute table of PropertyBoundaries\_WVDNR\_20171011  
 SELECT \* FROM PropertyBoundaries\_WVDNR\_20171011 WHERE: "hWaterfowl" = 1 OR  
 "hGrouse" = 1 OR "hWoodcock" = 1 OR "tBeaver" = 1 OR "tMink" = 1 OR "tMuskrat" = 1  
 OR "hDeer" = 1 OR "hBear" = 1 OR "hRabbit" = 1 OR "tBobcat" = 1 OR "tCoyote" = 1 OR  
 "tRedFox" = 1 OR "tRaccoon" = 1 OR "tOpossum" = 1

Select by Location  
 Select features from: WU\_PublicUse  
 Source layer: PropertyBoundaries\_WVDNR\_20171011  
 Use Selected Features  
 Spatial selection method for target layer feature(s): intersect the source feature

**## Assign point and clear selections**

Open attribute table of WU\_PublicUse  
 R-click PublicUse and Field Calculate PublicUse = 1  
 Clear all selections

**## STEP 3: High public use**

**## Select wetlands within 10 m of a mapped trail or a public fishing access point**

Select by Location

Select features from: WU\_PublicUse

Source layer: trails\_Sep\_27\_2017\_webmercator

Spatial selection method for target layer feature(s): are within a distance of the source layer feature

Apply a search distance: 10 meters

Select by Location

Add to the currently selected features in: WU\_PublicUse

Source layer: PublicFishingAccessSites\_2017\_10

Spatial selection method for target layer feature(s): are within a distance of the source layer feature

Apply a search distance: 10 meters

### **## Add to Selection wetlands in National Wildlife Refuges**

Select by Location

Add to the currently selected features in: WU\_PublicUse

Source layer: nationalWildlifeRefuge\_USFWS\_20170803\_utm83

Spatial selection method for target layer feature(s): intersect the source feature

Do not apply a search distance

### **## Add to Selection wetlands in special botanical areas supporting long-term research**

Select by Location

Add to the currently selected features in: WU\_PublicUse

Source layer: botanical\_areas\_MNF.shp

Spatial selection method for target layer feature(s): intersect the source feature

### **## Add to Selection wetlands in certain state parks**

Open attribute table of stateParkBoundaries\_WVDNR\_20170927\_utm83

```
SELECT * FROM stateParkBoundaries_WVDNR_20170927_utm83 WHERE: "Unit_Nm" IN ('Blackwater Falls State Park', 'Canaan Valley Resort State Park', 'Cathedral State Park')
```

Select by Location

Add to the currently selected features in: WU\_PublicUse

Source layer: stateParkBoundaries\_WVDNR\_20170927\_utm83

Use Selected Features

Spatial selection method for target layer feature(s): intersect the source feature

### **## Add to Selection wetlands in certain local parks**

Open attribute table of countyCityParkBoundaries\_20170731\_utm83

SELECT \* FROM countyCityParkBoundaries\_20170731\_utm83 WHERE: "Unit\_Nm" IN ('WV Botanic Garden', 'Meadowood Park', 'McDonough Wildlife Refuge ', 'Johnson T. Janes Nature Preserve and Conservation Park')

Select by Location

Add to the currently selected features in: WU\_PublicUse

Source layer: countyCityParkBoundaries\_20170731\_utm83

Use Selected Features

Spatial selection method for target layer feature(s): intersect the source feature

### **## Add to Selection wetlands in certain WMAs**

Open attribute table of wvdnrManagedLands\_wvdnr\_20170731\_utm83

SELECT \* FROM wvdnrManagedLands\_wvdnr\_20170731\_utm83 WHERE: "Unit\_Nm" IN ('Fairfax Pond / Rehe Wildlife Management Area', 'Green Bottom Wildlife Management Area', 'Little Canaan Wildlife Management Area', 'McClintic Wildlife Management Area', 'Meadow River Wildlife Management Area', 'Pleasant Creek Wildlife Management Area', 'Short Mountain Wildlife Management Area', 'Valley Bend Wetlands Wildlife Management Area')

Select by Location

Add to the currently selected features in: WU\_PublicUse

Source layer: wvdnrManagedLands\_wvdnr\_20170731\_utm83

Use Selected Features

Spatial selection method for target layer feature(s): intersect the source feature

### **## Add to Selection certain Exemplary Wetlands not already selected**

Open attribute table of ExemplaryOrBrankedWetlands31Mar2015

SELECT \* FROM ExemplaryOrBrankedWetlands31Mar2015 WHERE: "Name" IN ('Alder Run Bog', 'Altona-Piedmont Marsh', 'Bear Rocks Bog', 'Cranesville Swamp', 'Harewood Marsh', 'Spruce Knob Lake inlet', 'Spruce Knob Lake outlet', 'Winfield Swamp')

Select by Location

Add to the currently selected features in: WU\_PublicUse

Source layer: ExemplaryOrBrankedWetlands31Mar2015

Use Selected Features

Spatial selection method for target layer feature(s): intersect the source feature

### **## Add to Selection wetlands from the InfrastructureWetlands feature class**

Select by Location

Add to the currently selected features in: WU\_PublicUse

Source layer: InfrastructureWetlands

Spatial selection method for target layer feature(s): intersect the source feature

### **## Add to Selection wetlands within 100 meters of an eBird birding hotspot**

Select by Location

Add to the currently selected features in: WU\_PublicUse

Source layer: eBirdHotspots\_20171011

Spatial selection method for target layer feature(s): are within a distance of the source layer feature

Apply a search distance: 100 meters

**## Assign points and clear selections**

Open attribute table of WU\_PublicUse

R-click PublicUse and Field Calculate PublicUse = 2

Clear all selections

## 5.6.57 RoadRail: Road and Railroads

Version date: 24 January 2018

Strategy: completed 3/12/2016 EAB

GIS method: completed 3/12/2016; verified 3/12/2016; 1/24/2018 EAB Updated to replace railways layer with better source data.

Python coding: started & completed 3/15/2016 MCA; updated 1/24/2018 YH

Final review by EAB: 3/15/2016

Purpose:

Water Quality Function, Opportunity aspect

Max 2 points

Description:

Rationale: Road and rail crossings can increase sediment and contaminant loads (especially salt and petrochemicals) to a wetland (McElfish et al. 2008).

Summary of strategy: Assign 1 point to Wetland Units within 50 meters of a road or railroad track.

Assign 2 points to Wetland Units within 5 meters of a road or railroad track. Note that the “M:\LayerFiles\arcsde\_backup.gdb\basemap\_cultural\_non\_replica\SDE\_railway\_tiger” layer is more accurately and completely mapped than the “M:\basemap\tiger\_2013\WV\_Transportation\_UTM.gdb\Rail” layer.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb (WU\_20150514)
- M:\basemap\tiger\_2013\WV\_Transportation\_UTM.gdb
  - Feature Class: All\_Roads
- M:\LayerFiles\arcsde\_backup.gdb\basemap\_cultural\_non\_replica\SDE\_railway\_tiger

Input Variables:

None

Method:

### **## Create feature class to store RoadRail variable**

R-click WU\_20150514 and select Data/Export Data

Output feature class: WU\_RoadRail

### **## Add RoadRail field to Wetland Units and set initial point value to zero.**

Open attribute table of WU\_RoadRail

Add field “RoadRail” (short integer)

R-click RoadRail and Field Calculate RoadRail = 0

**## Select the Wetland Units within 50 meters of a road or railroad track and assign 1 point.**

Select by location

Selection method: select features from

Target Layer: WU\_RoadRail

Source layer: All\_Roads

Spatial selection method: are within a distance of the source layer feature

Apply a search distance: 50 meters

Select by location

Selection method: add to the currently selected features in

Target Layer: WU\_RoadRail

Source layer: SDE\_railway\_tiger

Spatial selection method: are within a distance of the source layer feature

Apply a search distance: 50 meters

In WU\_RoadRail, R-click RoadRail and Field Calculate RoadRail = 1

**## Select the Wetland Units within 5 meters of a road or railroad track and assign 2 points.**

Select by location

Selection method: select features from

Target Layer: WU\_RoadRail

Source layer: All\_Roads

Spatial selection method: are within a distance of the source layer feature

Apply a search distance: 5 meters

Select by location

Selection method: add to the currently selected features in

Target Layer: WU\_RoadRail

Source layer: SDE\_railway\_tiger

Spatial selection method: are within a distance of the source layer feature

Apply a search distance: 5 meters

In WU\_RoadRail, R-click RoadRail and Field Calculate RoadRail = 2



## 5.6.58 Runoff: Runoff and Storage Potential

Version date: 9 January 2017

Strategy: Completed 3/24/2016 EAB

GIS method: completed 3/25/2016 EAB; verified 4/15/2016 EAB; updated & re-verified 12/20/2016 EAB; re-verified with new SoilRunoff values (peatlands = 0) EAB 1/9/2017

Python coding: Completed 12/20/2016 MCA; 1/11/2017 Re-ran MCA

Final review by EAB: 1/11/2017

Purpose:

Input to Flood Attenuation / Potential

Max 5 points (floodplain), 4 points (groundwater).

Rationale: Slowing and storing runoff is an essential aspect of flood attenuation by wetlands.

Soils with low runoff/high infiltration characteristics, seasonal ponding, complex surface topography, complex upland edge or a close hydrologic connection with a stream contribute to the ability of a wetland to perform this function.

Summary of strategy: Combine points for SoilRunoff, SeasonPond, and Microtopo. If total exceeds 5 points for floodplain wetlands, reduce to 5. If total exceeds 4 points for groundwater wetlands, reduce to 4.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb (WU\_20150514)

Input Variables:

- SoilRunoff (2 points)
- SeasonPond (3 points)
- Microtopo (2 points)
- Floodplain

Method:

### **## Spatial joins to add input variables to Wetland Units attribute table**

ArcToolbox / Analysis Tools / Overlay / Spatial Join

Target Feature: WU\_20150514

Join Feature: WU\_SoilRunoff

Output Feature Class: WU\_Runoff1

Join operation: JOIN\_ONE\_TO\_ONE

Check box "Keep all target features"

Field Map of Join Features: retain the following:

Shape\_Length

Shape\_Area

SoilRunoff

Match option: CONTAINS

ArcToolbox / Analysis Tools / Overlay / Spatial Join

Target Feature: WU\_Runoff1

Join Feature: WU\_SeasonPond

Output Feature Class: WU\_Runoff2

Join operation: JOIN\_ONE\_TO\_ONE

Check box "Keep all target features"

Field Map of Join Features: retain the following:

Shape\_Length

Shape\_Area

SoilRunoff

SeasonPond

Match option: CONTAINS

ArcToolbox / Analysis Tools / Overlay / Spatial Join

Target Feature: WU\_Runoff2

Join Feature: WU\_Microtopo

Output Feature Class: WU\_Runoff3

Join operation: JOIN\_ONE\_TO\_ONE

Check box "Keep all target features"

Field Map of Join Features: retain the following:

Shape\_Length

Shape\_Area

SoilRunoff

SeasonPond

Microtopo

Match option: CONTAINS

ArcToolbox / Analysis Tools / Overlay / Spatial Join

Target Feature: WU\_Runoff3

Join Feature: WU\_Floodplain

Output Feature Class: WU\_Runoff

Join operation: JOIN\_ONE\_TO\_ONE

Check box "Keep all target features"

Field Map of Join Features: retain the following:

Shape\_Length

Shape\_Area

SoilRunoff

SeasonPond

Microtopo

Floodplain

Match option: CONTAINS

**## Add Runoff field to Wetland Units and set initial point value to zero.**

Open attribute table of WU\_Runoff

Add field "Runoff" (short integer)

R-click Runoff and Field Calculate Runoff = 0

**## Sum the points for SoilRunoff, SeasonPond, Microtopo.**

Open attribute table of WU\_Runoff

R-click Runoff and Field Calculate "Runoff" = [SoilRunoff] + [SeasonPond] + [Microtopo]

**## Reduce the total points to 5 (floodplain) or 4 (groundwater).**

Open attribute table of WU\_Runoff

SELECT \* FROM WU\_Runoff WHERE: "Runoff" > 5

Field Calculate (selection only) "Runoff" = 5

Clear Selection

SELECT \* FROM WU\_Runoff WHERE: "Runoff" > 4 AND "Floodplain" = 'N'

Field Calculate (selection only) "Runoff" = 4

## 5.6.59 Runoff50m: Lands producing runoff within 50 meters of wetland boundary

Version date: 28 Feb 2017

Strategy: completed 4/21/2016 EAB

GIS method: 4/21/2016 EAB

Python coding: 2/14/2017 MCA *Note that this procedure is based on the Disturb50m variable, and much of the code can be shared.* Revision with RunoffLand Godzilla polygons simplified 2/28/2017.

Final review by EAB: 2/28/2017

Purpose: :

Flood Attenuation Function / Opportunity aspect

Max 2 points

Description:

Rationale: Impervious surfaces, urban areas, agricultural areas, mining, industrial and commercial land uses, and recent timber harvests contribute to increased runoff. Soil types with high runoff/low infiltration characteristics also produce runoff. The land use and soil type immediately adjacent to a wetland have a strong influence on the surface runoff that the wetland receives.

Strategy: Overlay 50m wetland buffer with land uses and soil types that are likely to contribute to increased runoff. Assign points as follows: >33% of area within 50 meters in such land uses = 2 points; > 10% = 1 point; <=10% = 0 points.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb
  - Feature Class: WU\_20150514
  - Feature Class: Buffer50m (this was created for Disturb50m variable)
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WaterQualityDatasets.gdb
  - Feature Class: RunoffLand

Input Variables:

None

Method:

**## Intersect the 50m buffers and the runoff lands.**

ArcToolbox / Analysis Tools / Overlay / Intersect

Input features: Buffer50m

RunoffLand

Output feature class: Buffer50mRun

Join attributes: ALL

Output type: INPUT

### **## Dissolve runoff lands by wetland buffer**

ArcToolbox / Data Management Tools / Generalization / Dissolve  
Input feature: Buffer50mRun  
Output Feature Class: Buffer50mRun\_diss  
Dissolve Fields: WUKey  
Statistics Fields: BufferArea (Statistic Type = First)  
Check box "Create multipart features" (default)

### **## Add field and calculate ratio of runoff area to total drainage area.**

Open attribute table of Buffer50mRun\_diss  
Add field "Run50mRat" (float)  
Field calculate Run50mRat = [Shape\_Area] / [FIRST\_BufferArea]

### **## Join ratio of runoff land to Wetland Units**

ArcToolbox / Data Management Tools / Joins / Add Join  
Input table: WU\_20150514  
Input Join Field: WUKey  
Join Table: Buffer50mRun\_diss  
Output Join Field: WUKey

### **## Export joined data**

R-click WU\_20150514 and select Data / Export Data  
Output feature class: WU\_Runoff50m

### **## Add field to Wetland Units and set initial point value to zero.**

Open attribute table of WU\_Runoff50m  
Add field "Runoff50m" (short integer)  
R-click Runoff50m and Field Calculate Runoff50m = 0

### **## Assign points.**

SELECT \* FROM WU\_Runoff50m WHERE: "Run50mRat" > 0.1  
R-click Runoff50m and Field Calculate Runoff50m = 1

SELECT \* FROM WU\_Runoff50m WHERE: "Run50mRat" > 0.33  
R-click Runoff50m and Field Calculate Runoff50m = 2

## 5.6.60 RunoffWshd: Runoff within contributing watershed

Version date: 7 March 2017

Strategy: completed 4/21/2016 EAB

GIS method: 4/21/2016 EAB

Python coding: 3/7/2017 MCA

Final review by EAB: 3/7/2017

*Note that this procedure is based on the DisturbWshd variable, and much of the code can probably be shared.*

Purpose:

Flood Attenuation Function / Opportunity aspect

Max 2 points

Description:

Rationale: Impervious surfaces, urban areas, agricultural areas, mining, industrial and commercial land uses contribute to increased runoff in a catchment (Wisconsin GIS-RAM metric). Recent logging, and high runoff/low infiltration soil types also contribute to runoff. The presence of these areas in the contributing watershed of a wetland is a good indicator that surface runoff may be reaching the wetland, especially during storm events.

Summary of strategy: Calculate the ratio of runoff-producing area to total area within the contributing watershed of each Wetland Unit. Assign points as follows: 25% of contributing watershed area in runoff lands = 2 points; 10-25% = 1 point; <10% = 0 points.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb
  - Feature Class: WU\_20150514
  - Feature Class: DrainageArea27m
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WaterQualityDatasets.gdb
  - Feature Class: RunoffLand

Method:

**## Intersect the drainage areas and the runoff areas.**

ArcToolbox / Analysis Tools / Overlay / Intersect

Input features: DrainageArea27m

RunoffLand

Output feature class: DrainAreaRun

Join attributes: ALL

Output type: INPUT

**## Dissolve runoff areas by drainage area**

ArcToolbox / Data Management Tools / Generalization / Dissolve  
Input feature: DrainAreaRun  
Output Feature Class: DrainAreaRun\_diss  
Dissolve Fields: WUKey  
Statistics Fields: CntrWshd (Statistic Type = First)  
Check box "Create multipart features" (default)

**## Add field to DrainAreaRun\_diss and calculate ratio of runoff area to total drainage area.**

Open attribute table of DrainAreaRun\_diss  
Add field "RunWshdRat" (float)  
Field calculate RunWshdRat = [SHAPE\_Area] / [FIRST\_CntrWshd]

**## Join ratio of runoff area to Wetland Units**

ArcToolbox / Data Management Tools / Joins / Add Join  
Input table: WU\_20150514  
Input Join Field: WUKey  
Join Table: DrainAreaRun\_diss  
Output Join Field: WUKey

**## Export joined data**

R-click WU\_20150514 and select Data / Export Data  
Output feature class: WU\_RunoffWshd

**## Add field to Wetland Units and set initial point value to zero.**

Open attribute table of WU\_RunoffWshd  
Add field "RunoffWshd" (short integer)  
R-click RunoffWshd and Field Calculate RunoffWshd = 0

**## Assign points.**

SELECT \* FROM WU\_RunoffWshd WHERE: RunWshdRat > 0.1  
R-click RunoffWshd and Field Calculate RunoffWshd = 1

SELECT \* FROM WU\_RunoffWshd WHERE: RunWshdRat > 0.25  
R-click RunoffWshd and Field Calculate RunoffWshd = 2

### 5.6.61 SeasonPond: Seasonal Ponding

Version date: 10 March 2016

Strategy: completed 2/27/2016 EAB

GIS method: completed 3/4/2016 & verified 3/10/2016 EAB

Python code: started and completed on 3/15/2016 MCA

Final review by EAB: 3/15/2016

Purpose:

Input to Water Quality/Potential aspect/ChemTime Factor  
Max 3 points. Groundwater wetlands only.

Description:

Rationale: The area of the wetland that is seasonally ponded is an important characteristic in understanding how well it will remove nutrients, specifically nitrogen. The highest levels of nitrogen transformation occur in areas of the wetland that undergo a cyclic change between oxic (oxygen present) and anoxic (oxygen absent) conditions. The oxic regime (oxygen present) is needed so certain types of bacteria will change nitrogen that is in the form of ammonium ion (NH<sub>4</sub><sup>+</sup>) to nitrate, and the anoxic regime is needed for denitrification (changing nitrate to nitrogen gas) (Mitsch and Gosselink 1993). The area that is seasonally ponded is used as an indicator of the area in the wetland that undergoes this seasonal cycling. The soils are oxygenated when dry but become anoxic during the time they are flooded.

Summary of strategy: EnhWVWetland. Select wetland polygons from the NWI that are NOT permanently flooded. Calculate the ratio of the non-permanently flooded area to the total area of the Wetland Unit. Assign points as follows:

- SeaPondRatio = 70-100% cover: 3 points
- SeaPondRatio = 40-70% cover: 2 points
- SeaPondRatio = 10-40% cover: 1 point
- SeaPondRatio < 10% cover: 0 point

Definitions:

Cowardin Water Regime modifier H = permanently flooded

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb (WU\_20150514)
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\EnhancedNWI\_20150511.gdb (EnhWVWetland)

Input Variables:

None

Method:

**## Select all wetland polygons that are not permanently flooded**



Clear all selections.

Select \* FROM EnhWVWetland WHERE: "ATTRIBUTE" NOT LIKE '%H%' AND "ATTRIBUTE" LIKE 'P%'

### **## Create layer of non-permanently flooded wetlands from selection**

R-click EnhWVWetland / Data / Export Data

Export: Selected features

Output feature class: "SeasonPond"

### **## Join non-permanently flooded wetlands to Wetland Units and sum the non-permanently flooded area**

Analysis Tools / Overlay / Spatial Join

Target features: WU\_20150514

Join features: SeasonPond

Output feature class: WU\_SeasonPond

Join Operation: JOIN\_ONE\_TO\_ONE

Check box "Keep All Target Features"

Field Map of Join Features

R-click Shape\_Area\_1 and select "Merge Rule" / "Sum"

Match Option: INTERSECT

### **## Add field to store ratio of non-permanently-flooded area to total area**

In WU\_SeasonPond, add field: SeaPondRatio (float)

### **## Calculate ratio of non-permanently flooded area to Wetland Unit area.**

In WU\_SeasonPond, R-click attribute SeaPondRatio

Field Calculate SeaPondRatio = [SHAPE\_Area\_1] / [Shape\_Area]

### **## Add field to store points for non-permanently flooded area and set initial value to zero.**

In WU\_SeasonPond, add field: SeasonPond (short integer)

Field calculate SeasonPond = 0

### **## Assign points to Wetland Units for seasonal ponding**

SELECT \* FROM WU\_SeasonPond WHERE: "SeaPondRatio" > 0.1

R-click SeasonPond, Field Calculate SeasonPond = 1

SELECT \* FROM WU\_SeasonPond WHERE: "SeaPondRatio" > 0.4

R-click SeasonPond, Field Calculate SeasonPond = 2

```
SELECT * FROM WU_SeasonPond WHERE: "SeaPondRatio" > 0.7  
R-click SeasonPond, Field Calculate SeasonPond = 3
```

## 5.6.62 Slope: Median Percent Slope

Version date: 2/21/2024

Strategy: completed 2/17/2016 EAB

GIS method: completed 2/26/2016 JCC (reviewed by EAB)

Python code: Started 3/2/2016 MCA, Finished 3/3/2016 but the code takes a long time to run

Python results verified by MCA and EAB: 7/6/2017

Purpose:

Input to multiple variables and functions

Description:

SLOPE is calculated as the median value of percent slope pixels within a Wetland Unit.

Definitions:

None

Source Data:

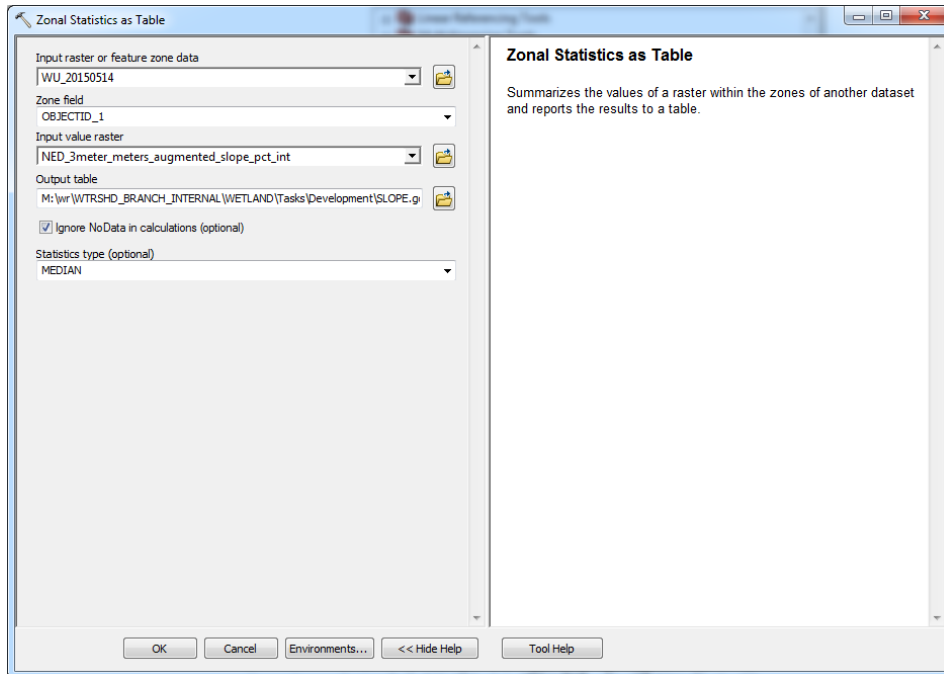
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb (WU\_20150514)
- Database: M:\dems\ned\_slope\_aspect.gdb  
Raster: ~~NED\_3meter\_meters\_augmented\_slope\_pct\_int~~*Note that the zonal statistics tool will run faster if an intermediate raster layer of slope median for each Wetland Unit is calculated first. However, it takes significant time to calculate the intermediate raster layer, so it is preferable to run the zonal statistics directly from the NED raster above. The intermediate raster layer corresponding to WU\_20150514 is at: M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\Slope\_raster\ Raster: median\_slope Please note that this "median\_slope" raster ONLY works with WU\_20150514; it must be re-generated for any other set of Wetland Unit polygons.*
- M:\elevation\statewide\_slope\_pct.tif (new slope file in 2024)

Input Variables:

None

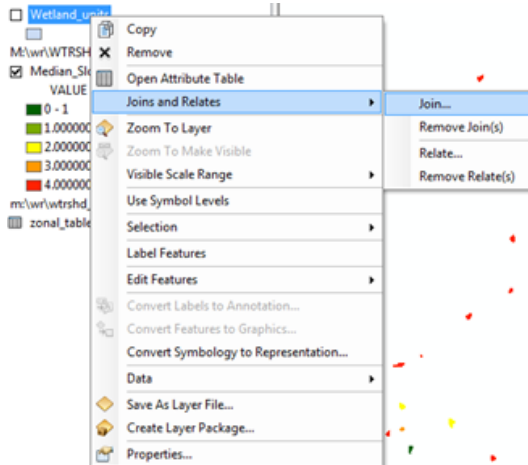
Method:

1. Spatial Analyst Tools/Zonal/Zonal Statistics as Table Tool
  - a. Input feature zone data = WU20150514
  - b. Zone field = ObjectID
  - c. Input Value raster = ~~NED\_3meter\_meters\_augmented\_slope\_pct\_int~~  
M:\elevation\statewide\_slope\_pct.tif
  - d. Output table: <select location>
  - e. Check Ignore No Data
  - f. Statistics Type: Median

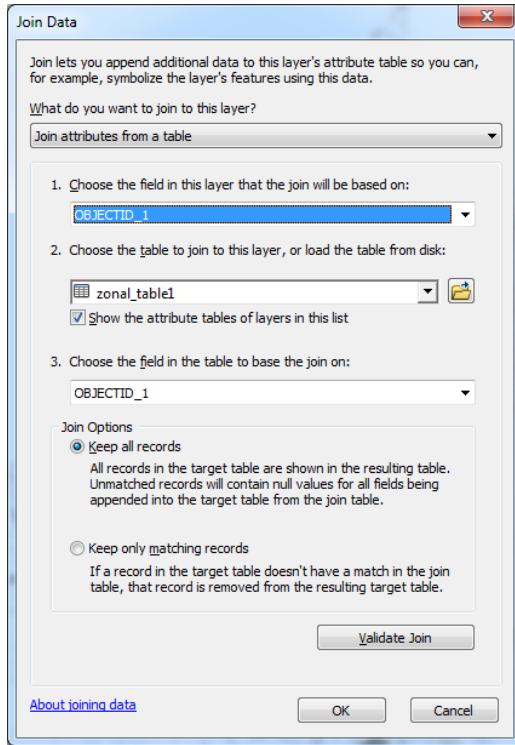


2. Join Wetland Units so the Zonal Statistic Table Output

- a. Right-click WU20151514 Shapefile in TOC
  - i.
- b. Click Joins and Related
- c. Click "Join..."

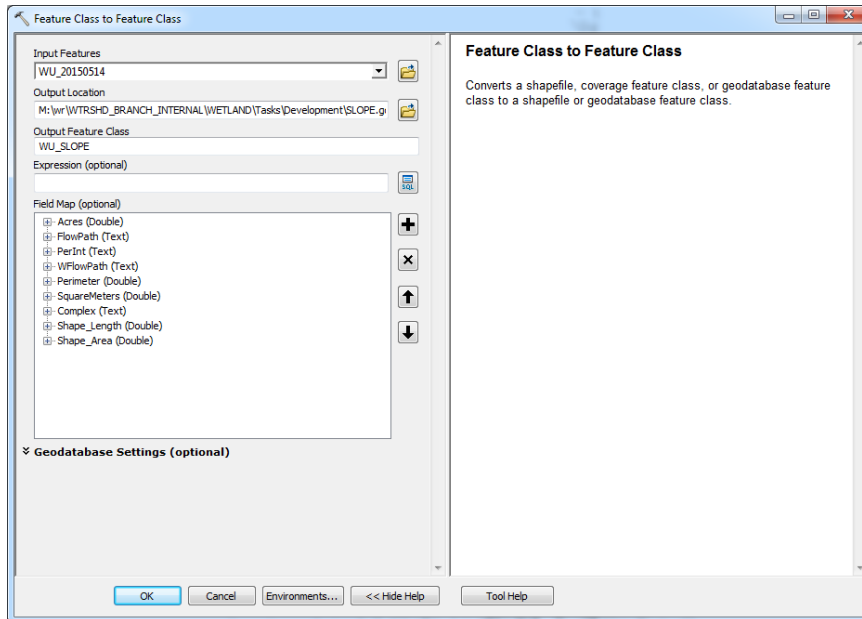


- d.
3. This will display the "Join Data pop-up window"
- a. Select "Join attributes from a table"
  - b. "Choose the field..." = OBJECTID\_1
  - c. "Choose the table to join..." = zonal\_table1
  - d. "Choose the field in the table..." = OBJECTID\_1
  - e. Check "Keep all records"



f.

4. Export the joined data to a Feature Class (Conversion Tools/To Geodatabase/Feature Class to FeatureClass)
  - a. Go to the “Feature Class to FeatureClass” Tool
  - b. Input Features: WU\_20150514
  - c. Output Location: Desired Geodatabase
  - d. Output Feature Class: WU\_SLOPE
  - e. Click “OK”



f.

5. Rename MEDIAN field to SLOPE
  - a. Open the attribute table to WU\_SLOPE
  - b. Add field "SLOPE" (short integer) to attribute table
  - c. Field Calculate "SLOPE" = MEDIAN
  - d. Delete the MEDIAN field

### 5.6.63 SlopeWshd: Mean Percent Slope of the Contributing Watershed

Version date: 21 February 2024 (slope source file updated)

Previous version(s): 22 December 2016

Strategy: completed 4/21/2016 EAB

GIS method: completed 4/21/2016 EAB & JCC; 10/6/16 EAB I think we need to do step 1 in Python rather than ArcGIS because of need for iteration

Python code: Completed 2/8/2017 MCA

Final review by EAB: 2/8/2017

*Note that this procedure is based on the SLOPE variable, and some of the code can probably be shared.*

Purpose:

Input to Flood Attenuation Function / Opportunity aspect

Description:

Rationale: Steep slopes contribute to rapid runoff and increases in flood flows during storm events. Wetlands below these slopes will have more opportunity to intercept and slow flood flows (Wisconsin GIS-RAM metric).

Strategy: Calculate mean percent slope of contributing watershed. Slopes > 15% = 2 points; slopes 5-15% = 1 point; slopes < 5% = 0 points.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb
  - Feature Class: WU\_20150514
  - Feature Class: DrainageArea27m
- ~~M:\dems\ned\_slope\_aspect.gdb~~
  - ~~Raster: NED\_3meter\_meters\_augmented\_slope\_pct~~
- M:\elevation\statewide\_slope\_pct.tif (new source file 2024)

Method:

6. Spatial Analyst Tools/Zonal/Zonal Statistics as Table Tool
  - a. Input feature zone data = DrainageArea27m
  - b. Zone field = WUKey
  - c. Input Value raster = ~~NED\_3meter\_meters\_augmented\_slope\_pct~~  
M:\elevation\statewide\_slope\_pct.tif
  - d. Output table: slope\_wshd
  - e. Check box "Ignore NoData in calculations"
  - f. Statistics Type: Mean

Step 1 issue: DrainageArea27m has overlapping polygons, and the resulting output "slope\_wshd" table only has values for one-third of the total drainage areas. Can we re-

design this step to iterate the zonal analysis for each polygon, in order to get around the problem of overlapping polygons? Here is the text from ArcGIS help:

If the zone feature input has overlapping polygons, the zonal analysis will not be performed for each individual polygon. Since the feature input is converted to a raster, each location can only have one value.

An alternative method is to process the zonal statistics iteratively for each of the polygon zones and collate the results.

Resolution: done, but it is time-consuming to run the entire state. It will not be a problem for smaller datasets.

7. Join DrainageArea27m to the Zonal Statistic Table Output
  - a. Right-click DrainageArea27m
  - b. Click Joins and Relates
  - c. Click "Join..."
  
8. This will display the "Join Data" pop-up window
  - a. Select "Join attributes from a table"
  - b. "Choose the field..." = WUKey
  - c. "Choose the table to join..." = slope\_wshd
  - d. "Choose the field in the table..." = WUKey
  - e. Check "Keep all records"
  
9. Export the joined data to a Feature Class (Conversion Tools/To Geodatabase/Feature Class to FeatureClass)
  - a. Go to the "Feature Class to FeatureClass" Tool
  - b. Input Features: DrainageArea27m
  - c. Output Location: Desired Geodatabase
  - d. Output Feature Class: SlopeWshd1
  - e. Click "OK"
  
10. Rename MEAN field
  - a. Open the attribute table to SlopeWshd1
  - b. Add field "MnSlopeWshd" (short integer) to attribute table
  - c. Field Calculate "MnSlopeWshd" = MEAN

## **## Join the slope values to Wetland Units.**

ArcToolbox / Data Management Tools / Joins / Join Field

Input table: WU\_20150514

Input Join Field: OBJECTID\_1

Join Table: SlopeWshd1

Output Join Field: WUKey

Join Fields: WUKey, MnSlopeWshd

## **## Export joined data**

R-click WU\_20150514 and select Data / Export Data



Output feature class: WU\_SlopeWshd

**## Add field to Wetland Units and set initial point value to zero.**

Open attribute table of WU\_SlopeWshd

Add field "SlopeWshd" (short integer)

R-click SlopeWshd and Field Calculate SlopeWshd = 0

**## Assign points.**

SELECT \* FROM WU\_SlopeWshd WHERE: MnSlopeWshd > 5

R-click SlopeWshd and Field Calculate SlopeWshd = 1

SELECT \* FROM WU\_SlopeWshd WHERE: MnSlopeWshd > 15

R-click SlopeWshd and Field Calculate SlopeWshd = 2

## 5.6.64 SoilH: Hydrologic regime for soil

Version date: 27 September 2017

Strategy: Completed 3/16/2017 EAB

GIS method: 9/27/2017 EAB; results verified 9/27/2017 EAB

Python coding: 9/28/2017 YH

Final review by EAB: 10/2/2017

Description:

Input to Habitat & Ecological Integrity / Potential

Max 6 points

Rationale: Undisturbed soils, organic or calcareous soils, and structural patches all contribute important physical habitat characteristics to wetlands.

Strategy: Sum the points for the metrics SoilIntact, SoilOrgCalc, and StrucPatch.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandFunctionResults\WetlandFunction.gdb
  - Feature Class: WU\_Disturb50m
    - Field: SoilIntact
  - Feature Class: WU\_SoilOrgCalc
    - Field: SoilOrgCalc
  - Feature Class: WU\_StrucPatch
    - Field: StrucPatch

Method:

*## Note that the step below could be done with a Join on WUKey instead of a Spatial Join if that is easier to code.*

### **## Spatial Joins to merge fields into one attribute table**

ArcToolbox / Analysis Tools / Overlay / Spatial Join

Target Features: WU\_Disturb50m

Join Features: WU\_SoilOrgCalc

Output Feature Class: WetlandFunction.gdb\WU\_SoilH1

Join Operation: JOIN\_ONE\_TO\_ONE

Check "Keep All Target Features"

Field Map of Join Features:

WUKey

Shape\_Length

Shape\_Area

SoilIntact

SoilOrgCalc

Match Option: CONTAINS

ArcToolbox / Analysis Tools / Overlay / Spatial Join  
Target Features: WU\_SoilH1  
Join Features: WU\_StrucPatch  
Output Feature Class: WetlandFunction.gdb\WU\_SoilH  
Join Operation: JOIN\_ONE\_TO\_ONE  
Check "Keep All Target Features"  
Field Map of Join Features:  
WUKey  
Shape\_Length  
Shape\_Area  
SoilIntact  
SoilOrgCalc  
StrucPatch  
Match Option: CONTAINS

**## Add field to store SoilH and set initial value to zero**

Open attribute table of WU\_SoilH  
Add field "SoilH" (short integer)  
Field Calculate SoilH = 0

**## Assign points to SoilH**

Open attribute table of WU\_SoilH  
Field Calculate SoilH = [SoilIntact] + [SoilOrgCalc] + [StrucPatch]

## 5.6.65 SoilIntact: Lack of Soil Disturbance or Compaction

Version date: 27 September 2017

Strategy: Completed 3/16/2017 EAB

GIS method: 9/27/2017 EAB; results verified 9/27/2017 EAB

Python coding: 9/28/2017 YH

Final review by EAB: 10/2/2017

Description:

Input to Habitat & Ecological Integrity / Potential / SoilH

Max 2 points

Rationale: Soil disturbance or compaction reduces the habitat value and ecological integrity of a wetland. This metric is best observed in the field.

Strategy: Estimate using the proxy of land use disturbance in 50-meter buffer (NLCD developed areas, urbanized areas, recent timber harvest, and grazed pastures). Assign points as follows:

- 2 points: No disturbed land uses within 50m buffer
- 1 point: Trace to 50% of 50m buffer is covered by disturbed land uses
- 0 points: > 50% of 50m buffer is covered by disturbed land uses

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandFunctionResults\WetlandFunction.gdb
  - Feature Class: WU\_Disturb50m
    - Field: Dist50mRat

Method:

**## Add SoilIntact field and set initial point value to zero.**

Open attribute table of WU\_Disturb50m

Add field "SoilIntact" (short integer)

R-click SoilIntact and Field Calculate SoilIntact = 0

**## Assign points to SoilIntact**

Open attribute table of WU\_Disturb50m

SELECT \* FROM WU\_Disturb50m WHERE: Dist50mRat IS NULL

Field Calculate SoilIntact = 2

SELECT \* FROM WU\_Disturb50m WHERE: Dist50mRat > 0

Field Calculate SoilIntact = 1

SELECT \* FROM WU\_Disturb50m WHERE: Dist50mRat > 0.5

Field Calculate SoilIntact = 0

### 5.6.66 SoilOrgCalc: Special soil types, i.e., organic or calcareous soil

Version date: 24 September 2017

Strategy: Completed 3/16/2017 EAB

GIS method: 9/27/2017 EAB; results verified 9/27/2017 EAB

Python coding: 9/28/2017 YH

Final review by EAB: 10/2/2017 EAB

Purpose:

Input to Habitat & Ecological Integrity / Potential / SoilH

Max 1 point

Description:

Rationale: Soils developed on limestone, dolomite, or marl deposits contain elevated levels of calcium or magnesium. A rich and uniquely adapted flora and fauna are characteristic of calcareous wetlands. Peatlands, characterized by deep organic soils, also provide habitat for uniquely adapted flora and fauna.

Strategy: Assign one point if the criteria are met for either organic soil or for calcareous soil

- Histosol variable (SSURGO organic content or known peatland) OR
- Karst metric: SSURGO calcareous soil, SSURGO karst or limestone/dolomite bedrock geology

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandFunctionResults\WetlandFunction.gdb
  - Feature Class: WU\_Histosol
    - Field: Histosol
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandFunctionResults\WetlandFunction.gdb
  - Feature Class: WU\_Karst
    - Field: Karst

Method:

*## Note that the Spatial Join could be replaced by a Join on WUKey if that is easier.*

#### **## Spatial join to merge Histosol and Karst into one attribute table**

ArcToolbox / Analysis Tools / Overlay / Spatial Join

Target Feature: WU\_Histosol

Join Feature: WU\_Karst

Output Feature Class: WetlandFunctionResults\WetlandFunction.gdb\WU\_SoilOrgCalc

Join operation: JOIN\_ONE\_TO\_ONE

Check box "Keep all target features"

Field Map of Join Features: retain the following:

WUKey

Shape\_Length

Shape\_Area

Histosol

Karst

Match option: CONTAINS

**## Add SoilOrgCalc field and set initial point value to zero.**

Open attribute table of WU\_SoilOrgCalc

Add field "SoilOrgCalc" (short integer)

R-click SoilOrgCalc and Field Calculate SoilOrgCalc = 0

**## Assign points to SoilOrgCalc**

Open attribute table of WU\_SoilOrgCalc

SELECT \* FROM WU\_SoilOrgCalc WHERE: ("Histosol" + "Karst") > 0

Field Calculate SoilOrgCalc = 1

### 5.6.67 SoilRunoff: Soil Runoff and Infiltration Potential

Version date: 7 January 2017

Strategy: Completed 3/24/2016 EAB

GIS method: Completed 3/24/2016 EAB; revised 1/7/2017 EAB (peatlands changed from 2 to 0 points)

Python code: 5/24/2016 Nate Gunn; Revision 1/10/2017 MCA

Final review by EAB: 1/11/2017

Purpose:

Input to Flood Attenuation / Potential

Max 2 points.

Description:

Rationale: Wetlands with soil that have characteristics of low runoff and high infiltration are better able to slow and absorb flood flows. Soils are characterized by NRCS according to hydrologic group based on runoff and infiltration characteristics. The high water table in peatlands places them in the high runoff group.

Strategy: Assign 0 points to Wetland Units with soils that have high runoff characteristics. Assign 1 point to Wetland Units with soils that have moderate runoff/infiltration. Assign 2 points to Wetland Units with soils that have low runoff/high infiltration characteristics.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb (WU\_20150514)
- M:\basemap\ssurgo\ssurgo.gdb
  - Feature Class: ssurgo\_wv
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandsGeodatasets.gdb
  - Feature Class: Peatlands\_20160228

Method:

**## Create feature class to store SoilRunoff**

R-click WU\_20150514 and select Data/Export Data

Output feature class: WU\_SoilRunoff

**## Add SoilRunoff field to Wetland Units and set initial point value to zero.**

Open attribute table of WU\_SoilRunoff

Add field "SoilRunoff" (short integer)

R-click SoilRunoff and Field Calculate SoilRunoff = 0

**## Select SSURGO soils that have moderate runoff/infiltration**

Select by Attributes

Method: Create a new selection

```
SELECT * FROM ssurgo_wv WHERE: "hydgrpdc" IN ('C', 'C/D')
```

### **## Select Wetland Units that contain soils with moderate runoff/infiltration**

Select by Location

Selection method: select features from

Target layer: WU\_SoilRunoff

Source layer: ssurgo\_wv

Check box "Use selected features"

Spatial selection method: intersect the source layer feature

### **## Assign points to SoilRunoff.**

In WU\_SoilRunoff, Field Calculate (selection only) SoilRunoff = 1

### **## Select SSURGO soils that have low runoff/high infiltration**

Select by Attributes

Method: Create a new selection

```
SELECT * FROM ssurgo_wv WHERE: "hydgrpdc" IN ('A', 'A/D', 'B', 'B/D')
```

### **## Select Wetland Units that contain soils with low runoff/high infiltration**

Select by Location

Selection method: select features from

Target layer: WU\_SoilRunoff

Source layer: ssurgo\_wv

Check box "Use selected features"

Spatial selection method: intersect the source layer feature

### **## Update points in SoilRunoff.**

In WU\_SoilRunoff, Field Calculate (selection only) SoilRunoff = 2

### **## Select Wetland Units with peatlands**

Select by Location

Selection method: select features from

Target layer: WU\_SoilRunoff

Source layer: Peatlands\_20160228

Spatial selection method: intersect the source layer feature

### **## Update points in SoilRunoff.**

In WU\_SoilRunoff, Field Calculate (selection only) SoilRunoff = 0



## 5.6.68 StreamEdge: Complexity of wetland/stream interface

Version date: 16 November 2016

Strategy: completed 4/14/2016 EAB

GIS method: drafted 4/14/2016 EAB, verified 4/15/2016 EAB; re-verified 11/16/16 EAB;  
replace EnhWVWetland with NWIExports.gdb\Rivers 2/15/2018 EAB

Python coding: Started 8/30/2016 MCA, Completed 12/16/2016 MCA

Final review by EAB: 12/19/2016

Purpose:

Used in Flood Attenuation Function / Potential aspect / Runoff

Max 2 points

Description:

Rationale: Wetlands that are strongly connected to streams have a high capacity to receive overbank flow and intercept floodwaters (Wisconsin GIS-RAM metric). *Note that we cannot determine whether a stream is disconnected/entrenched from GIS. This will be measured during rapid field assessment. The GIS metric is limited to the length/complexity of shared stream/wetland boundaries. Ditches and drains should NOT be included in this metric.*

Strategy: Sum of shared Wetland Unit/river (polygonal stream) boundary lengths and length of NHD stream segments within wetland, divided by the square root of the Wetland Unit area. Assign 2 points to Wetland Units with a ratio > 3.4, 1 point if the ratio is 1-3.4, and zero points if the ratio < 1. *Note that these thresholds were set by examining the histogram of values, with the highest class (2 points) representing the upper tail of the distribution, i.e., more than one standard deviation above the median. The middle class (1 point) represents the middle of the peak to where the upper tail begins, and also has the real-world significance of being more sinuous than a straight line through a theoretical square wetland.*

Source data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb  
Feature Class: **WU\_20150514**
- M:\basemap\NHDH\_WV.gdb, Feature Dataset: Hydrography, Feature Class: **NHDFlowline**  
Note that NHD data is incorrectly attributed (no ephemeral or intermittent streams) in Preston County and parts of Monongalia, Barbour, Morgan, Kanawha, Putnam, Wirt, Marshall, Tucker, and small parts of about 10 additional counties. Not much we can do about this for now.
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceFunctionalAssessment\NWIExports.gdb
  - Feature Class: **Rivers**

Method:

**## PART 1: RIVER LENGTH**

**## Select Wetland Units that share a boundary with a river and export them.**

Clear all selections  
Select by Location  
Target: WU\_20150514  
Source: NWIExports.gdb\Rivers  
Spatial selection: intersect the source layer feature.

R-click WU\_20150514 and select Data / Export Data  
Export: Selected features  
Output feature class: WUbyRiver

### **## Convert Wetland polygons to lines**

Data Management Tools / Features / Polygon to Line  
Input Features: WUbyRiver  
Output Feature Class: WURiverLines  
Do not check box “Identify and store polygon...”

### **### Retain only the wet perimeter lines**

Analysis Tools / Overlay / Intersect  
Input features: WURiverLines  
                  NWIExports.gdb\Rivers  
Output feature class: RiverEdges  
Join Attributes: ONLY\_FID  
Output Type: Input

### **## Add field and calculate wet perimeter in RiverEdges**

In RiverEdges, add field “RiverPerim” (float)  
Field Calculate “RiverPerim” = [Shape\_Length]

### **## Spatial Join Wetland Units to RiverEdges**

Clear all selections.

Analysis Tools / Overlay / Spatial Join  
Target Features: WU\_20150514  
Join Features: RiverEdges  
Output Feature Class: WU\_StreamEdge1  
Join operation: Join\_one\_to\_one  
Check box “Keep all target features”  
Field map of join features: (retain the following)  
Shape\_Length  
Shape\_Area  
RiverPerim (R-click, Merge Rule = SUM)

Match Option: Intersect

### **## PART 2: STREAM LENGTH**

#### **## Intersect stream lengths with Wetland Units**

Analysis Tools / Overlay / Intersect

Input features: WU\_StreamEdge1

NHDFlowline

Output feature class: WUStream

Join Attributes: ONLY\_FID

Output Type: Input

#### **## Add field to WUStream to store stream length**

Add field StreamL (float) to WUStream attribute table

Calculate Geometry / Property: Length; Units: meters

#### **## Sum the stream lengths within each WU.**

Analysis Tools / Overlay / Spatial Join

Target Features: WU\_StreamEdge1

Join Features: WUStream

Output Feature Class: WU\_StreamEdge

Join operation: Join\_one\_to\_one

Check box "Keep all target features"

Field map of join features: (retain the following)

Shape\_Length

Shape\_Area

RiverPerim

StreamL (R-click, Merge Rule = SUM)

Match Option: Intersect

#### **## PART 3: Calculate ratio and assign points.**

Open attribute table of WU\_StreamEdge

Select by Attributes

SELECT \* FROM WU\_StreamEdge WHERE: "RiverPerim" IS NULL

Field calculate RiverPerim = 0

SELECT \* FROM WU\_StreamEdge WHERE: "StreamL" IS NULL

Field calculate StreamL = 0

Clear selections

Add fields to attribute table: StreamEdge (short integer), StreamRatio (float)

Field calculate StreamEdge = 0, StreamRatio = 0

Field calculate StreamRatio = ([RiverPerim] + [StreamL]) / ([Shape\_Area] ^ 0.5)

SELECT \* FROM WU\_StreamEdge WHERE: "StreamRatio" > 1

Field calculate StreamEdge = 1

SELECT \* FROM WU\_StreamEdge WHERE: "StreamRatio" > 3.4

Field calculate StreamEdge = 2

## 5.6.69 StrucPatch: Structural Patch Richness

Version date: 27 September 2017

Strategy: Completed 3/16/2017 EAB

GIS method: 9/27/2017 EAB; results verified 9/27/2017 EAB

Python coding: 9/28/2017 YH (YH: results are off by 3 out of 43124 Wetland Units – this was traced back to StreamEdge3. EAB: this should resolve itself when the earlier metrics are re-run)

Final review by EAB: 9/28/2017 EAB

Purpose:

Input to Habitat & Ecological Integrity / Potential / SoilH

Max 3 points

Description:

Rationale: Structural patches offer key habitat elements to species, increasing biodiversity, complexity, and ecological integrity of a wetland. This metric is best assessed in the field.

Strategy: In GIS, this metric is estimated using the proxies of interspersion of NWI polygons, complexity of the upland-wetland interface, stream channel complexity within the wetland, and the amount of woody vegetation in the wetland. Sum VegHorInt (interspersion of NWI codes, 0-3), VegVerStr (0-3), and StreamRatio (0-3 points in quantiles 0, 1.4, 2.4, >2.4). Sum all points and divide by the number of factors.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandFunctionResults\WetlandFunction.gdb
  - Feature Class: WU\_Microtopo
    - Field: VegHorInt
  - Feature Class: WU\_VegVerStr
    - Field: VegVerStr
  - Feature Class: WU\_StreamEdge
    - Field: StreamEdge

Method:

*## Note that the Spatial Join could be replaced by a Join on WUKey if that is easier.*

**## Spatial joins to merge input metrics (VegHorInt, VegVerStr, StreamEdge) into one attribute table**

ArcToolbox / Analysis Tools / Overlay / Spatial Join

Target Feature: WU\_Microtopo

Join Feature: WU\_VerVerStr

Output Feature Class: WetlandFunctionResults\WetlandFunction.gdb\WU\_StrucPatch1

Join operation: JOIN\_ONE\_TO\_ONE

Check box “Keep all target features”

Field Map of Join Features: retain the following:

WUKey

Shape\_Length

Shape\_Area

VegHorInt

VegVerStr

Match option: CONTAINS

ArcToolbox / Analysis Tools / Overlay / Spatial Join

Target Feature: WU\_StrucPatch1

Join Feature: WU\_StreamEdge

Output Feature Class: WetlandFunctionResults\WetlandFunction.gdb\WU\_StrucPatch

Join operation: JOIN\_ONE\_TO\_ONE

Check box "Keep all target features"

Field Map of Join Features: retain the following:

WUKey

Shape\_Length

Shape\_Area

VegHorInt

VegVerStr

StreamEdge

Match option: CONTAINS

### **## Add StreamEdge3 field and set initial point value to zero.**

Open attribute table of WU\_StrucPatch

Add field "StreamEdge3" (short integer)

R-click StreamEdge3 and Field Calculate StreamEdge3 = 0

### **## Assign points to StreamEdge3**

Open attribute table of WU\_StrucPatch

SELECT \* FROM WU\_StrucPatch WHERE: "StreamRatio" > 0

Field Calculate StreamEdge3 = 1

Open attribute table of WU\_StrucPatch

SELECT \* FROM WU\_StrucPatch WHERE: "StreamRatio" > 1.4

Field Calculate StreamEdge3 = 2

Open attribute table of WU\_StrucPatch

SELECT \* FROM WU\_StrucPatch WHERE: "StreamRatio" > 2.4

Field Calculate StreamEdge3 = 3

### **## Add StrucPatch field and set initial point value to zero.**

Open attribute table of WU\_StrucPatch

Add field "StrucPatch" (short integer)  
R-click StrucPatch and Field Calculate StrucPatch = 0

### **## Assign points to StrucPatch**

Open attribute table of WU\_StrucPatch  
SELECT \* FROM WU\_StrucPatch WHERE: ("VegHorInt" + "VegVerStr" + "StreamEdge3")  
> 1  
Field Calculate StrucPatch = 1

### **## Assign points to StrucPatch**

Open attribute table of WU\_StrucPatch  
SELECT \* FROM WU\_StrucPatch WHERE: ("VegHorInt" + "VegVerStr" + "StreamEdge3")  
> 3  
Field Calculate StrucPatch = 2

### **## Assign points to StrucPatch**

Open attribute table of WU\_StrucPatch  
SELECT \* FROM WU\_StrucPatch WHERE: ("VegHorInt" + "VegVerStr" + "StreamEdge3")  
> 5  
Field Calculate StrucPatch = 3

## 5.6.70 SWoutflow, SWOutflow2: Surface Water Outflows

Version date: 25 October 2016

Strategy: Completed 2/17/2016 EAB

GIS method: Completed 2/17/2016 EAB, Revised & Verified 3/24/2016 EAB

Python code: Started & completed 6/14/2016 MCA \* see notes to talk to EAB

EAB 10/3/2016: need to re-run after WFlowPath is updated. Revised 10/27/16 MCA; completed 12/19/2016.

Final review by EAB: 12/19/2016

Purpose:

SWOutflow: Input to Water Quality.

Max 4 points. Groundwater wetlands only.

SWOutflow2: Input to Flood Attenuation.

Max 2 points. Groundwater wetlands only.

Description:

Rationale for SWOutflow (water quality): Pollutants that are in the form of particulates (e.g., sediment, or phosphorus that is bound to sediment) will be retained in a wetland with no outlet. Wetlands with no outlet are scored the highest for this indicator. An outlet that flows only seasonally is usually better at trapping particulates than one that is flowing all the time.

Rationale for SWOutflow2 (flood attenuation): Surface water is retained in a wetland with no outlet. Wetlands with an outlet that is highly constricted, or flows only seasonally, are more likely to retain water than those with permanently flowing outlets.

Strategy for SWOutflow (water quality): No surface water outlet = 4 points; Intermittent or highly constricted permanent outlet = 3 points; permanently flowing surface outlet = 1 point.

Strategy for SWOutflow2 (flood attenuation): Assign points based on Tiner Water Flow Path (WFlowPath) as follows: No surface water outlet = 2 points; Intermittent or highly constricted permanent outlet = 1 point; permanently flowing surface outlet = 0 point.

*Note 1: Highly constricted outlets can be determined during rapid field assessment, but we are not able to identify them remotely at this point.*

*Note 2: SWoutflow2 differs from SWoutflow in that the total points are 2 instead of 4.*

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb (WU\_20150514)

Input Variables:

- Water Flow Path (WFlowPath)
- Floodplain

Method:

**## Spatial join to add input variables WFlowPath and Floodplain to attribute table**



**## and create feature class to store Surface Water Outflow factor**

ArcToolbox / Analysis Tools / Overlay / Spatial Join

Target Features: WU\_Floodplain

Join Features: WU\_WFlowPath

Output Feature Class: WU\_SWOutflow

Join Operation: JOIN\_ONE\_TO\_ONE

Check box “Keep All Target Features”

Field Map of Join Features: retain the following:

Shape\_Length

Shape\_Area

WFlowPath

Floodplain

Match Option: CONTAINS

**## Add SWOutflow fields to Wetland Units and set initial point value to zero.**

Open attribute table of WU\_SWOutflow

Add fields “SWOutflow” (short integer) and “SWOutflow2” (short integer)

R-click SWOutflow and Field Calculate SWOutflow = 0

R-click SWOutflow2 and Field Calculate SWOutflow2 = 0

**## Assign points for to SWoutflow.**

Clear all selections.

SELECT \* FROM WU\_SWOutflow WHERE: "Floodplain" = 'N'

Field Calculate SWoutflow = 1

Clear all selections.

SELECT \* FROM WU\_SWOutflow WHERE: "Floodplain" = 'N' AND "WFlowPath" IN ('OI', 'TI', 'BI', 'IB')

Field Calculate (selection only) SWoutflow = 3

Field Calculate (selection only) SWoutflow2 = 1

Clear all selections.

SELECT \* FROM WU\_SWOutflow WHERE: "Floodplain" = 'N' AND "WFlowPath" IN ('IS')

Field Calculate (selection only) SWoutflow = 4

Field Calculate (selection only) SWoutflow2 = 2

### 5.6.71 TMDL: Wetland is in a watershed with a TMDL plan

*NOTE: This layer was discontinued in 2022 when the statewide TMDLs were completed and the existence of a TMDL plan no longer served to distinguish between wetlands.*

Version date: 16 March 2016

Strategy: 3/16/2016

GIS method: drafted 3/16/2016

Python code: not needed – this is the procedure to create a spatial dataset and only needs to be updated every year or two.

Final review by EAB: 3/16/2016

Purpose:

Water Quality Function, Value to Society aspect

Maximum 2 points (assigned in WQPlan factor)

This procedure creates a layer showing the watersheds with a TMDL plan.

Description:

TMDL (Total Maximum Daily Load). A TMDL exists for the drainage in which the wetland is found (2 points). A Total Maximum Daily Load (TMDL) plan is a plan of action used to clean up streams that are not meeting water quality standards. The TMDL program is part of the Watershed Branch of the WVDEP. TMDLs have been completed for 32 watersheds in West Virginia, listed at: <http://www.dep.wv.gov/wwe/watershed/tmdl/Pages/default.aspx>

Source Data:

- M:\wr\WTRSHD\_BRANCH\TMDL FINAL GIS DATA\TMDL Subsheds (SWS) alphabetical order.lyr

Method:

#### **Create layer showing watersheds with a TMDL plan**

Open TMDL Subsheds layers. Export the first watershed to a new feature class “TMDL” and load data from all subsequent watersheds into this polygon feature class.

**Final data layer is stored in:**

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WaterQualityDatasets.gdb
  - Feature Class: TMDL

#### **Annual updates**

Updates should be done annually, comparing “TMDL” to the newest delineations and adding any additional watersheds to the compiled feature class.

### 5.6.73 VegAll: All Vegetation Types

Version date: 24 March 2016

Strategy: 3/24/2016 EAB

GIS method: completed & verified 3/24/2016 EAB; modified to expand selected polygons to include vegetated lacustrine littoral and vegetated riverine 2/3/2022 EAB

Python code: started 5/12/2016 MCA, completed 5/13/2016

Final review by EAB: 10/4/2016

Purpose:

Input to Flood Attenuation / Potential / Vegetation Factor

Max 1 point.

Description:

Rationale: All vegetation, even grazed pastures and aquatic bed vegetation, plays at least a minor role in slowing flood flows.

Summary of strategy: Assign 1 point to Wetland Units with at least 50% areal cover by vegetation of any type.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb (WU\_20150514)
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\EnhancedNWI\_20150511.gdb (EnhWVWetland)

Method:

**## Select the forest, shrubland, emergent, moss, and aquatic bed vegetation.**

Clear all selections

SELECT \* FROM EnhWVWetland WHERE:

```
"ATTRIBUTE" LIKE 'PEM%' OR "ATTRIBUTE" LIKE 'PFO%' OR "ATTRIBUTE" LIKE 'PSS%' OR "ATTRIBUTE" LIKE 'PAB%' OR "ATTRIBUTE" LIKE 'PML%' OR "ATTRIBUTE" LIKE 'L2AB%' OR "ATTRIBUTE" LIKE 'L2US5%' OR "ATTRIBUTE" LIKE 'L2EM%' OR "ATTRIBUTE" LIKE 'R2AB%' OR "ATTRIBUTE" LIKE 'R3AB%' OR "ATTRIBUTE" LIKE 'R2US5%' OR "ATTRIBUTE" LIKE 'R3US5%' OR "ATTRIBUTE" LIKE 'R2EM%' OR "ATTRIBUTE" LIKE 'R3EM%' OR "ATTRIBUTE" LIKE 'R4SB7%
```

**## Create layer of all vegetation from selection**

R-click EnhWVWetland / Data / Export Data

Export: Selected features

Output feature class: "VegAll"

**## Add field to store vegetation area**

Open attribute table of VegAll  
Add field VegArea (float)  
R-click VegArea and Field Calculator:  $\text{VegArea} = [\text{SHAPE\_Area}]$

**## Join vegetation to wetland units and sum the vegetation area**

Analysis Tools / Overlay / Spatial Join  
Target Features: WU\_20150514  
Join Features: VegAll  
Output Feature Class: WU\_VegAll  
Join Operation: JOIN\_ONE\_TO\_ONE  
Check box "Keep all target features"  
Field Map of Join Features: retain Shape\_Length, Shape\_Area, VegArea  
R-click VegArea and select "Merge Rule", "Sum"  
Match Option: INTERSECT

**## Add field to store ratio of vegetated area to total area**

In WU\_VegAll, add field: VegRatio (float)

**## Calculate ratio of vegetation to Wetland Unit area.**

In WU\_VegAll, R-click attribute VegRatio  
Field Calculate  $\text{VegRatio} = [\text{VegArea}] / [\text{Shape\_Area}]$

**## Add new attribute field to store points for VegAll and set initial value to zero.**

In WU\_VegAll, add field: VegAll (short integer)  
Field calculate  $\text{VegAll} = 0$

**## Assign points to Wetland Units for vegetation**

SELECT \* FROM WU\_VegAll WHERE: "VegRatio" > 0.5  
R-click VegAll, Field Calculate  $\text{VegAll} = 1$

## 5.6.74 VegByLP: Vegetation fringing open water

Version date: 14 March 2018

Strategy: completed EAB 18 Feb 2016

GIS method: completed 3/2/2016 EAB & JCC; verified 3/2/2016 EAB; revised to (a) replace EnhWVWetland with NWIExports/RiverLakes, (b) replace procedure to select Lakes with NWI export of Lakes, and (c) replace selection criteria for VegAll to include vegetated lacustrine and riverine wetlands 2/15/2018 EAB. Revised to replace Lakes with RiversLakes and to add perennial streams 3/6/2018 EAB.

Python coding: Started 3/22/2016 MCA & completed 3/23/2016 MCA

Final review by EAB: 3/24/2016

Purpose:

Used in Water Quality Function / WQPotential / VegWQ

Max 1 point

Description:

Rationale: Vegetation fringing the banks of open water, including lakes, reservoirs, ponds or streams, provides vertical structure to filter out pollutants or absorb them, enhancing sediment retention and stabilization, phosphorus retention, and nitrate removal (Adamus et al. 2010, Hruby 2012). Wetlands in which the average width of shoreline vegetation is large are more likely to retain sediment and toxic compounds than where shoreline vegetation is narrow (Adamus et al. 1991). Aquatic bed species that die back every year play a role in improving water quality. These plants take up nutrients in the spring and summer that would otherwise be available to stimulate algal blooms in the water body (Reynolds and Davies 2001). In addition, aquatic bed species change the chemistry of the lake/pond bottom to facilitate the binding of phosphorus (Moore et al. 1994). Vegetated shorelines provide physical protection from erosion, including shoreline anchoring and the dissipation of erosive forces (Adamus and others. 1991). Fringing wetlands that have extensive, persistent (especially woody) plants provide protection from overland flows or waves associated with large storms (Adamus and others 1991). GIS estimation of this metric is replaced during the field assessment.

Summary of strategy: Assign 1 point to vegetated Wetland Units that

- intersect a river, lake, or reservoir
- contain pond(s)
- contain a through-flowing perennial stream

Source data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb
  - Feature Class: **WU\_20150514**
- [NewInputPolygons]
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceFunctionalAssessment\NWIExports.gdb
  - Feature Class: RiversLakes
- WFlowPath

Method:

**## Add fields to Wetland Units feature class.**

Add fields: VegByLP (short integer), PondRatio (float),

**## Set initial value of VegByLP to zero.**

Field calculate VegByLP = 0

**## PART 1: CREATE VEGETATION LAYER.**

**## Select the forest, shrubland, emergent, moss, and aquatic bed vegetation.**

Clear all selections

SELECT \* FROM [NewInputPolygons] WHERE:

"ATTRIBUTE" LIKE '%EM%' OR "ATTRIBUTE" LIKE '%AB%' OR "ATTRIBUTE" LIKE 'PFO%' OR "ATTRIBUTE" LIKE 'PSS%' OR "ATTRIBUTE" LIKE 'PML%'

Create layer from selection.

Export data to feature class: VegAll

**## PART 2: CREATE RIVER AND LAKE SELECTIONS.**

**## Select Wetland Units that intersect rivers or lakes.**

Clear all selections

Select by Location

Target: Wetland Units

Source: NWIExports.gdb\RiversLakes

Spatial selection: intersect the source layer feature.

Create layer from selection.

Export data to feature class: WUbyLake

**## Select WUbyLake that are vegetated**

Select by Location

Target: WUbyLake

Source: VegAll

Spatial selection: contain the source layer feature

Create layer from selection.

Export data to feature class: WUbyLakeVegAll

**## Assign 1 point to VegByLP for the records in WUbyLakeVegAll.**

Field calculate VegByLP = 1

**## PART 3: CREATE POND SELECTIONS.**

**## Select ponds.**

Clear all selections

SELECT \* FROM [NewInputPolygons] WHERE:  
"ATTRIBUTE" LIKE 'PA%' OR "ATTRIBUTE" LIKE 'PU%'  
Create layer from selection.  
Export data to feature class: Ponds

### **## Select Wetland Units that contain ponds**

Clear all selections  
Select by Location  
Target: Wetland Units  
Source: Ponds  
Spatial selection: contain the source layer feature  
Create layer from selection.  
Export data to feature class: WUwithPond

### **## Select WUwithPond that are vegetated**

Select by Location  
Target: WUwithPond  
Source: VegAll  
Spatial selection: contain the source layer feature  
Create layer from selection.  
Export data to feature class: WUwithPondVegAll

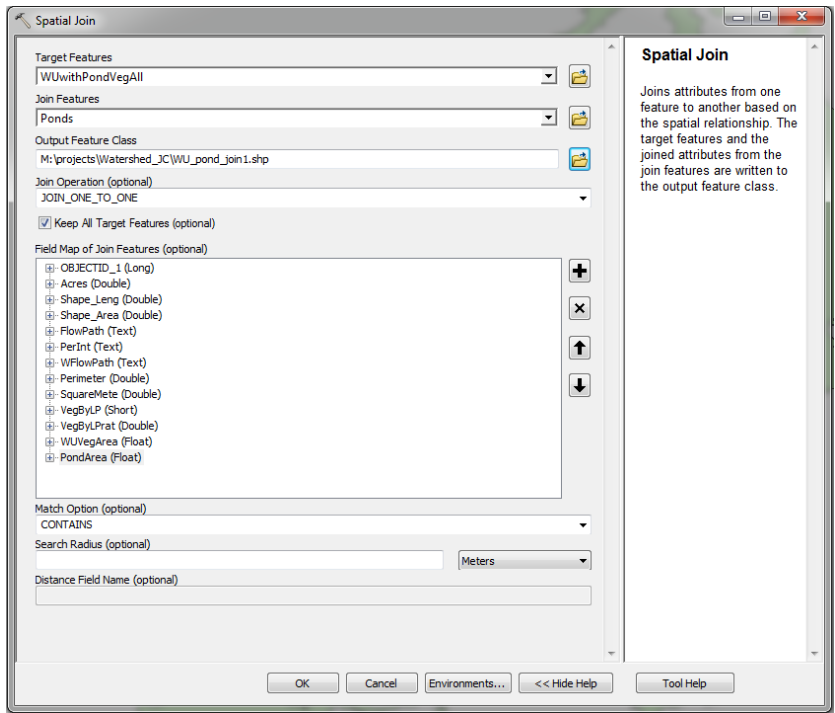
### **## Add Area fields and calculate geometry in WUwithPondVegAll**

In Ponds, add field: PondArea (Float)  
R-click PondArea, Field Calculator, PondArea = [Shape\_Area]  
In WUwithPondVegAll = WUarea (Float)  
R-click WUArea, Field Calculator, WUArea = [Shape\_Area]

### **## Spatial join vegetated WU with ponds**

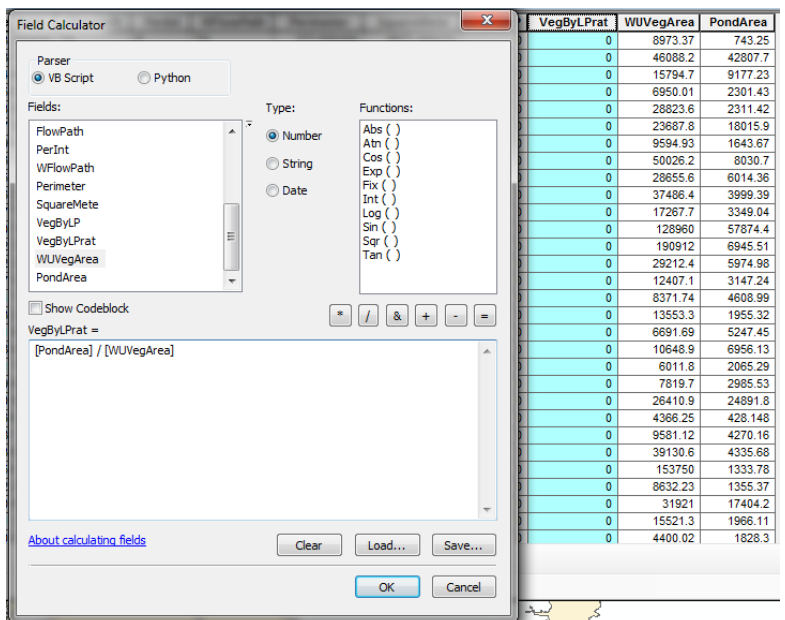
Analysis Tools / Overlay / Spatial Join Tool

- a. Target: WUwithPondVegAll
- b. Join Features: Ponds
- c. Output: WUwithPondVegAll\_join
- d. Join: One-to-one
- e. Field Map: retain fields:
  - i. Shape\_Length
  - ii. Shape\_Area
  - iii. VegByLP (short integer)
  - iv. WUarea (float)
  - v. PondArea (float)
  - vi. PondRatio (float)
- f. Match Option: Contains



**## Calculate ratio of pond area (Ponds) to vegetated Wetland Unit (WUwithPondVegAll\_join)**

Right click PondRatio in attribute field of WUwithPondVegAll\_join  
 Field Calculate PondRatio = [PondArea] / [WUarea]





**## Assign 1 point to VegByLP if pond area is <100% of Wetland Unit area.**

Clear all selections

SELECT \* FROM WUwithPondVegAll\_join WHERE: "PondRatio" < 1

Field calculate VegByLP = 1

**## PART 4: COMBINE RESULTS**

**## Join lake results to Wetland Units**

Analysis Tools / Overlay / Spatial Join

Target Features: WU\_20150514

Join Features: WUbyLakeVegAll

Output Feature Class: WU\_VegByLake

Join operation: JOIN\_ONE\_TO\_ONE

Checkbox "Keep all target features"

Match Option: INTERSECT

**## Select lake results and write to Wetland Units**

SELECT \* FROM WU\_VegByLake WHERE: "VegByLP\_1" = 1 (93 out of 43214 selected)

R-click VegByLP and Field Calculate VegByLP = 1

Clear all selections.

**## Join pond results to Wetland Units**

Analysis Tools / Overlay / Spatial Join

Target Features: WU\_VegByLake

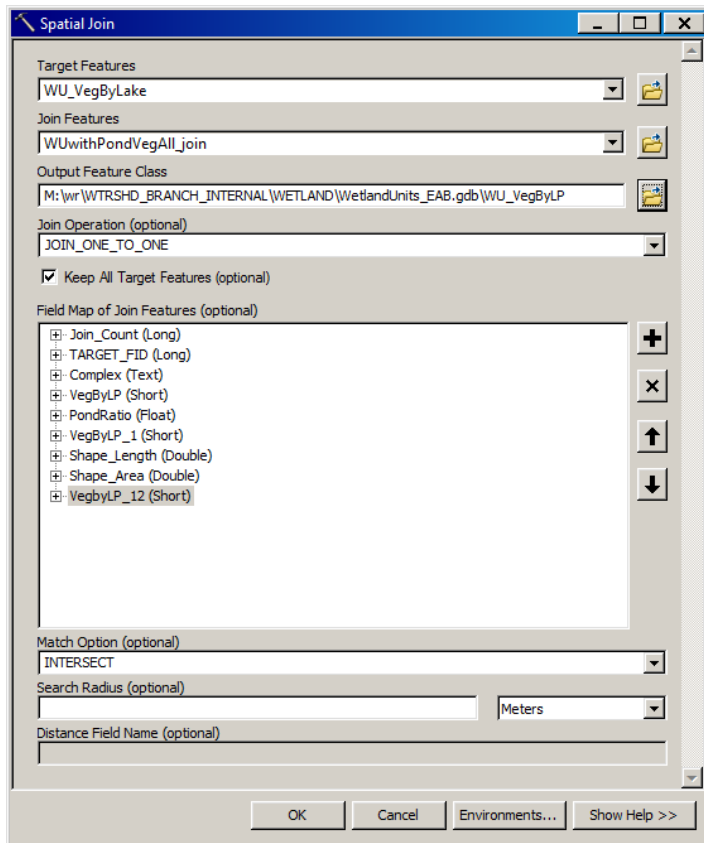
Join Features: WUwithPondVegAll\_join

Output Feature Class: WU\_VegByLP1

Join operation: JOIN\_ONE\_TO\_ONE

Checkbox "Keep all target features"

Match Option: INTERSECT



### ## Select pond results and write to Wetland Units

SELECT \* FROM WU\_VegByLP1 WHERE: "VegByLP\_12" = 1  
 R-click VegByLP1 and Field Calculate VegByLP = 1  
 Clear all selections.

### ## Delete unnecessary fields from WU\_VegByLP1

Delete VegByLP\_1 and VegByLP\_12 from the WU\_VegByLP1 feature class. This data has been consolidated into the VegByLP field and is no longer needed.

### ## PART 5: Add vegetated wetlands that contain a through-flowing perennial stream.

#### ## Spatial Join WU\_VegByLP1 to WU\_WFlowPath

ArcToolBox / Analysis Tools / Spatial Join

Target features: WU\_VegByLP1

Join features: WU\_WFlowPath

Output feature class: WU\_VegByLP

Join operation: JOIN\_ONE\_TO\_ONE

Check "Keep all target features"

Field map of join features:

VegByLP

PondRatio

Shape\_Length

Shape\_Area

WFlowPath

WUKey

Match Option: CONTAINS

### **## Select vegetated wetlands**

Select by Location

Selection method: select features from

Target layer: WU\_VegByLP

Source layer: VegAll

Spatial selection method: intersect the source layer feature

### **## Selected vegetated wetlands the contain a through-flowing perennial stream**

Open attribute table of WU\_VegByLP

Select by Attributes

Method: Select from current selection

SELECT \* FROM WU\_VegByLP WHERE: WFlowPath = 'TP'

### **## Assign points to VegByLP**

Open attribute table of WU\_VegByLP

R-click VegByLP and Field Calculate VegByLP = 1

## 5.6.75 VegFA: Vegetation

Version date: 16 November 2016

Strategy: Completed 3/24/2016 EAB

GIS method: Completed & verified 3/25/2016 EAB

Python coding: started 6/10/2016; completed 12/16/2016

Final review by EAB: 12/19/2016

Purpose:

Input to Flood Attenuation / Potential

Max 9 points for floodplain Wetland Units; 5 points for groundwater Wetland Units.

Description:

Rationale: Plants enhance flood attenuation by physically impeding flows, creating microtopographic depressions to store water, and by actively taking up water through their root systems.

Plants that persist throughout the year and provide a complex vertical structure to slow overland flows (live or dead trees, shrubs, and persistent herbs) enhance flood attenuation. However, their effectiveness is reduced if the plants are grazed or mowed to less than 6 inches in height, since their low stature offers little resistance to flood flows. Aquatic bed plants play a smaller role in slowing floods. Forest vegetation provides high interception and evapotranspiration during rainfall events. In floodplains, forest vegetation is particularly effective at slowing flows and providing temporary storage due to the structural complexity of tree trunks and branches, coarse woody debris and microtopographically complex root structures.

Summary of strategy: Sum the points for VegAll (1 point), VegPerUng (4 points max), VegWoody (4 points max) for each Wetland Unit. If the total for groundwater wetlands is greater than the maximum allowed points (5), reduce to the allowed amount. There is no point reduction for floodplain wetlands.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb (WU\_20150514)

Input Variables:

- VegAll (All Vegetation Types)
- VegPerUng4 (Persistent Ungrazed Vegetation)
- VegWoody4 (Woody Vegetation)
- Floodplain

Method:

**## Spatial joins to add input variables to Wetland Units attribute table**

ArcToolbox / Analysis Tools / Overlay / Spatial Join

Target Feature: WU\_20150514

Join Feature: WU\_Floodplain

Output Feature Class: WU\_VegFA1  
Join operation: JOIN\_ONE\_TO\_ONE  
Check box “Keep all target features”  
Field Map of Join Features: retain the following:  
Shape\_Length  
Shape\_Area  
Floodplain  
Match option: CONTAINS

ArcToolbox / Analysis Tools / Overlay / Spatial Join  
Target Feature: WU\_VegFA1  
Join Feature: WU\_VegAll  
Output Feature Class: WU\_VegFA2  
Join operation: JOIN\_ONE\_TO\_ONE  
Check box “Keep all target features”  
Field Map of Join Features: retain the following:  
Shape\_Length  
Shape\_Area  
Floodplain  
VegAll  
Match option: CONTAINS

ArcToolbox / Analysis Tools / Overlay / Spatial Join  
Target Feature: WU\_VegFA2  
Join Feature: WU\_VegPerUng  
Output Feature Class: WU\_VegFA3  
Join operation: JOIN\_ONE\_TO\_ONE  
Check box “Keep all target features”  
Field Map of Join Features: retain the following:  
Shape\_Length  
Shape\_Area  
Floodplain  
VegAll  
VerPerUng4  
Match option: CONTAINS

ArcToolbox / Analysis Tools / Overlay / Spatial Join  
Target Feature: WU\_VegFA3  
Join Feature: WU\_VegWoody  
Output Feature Class: WU\_VegFA  
Join operation: JOIN\_ONE\_TO\_ONE  
Check box “Keep all target features”  
Field Map of Join Features: retain the following:  
Shape\_Length  
Shape\_Area  
Floodplain

VegAll  
VerPerUng4  
VegWoody4  
Match option: CONTAINS

**## Add VegFA field to Wetland Units and set initial point value to zero.**

Open attribute table of WU\_VegFA  
Add field "VegFA" (short integer)  
R-click VegFA and Field Calculate VegFA = 0

**## Sum the points for VegAll, VegPerUng4, VegWoody4.**

R-click VegFA and Field Calculate "VegFA" = [VegAll] + [VegPerUng4] + [VegWoody4]

**## Reduce any excess point scores for groundwater wetlands to the maximum allowed.**

Clear all selections.  
SELECT \* FROM WU\_VegFA WHERE: "VegFA" > 5 AND "Floodplain" = 'N'  
Field Calculate (selection only) "VegFA" = 5

## 5.6.76 VegFQ: Vegetation Floristic Quality

Version date: 26 September 2017

Strategy: completed 3/16/2017 EAB

GIS method: completed 9/20/2017 EAB; verified 9/24/2017 EAB

Python code: 9/25/2017 YH

Final review by EAB: 9/26/2017

Purpose:

Input to Habitat and Ecological Integrity / Intrinsic Potential

Max 9 points.

Description:

Rationale: Floristic quality assessment (FQA) evaluates the ecological condition and integrity of natural habitats based on the plant species that grow in them. Each species is characterized by a Coefficient of Conservatism (CoC) based on its tolerance of disturbance and its fidelity to intact natural habitats (Swink and Wilhelm 1994, Wilhelm and Masters 1999). CoC values have been assigned to all species in the West Virginia flora (Rentch and Anderson 2006, WVDNR 2015). The assemblages of plant species present in a wetland reflects the potential number of niches available for invertebrates, birds, and mammals (Bourdagh 2014, Hruby et al. 2000, Knops et al. 1999). Plant biodiversity affects fundamental ecosystem processes such as nutrient dynamics, autotrophic production, susceptibility to invasive species and fungal disease, richness and structure of insect communities, and the overall integrity and functioning of ecosystems (Knops et al. 1999, Fennessy et al. 1998). Excessive nutrients, particularly total P and NO<sub>3</sub>-NO<sub>2</sub>-N, have been significantly correlated with lower floristic quality (Fennessy et al. 1998).

Strategy:

Proxies must be used for GIS estimation of floristic quality; this attribute is overwritten by field assessment data. Assign points as follows for each criterion below; sum is capped at 9 points:

- Persistent ungrazed vegetation (VerPerUng1, >50% veg, 9695 wetlands) = 1 point
- Forested wetlands (VegWoodyFor in VegWoody; 3 points (1487 wetlands); 2 points (960 wetlands); 1 point (498 wetlands); 0 points (40179 wetlands)
- PEM on marl. 3 points: PEM on marl > 1 ha in extent (30 wetlands); 2 points: PEM on marl comprises > 50% of wetland (20 wetlands); 1 point: PEM on marl > 200 m<sup>2</sup> in extent (19 wetlands)
- Deep organic soils (Histosol) present in wetland. Histosol = 3 points (291 wetlands), histic epipedon = 2 points (310 wetlands)
- Karst area (limestone/dolomite bedrock geology or SSURGO karst) > 0.67 of total wetland area = 3 points; karst 0.33-0.67 = 2 points; > 0.1 = 1 point
- Buffer disturbance is known to be correlated with floristic quality (Fennessy et al 1998). Disturb50m normally would go in "landscape opportunity", but since this is a way to discern floristic quality through GIS, it is also used here. *Evaluate weighting by comparing final composite scores for Floristic Quality. Tentatively, no buffer disturbance = 3 points, Dist50mRat < 10% buffer disturbance = 2 points, < 25% buffer disturbance = 1 point.*

- Landscape integrity index. This belongs in the “landscape opportunity” aspect, but it is also a way to discern floristic quality through GIS, and is used here. *Evaluate weighting by comparing final composite scores for Floristic Quality. LandInteg > 800 = 3 points, 700-800 = 2 points, 600-700 = 1 point*

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\Tasks\Complete\VegPerUng.gdb
  - Feature Class: WU\_VegPerUng
    - Field: VegPerUng1
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\Tasks\Complete\VegWoody.gdb
  - Feature Class: WU\_VegWoody
    - Field: VegWoodyFor
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\Tasks\Complete\MarlPEM.gdb
  - Feature Class: WU\_MarlPEM
    - Field: MarlPEM
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\Tasks\Complete\Histosol.gdb
  - Feature Class: WU\_Histosol
    - Field: Histosol
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\Tasks\Complete\Karst.gdb
  - Feature Class: WU\_Karst
    - Field: Karst
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\Tasks\Complete\Disturb50m.gdb
  - Feature Class: WU\_Disturb50m
    - Field: Dist50mRat
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\Tasks\Complete\LandInteg.gdb
  - Feature Class: WU\_LandInteg
    - Field: LandInteg
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\Tasks\Complete\VegAll.gdb
  - Feature Class: WU\_VegAll
    - Field: VegArea

Method:

*Note: the Spatial Joins below could also be done as Joins on the WUKey field if that is easier.*

**## Spatial join to merge VegPerUng1 and VegWoodyFor metrics**

ArcToolbox / Analysis Tools / Overlay / Spatial join

Target Feature: WU\_VegPerUng

Join Feature: WU\_VegWoody

Output feature class: WU\_VegFQ1

Join Operation: JOIN\_ONE\_TO\_ONE

Field Map of Join Features: retain the following

WUKey

Shape-Length



Shape\_Area  
VegPerUng1  
VegWoodyFor  
Match Option: CONTAINS

### **## Spatial join to merge MarlPEM metric**

ArcToolbox / Analysis Tools / Overlay / Spatial join  
Target Feature: WU\_VegFQ1  
Join Feature: WU\_MarlPEM  
Output feature class: WU\_VegFQ2  
Join Operation: JOIN\_ONE\_TO\_ONE  
Field Map of Join Features: retain the following  
WUKey  
    Shape-Length  
Shape\_Area  
VegPerUng1  
VegWoodyFor  
MarlPEM  
Match Option: CONTAINS

### **## Spatial join to merge Histosol metric**

ArcToolbox / Analysis Tools / Overlay / Spatial join  
Target Feature: WU\_VegFQ2  
Join Feature: WU\_Histosol  
Output feature class: WU\_VegFQ3  
Join Operation: JOIN\_ONE\_TO\_ONE  
Field Map of Join Features: retain the following  
WUKey  
    Shape-Length  
Shape\_Area  
VegPerUng1  
VegWoodyFor  
MarlPEM  
Histosol  
Match Option: CONTAINS

### **## Spatial join to merge Karst metric**

ArcToolbox / Analysis Tools / Overlay / Spatial join  
Target Feature: WU\_VegFQ3  
Join Feature: WU\_Karst  
Output feature class: WU\_VegFQ4  
Join Operation: JOIN\_ONE\_TO\_ONE  
Field Map of Join Features: retain the following

WUKey  
    Shape-Length  
Shape\_Area  
VegPerUng1  
VegWoodyFor  
MarlPEM  
Histosol  
Karst  
Match Option: CONTAINS

**## Spatial join to merge Dist50mRat**

ArcToolbox / Analysis Tools / Overlay / Spatial join  
Target Feature: WU\_VegFQ4  
Join Feature: WU\_Disturb50m  
Output feature class: WU\_VegFQ5  
Join Operation: JOIN\_ONE\_TO\_ONE  
Field Map of Join Features: retain the following  
WUKey  
    Shape-Length  
Shape\_Area  
VegPerUng1  
VegWoodyFor  
MarlPEM  
Histosol  
Karst  
Dist50mRat  
Match Option: CONTAINS

**## Spatial join to merge LandInteg metric**

ArcToolbox / Analysis Tools / Overlay / Spatial join  
Target Feature: WU\_VegFQ5  
Join Feature: WU\_LandInteg  
Output feature class: WU\_VegFQ6  
Join Operation: JOIN\_ONE\_TO\_ONE  
Field Map of Join Features: retain the following  
WUKey  
    Shape-Length  
Shape\_Area  
VegPerUng1  
VegWoodyFor  
MarlPEM  
Histosol  
Karst  
Dist50mRat

LandInteg  
Match Option: CONTAINS

### **## Spatial join to merge VegArea**

ArcToolbox / Analysis Tools / Overlay / Spatial join  
Target Feature: WU\_VegFQ6  
Join Feature: WU\_VegAll  
Output feature class: WU\_VegFQ  
Join Operation: JOIN\_ONE\_TO\_ONE  
Field Map of Join Features: retain the following  
WUKey  
    Shape-Length  
Shape\_Area  
VegPerUngl  
VegWoodyFor  
MarlPEM  
Histosol  
Karst  
Dist50mRat  
LandInteg  
VegArea  
Match Option: CONTAINS

### **## Add fields to store Dist50mFQ and VegFQ and set initial values to zero**

Open attribute table of WU\_VegFQ  
Add fields Dist50mFQ (short integer) and VegFQ (short integer)  
Field Calculate Dist50mFQ = 0  
Field Calculate VegFQ = 0

### **## Assign points to Dist50mFQ**

SELECT \* FROM WU\_VegFQ WHERE Dist50mRat < 0.25  
Field Calculate Dist50mFQ = 1

SELECT \* FROM WU\_VegFQ WHERE Dist50mRat < 0.1  
(11343 out of 43124 selected)  
Field Calculate Dist50mFQ = 2

SELECT \* FROM WU\_VegFQ WHERE Dist50mRat = 0  
Field Calculate Dist50mFQ = 3

### **## Sum all points for VegFQ**

Open attribute table of WU\_VegFQ

Field Calculate VegFQ = [VegPerUng1] + [VegWoodyFor] + [MarlPEM] + [Histosol] + [Karst]  
+ [Dist50mFQ] + [LandInteg]

**## Reduce VegFQ values to cap of 9 points total**

Open attribute table of WU\_VegFQ  
SELECT \* FROM WU\_VegFQ WHERE VegFQ > 9  
Field Calculate VegFQ = 9

**## Reduce VegFQ values to zero for unvegetated wetlands**

Open attribute table of WU\_VegFQ  
SELECT \* FROM WU\_VegFQ WHERE VegArea IS NULL  
Field Calculate VegFQ = 0

## 5.6.77 VegH: Vegetation Structure and Quality

Version date: 24 September 2017

Strategy: Completed 3/16/2017 EAB

GIS method: 9/24/2017 EAB completed and results verified

Python coding: 9/25/2017 YH

Final review by EAB: 9/26/2017

Purpose:

Input to Habitat & Ecological Integrity / Potential

Max 15 points

Rationale: Vegetation is an outstanding proxy for overall biodiversity and habitat quality.

Strategy: Sum the points for all vegetation metrics.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\Tasks\Complete\VegVerStr.gdb
  - Feature Class: WU\_VegVerStr
    - Field: VegVerStr
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\Tasks\Complete\Microtopo.gdb
  - Feature Class: WU\_Microtopo
    - Field: VegHorInt
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\Tasks\Complete\VegFQ.gdb
  - Feature Class: WU\_VegFQ
    - Field: VegFQ

Method:

*Note that the Spatial Joins could be replaced by Joins on WUKey if that is easier.*

### **## Spatial join to merge VegVerStr and VegHorInt into one attribute table**

ArcToolbox / Analysis Tools / Overlay / Spatial Join

Target Feature: WU\_VegVerStr

Join Feature: WU\_Microtopo

Output Feature Class: WU\_VegH1

Join operation: JOIN\_ONE\_TO\_ONE

Check box "Keep all target features"

Field Map of Join Features: retain the following:

WUKey

Shape\_Length

Shape\_Area

VegVerStr

VegHorInt

Match option: CONTAINS

### **## Spatial join to merge VegFQ**

ArcToolbox / Analysis Tools / Overlay / Spatial Join

Target Feature: WU\_VegH1

Join Feature: WU\_VegFQ

Output Feature Class: WU\_VegH

Join operation: JOIN\_ONE\_TO\_ONE

Check box "Keep all target features"

Field Map of Join Features: retain the following:

WUKey

Shape\_Length

Shape\_Area

VegVerStr

VegHorInt

VegFQ

Match option: CONTAINS

**## Add VegH field to Wetland Units and set initial point value to zero.**

Open attribute table of WU\_VegH

Add field "VegH" (short integer)

R-click VegH and Field Calculate  $VegH = 0$

**## Sum the points for VegVerStr, VegHorInt, VegFQ**

R-click VegH and Field Calculate  $VegH = [VegVerStr] + [VegHorInt] + [VegFQ]$

## 5.6.78 VegHorInt: Horizontal Interspersion

Version date: 15 September 2017

Strategy: Completed 3/16/2017 EAB

GIS method: Completed 9/15/2017 EAB ; Verified 9/15/2017 EAB

Python code:

Final review by EAB:

Purpose:

Input to Habitat / Potential / Vegetation

Max 3 points.

Description:

Rationale: Interspersion of different habitat types provides multiple niches for species and is important in supporting biodiversity. Interspersion tends to be greater in larger wetlands, and serves as a partial proxy for wetland size (Adamus et al. 2010a, CWMW 2013, Hruby 2012, Mack 2001).

Strategy: Divide the perimeter of summed NWI (all) polygon perimeters by the square root of the Wetland Unit area. Then, compare this ratio to the number of NWI polygons in the wetland (part of method is the same as Flood Attenuation/Microtopo but with different point spread and addition of count of NWI polygons).

- 3 points: ratio > 10 AND at least 5 NWI polygons present
- 2 points: ratio > 6 AND at least 3 NWI polygons present
- 1 point: ratio > 4 AND at least 2 NWI polygons present
- 0 points: ratio <= 4 OR only 1 NWI polygon present

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\Tasks\Complete\Microtopo.gdb
  - Feature Class: WU\_Microtopo

Method:

**## Add new attribute field to store points for VegHorInt and set initial value to zero.**

In WU\_Microtopo, add field: VegHorInt (short integer)

Field calculate VegHorInt = 0

**## Assign points to Wetland Units for VegHorInt**

SELECT \* FROM WU\_Microtopo WHERE: "MicroRatio" > 4 AND "Join\_Count" > 1  
R-click VegHorInt, Field Calculate VegHorInt = 1

SELECT \* FROM WU\_Microtopo WHERE: "MicroRatio" > 6 AND "Join\_Count" > 2  
R-click VegHorInt, Field Calculate VegHorInt = 2

```
SELECT * FROM WU_Microtopo WHERE: "MicroRatio" > 10 AND "Join_Count" > 4  
R-click VegHorInt, Field Calculate VegHorInt = 3
```



## 5.6.79 VegPerUng, VegPerUng4, VegPerUng1: Persistent ungrazed vegetation

Version date: 14 February 2017

Strategy: completed EAB 14 Feb 2016

GIS method: completed EAB/CMA 2/27/2016, revised to include VegPerUng4 and VerPerUng1 on 4/13/2016 EAB; verified 4/14/2016 EAB

Python coding: VegPerUng Python coding completed 3/1/2016 MCA; VegPerUng4 Python coding completed 5/24/2016 MCA; VegPerUng1 Python coding completed 5/24/2016 MCA

QAPP updated: 2/27/2016 (PasturesNotHayfields source metadata added)

Final review by EAB: 3/2/2016, revision approved 10/4/2016

Purpose:

VegPerUng: Used in Water Quality Function / Potential / Vegetation. Max 5 points.

VegPerUng4: Used in Flood Attenuation Function / Potential / Vegetation. Max 4 points.

VegPerUng1: Used in Habitat and Ecological Integrity Function / Potential / Vegetation. Max 1 point.

Description:

VegPerUng rationale (water quality): Persistent, ungrazed vegetation improves water quality by acting as a filter to trap sediment, nutrients, and pollutants.

VegPerUng strategy (water quality): Sum the persistent ungrazed vegetation based on the Cowardin attribute in the Enhanced National Wetlands Inventory. Erase the mapped grazed pastures from this layer. Calculate the percentage of persistent ungrazed vegetation for each Wetland Unit, and assign points as follows:

- 5 points: VegPerUng is >2/3 of Wetland Unit area
- 3 points: VerPerUng is 1/3 to 2/3 of Wetland Unit area
- 1 point: VegPerUng is 1/10 to 1/3 of Wetland Unit area
- 0 points: VegPerUng is <1/10 of Wetland Unit area

Note that this variable could be improved by a better estimation of grazed areas. These are currently available for only a few parts of the state. James Summers has provided a few mapped watersheds, used in this variable. He has also provided estimates of the percentage of NLCD grassland that is probably pasture statewide. This latter data has not yet been incorporated into the VegPerUng variable, but could be used in the future.

VegPerUng4 rationale (flood attenuation): Persistent, ungrazed vegetation enhances flood attenuation by physically impeding flows, creating microtopographic depressions to store water, and by actively taking up water through root systems.

VerPerUng4 strategy (flood attenuation): Sum the persistent ungrazed vegetation based on the Cowardin attribute in the Enhanced National Wetlands Inventory. Erase the mapped grazed pastures from this layer. Calculate the percentage of persistent ungrazed vegetation for each Wetland Unit, and assign points as follows:

- 4 points: VegPerUng is >2/3 of Wetland Unit area
- 3 points: VerPerUng is 1/2 to 2/3 of Wetland Unit area
- 2 points: VegPerUng is 1/3 to 1/2 of Wetland Unit area

- 1 point: VegPerUng is 1/10 to 1/3 of Wetland Unit area
- 0 points: VegPerUng is <1/10 of Wetland Unit area

VegPerUng1 rationale (habitat and ecological integrity): Persistent, ungrazed vegetation uses carbon from the atmosphere and stores carbon in above- and below-ground biomass. This biomass provides important habitat and energy to organisms.

VegPerUng1 strategy (habitat and ecological integrity): Sum the persistent ungrazed vegetation based on the Cowardin attribute in the Enhanced National Wetlands Inventory. Erase the mapped grazed pastures from this layer. Calculate the percentage of persistent ungrazed vegetation for each Wetland Unit, and assign points as follows:

- 1 point: VegPerUng is 1/2 or more of Wetland Unit area
- 0 points: VegPerUng is <1/2 of Wetland Unit area

Source data:

M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\EnhancedNWI\_20150511.gdb

Feature Dataset: CONUS\_WVWetlandsProj

Feature Class: **EnhWVWetland**

M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WaterQualityDatasets.gdb

Feature Class: **PasturesNotHayfields**

M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb

Feature Class: **WU\_20150514**

Method:

**Select the forests, shrublands, and persistent emergent vegetation.**

SELECT \* FROM EnhWVWetland WHERE:

"ATTRIBUTE" NOT LIKE 'PEM2%' AND ("ATTRIBUTE" LIKE 'PEM%' OR  
"ATTRIBUTE" LIKE 'PFO%' OR "ATTRIBUTE" LIKE 'PSS%')

**Create layer from selection. Export data to geodatabase.**

This intermediate data can be called VegPFOPSSPEM

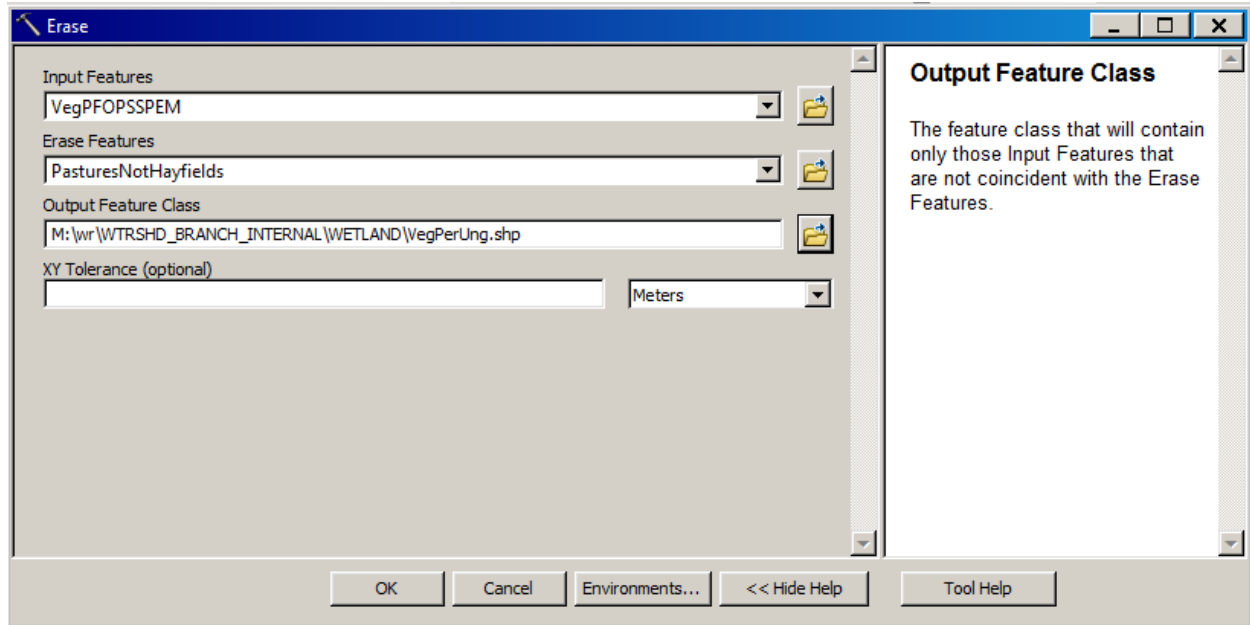
**Erase the known grazed pastures from the intermediate vegetation layer.**

ArcToolBox / Analysis / Overlay / Erase

Input: VegPFOPSSPEM

Erase: PasturesNotHayfields

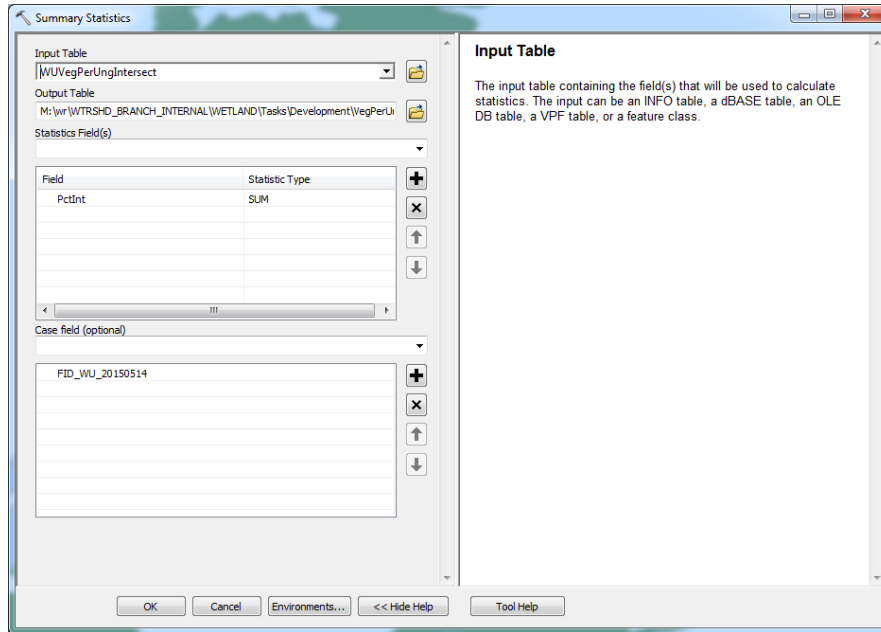
Output: VegPerUng



**Calculate the percentage of each Wetland Unit that is persistent ungrazed vegetation (VegPerUng)**

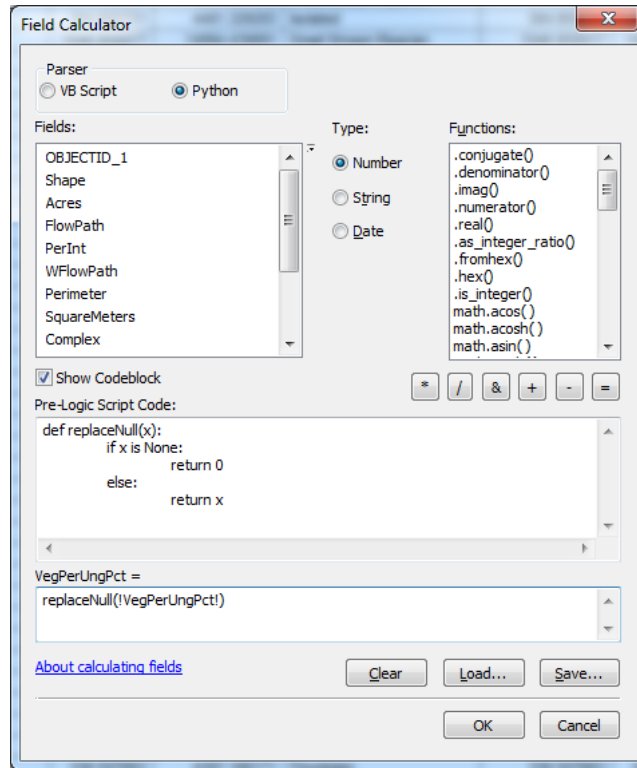
**Attribute each Wetland Unit with the percentage of VerPerUng.**

- Add new field (OrigArea) to the Wetland Unit attribute table.
  - This will retain the original area to be used to calculate the percent after the intersection has occurred.
- Right click on the (OrigArea) field and FieldCalculate where OrigArea = [Shape\_Area]
- Intersect the Wetland Units data with VegPerUng
  - The output feature class is "WUVegPerUngIntersect"
- Add new field (PctIntersect) to the WUVegPerUngIntersect attribute table.
- Right click on the (PctIntersect) field and FieldCalculate where PctIntersect = !SHAPE\_Area!/!OrigArea!\*100
  - Please note, the code above is python so please check the python radio button before executing the FieldCalculate function.
- Execute the Summary Statistics function



- 
- This function creates a table (WUVegPerUngIntersect\_SUM\_STAT) that contains the sums of the percentages for each Wetland Unit making it easier to join back to the Wetland Units data, copy the data over, and then assign points based on the percentages.
- Add new field (VegPerUngPct) to attribute table to store the percentage of persistent ungrazed vegetation for each Wetland Unit.
- Set the Null values to zero in VegPerUngPct.
- Add new field (VegPerUng) to attribute table to store the score in relation to the percentage of persistent ungrazed vegetation for each Wetland Unit.
- Set the Null values to zero in VegPerUng.
- Join Wetland Units to the WUVegPerUngIntersect\_SUM\_STAT table.
- Right click on the (VegPerUngPct) field and FieldCalculate where VegPerUngPct = !WUVegPerUngIntersect\_SUM\_STAT.SUM\_PctIntersect!
  - Please note, the code above is python so please check the python radio button before executing the FieldCalculate function.
- Remove the join to WUVegPerUngIntersect\_SUM\_STAT on the Wetland Units data.
- As a result of copying the percentages to the Wetland Units data, null values might be carried over. To fix this follow these steps:
  - Right click on the (VegPerUngPct) field and select Field Calculator
  - Make sure the python radio button is checked.
  - Check "Show Codeblock"
  - The following goes into the Codeblock textarea
 

```
def replaceNull(x):
    if x is None:
        return 0
    else:
        return x
```
  - VegPerUngPct = replaceNull(!VegPerUngPct!).
  - Now click ok



**Assign points to Wetland Units for VegPerUng.**

SELECT \* FROM WU\_20150514 WHERE: "VegPerUngPct" > 66.7  
 (R-click "VegPerUng" and Field Calculate "VegPerUng" = 5  
 Clear selections.

SELECT \* FROM WU\_20150514 WHERE: "VegPerUngPct" < 66.701 AND "VegPerUngPct" > 33.3  
 R-click "VegPerUng" and Field Calculate "VegPerUng" = 3  
 Clear selections.

SELECT \* FROM WU\_20150514 WHERE: "VegPerUngPct" < 33.301 AND "VegPerUngPct" > 10  
 R-click "VegPerUng" and Field Calculate "VegPerUng" = 1  
 Clear selections.

SELECT \* FROM WU\_20150514 WHERE: "VegPerUngPct" < 10.001  
 R-click "VegPerUng" and Field Calculate "VegPerUng" = 0  
 Clear selections.

**## Export Wetland Units to WU\_VegPerUng if this has not already been done.**

**## Add VegPerUng4 and VerPerUng1 to attribute table and set initial points to zero.**

Open attribute table of WU\_VegPerUng and add field VegPerUng4 and VerPerUng1 (short integers)

R-click VegPerUng4 and Field Calculate VegPerUng4 = 0

R-click VegPerUng1 and Field Calculate VegPerUng1 = 0

### **## Assign points to Wetland Units for VegPerUng4 and VegPerUng1**

SELECT \* FROM WU\_VegPerUng WHERE: "VegPerUngPct" > 10

R-click "VegPerUng4" and Field Calculate "VegPerUng4" = 1

SELECT \* FROM WU\_VegPerUng WHERE: "VegPerUngPct" > 33.

R-click "VegPerUng4" and Field Calculate "VegPerUng4" = 2

SELECT \* FROM WU\_VegPerUng WHERE: "VegPerUngPct" > 50

R-click "VegPerUng4" and Field Calculate "VegPerUng4" = 3

R-click "VegPerUng1" and Field Calculate "VegPerUng1" = 1

SELECT \* FROM WU\_VegPerUng WHERE: "VegPerUngPct" > 66.7

R-click "VegPerUng4" and Field Calculate "VegPerUng4" = 4

## 5.6.80 VegVerStr: Vegetation Vertical Structure

Version date: 18 September 2017

Strategy: completed 3/16/2017 EAB

GIS method: completed 9/14/2017 EAB; verified 9/14/2017 EAB

Python code:

Final review by EAB:

Purpose:

Input to Habitat / Potential / Vegetation Factor. Max 3 points.

Description:

Rationale for VegVerStr: Plant communities with complex vertical structure offer enhanced habitat niches for a variety of plants and animals.

Strategy for VegVerStr: Assign points based on the ratio of forest and vegetated classes to total area; minimum polygon size 0.1 acre (only count those codes whose aggregated area  $\geq 0.05$  ha).

- 3 points: PFO > 50% of wetland AND PFO  $\geq 0.05$  ha
- 2 points: (PFO > 5% of wetland AND PFO  $\geq 0.05$  ha) AND vegetated classes (PFO+PSS+PEM+PAB+PML) > 50% of wetland
- 1 point: vegetated classes (PFO+PSS+PEM+PAB+PML) > 5% of wetland AND vegetated classes  $\geq 0.05$  ha
- 0 point: none of the above criteria are met

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\Tasks\Complete\VegWoody.gdb
  - Feature Class: WU\_VegWoody
    - Fields: PFOarea, PFOratio
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\Tasks\Complete\VegAll.gdb
  - Feature Class: WU\_VegAll
    - Fields: VegArea, VegRatio

Method:

**## Retrieve the fields PFOarea (forest area in m<sup>2</sup>) and PFOratio (ratio of forest area to total wetland**

**## area) from the WU\_VegWoody feature class.**

**## Retrieve the fields VegArea (vegetated area in m<sup>2</sup>) and VegRatio (ratio of vegetated area to total**

**## wetland area) from the WU\_VegAll feature class.**

**## Store the fields in a new feature class: WU\_VegVerStr.**

ArcToolbox / Analysis Tools / Overlay / Spatial join

Target Feature: WU\_VegWoody

Join Feature: WU\_VegAll

Output feature class: WU\_VegVerStr  
Join Operation: JOIN\_ONE\_TO\_ONE  
Field Map of Join Features: retain the following  
WUKey  
    Shape-Length  
Shape\_Area  
PFOarea  
PFOratio  
VegArea  
VegRatio  
Match Option: CONTAINS

**## Add new attribute field to store points for VegVerStr and set initial value to zero.**

In WU\_VegVerStr, add field: VegVerStr (short integer)  
Field calculate VegVerStr = 0

**## Assign points to Wetland Units for VegVerStr**

SELECT \* FROM WU\_VegVerStr WHERE: "VegRatio" > 0.05 AND "VegArea" > 500  
R-click VegVerStr, Field Calculate VegVerStr = 1

SELECT \* FROM WU\_VegVerStr WHERE: "PFOratio" > 0.05 AND "PFOarea" > 500 AND  
"VegRatio" > 0.5  
R-click VegVerStr, Field Calculate VegVerStr = 2

SELECT \* FROM WU\_VegVerStr WHERE: "PFOratio" > 0.5 AND "PFOarea" > 500  
R-click VegVerStr, Field Calculate VegVerStr = 3

**Background notes: (not for coding)**

**Steps skipped by accessing already-computed values:**

**## Select the forest vegetation**

*## (Note that the PFOratio and PFOarea were created in WU\_VegWoody and could be accessed from there, thus skipping multiple steps)*

Clear Selection

SELECT \* FROM ENHWVWetland WHERE: "ATTRIBUTE" LIKE 'PFO%'

**## Create layer of forest vegetation from selection.**

R-click EnhVWetland / Data / Export Data  
Export: Selected features



Output feature class: "VegPFO"  
Clear Selection

### **## Add field to store forest area**

Open attribute table of VegPFO  
Add field PFOarea (float)  
R-click PFOarea and Field Calculator: PFOarea = [SHAPE\_Area]

### **## Select the forest, shrubland, emergent, moss, and aquatic bed vegetation.**

*## (Note that VegArea and VegRatio were created in WU\_VegAll and could be accessed from there, thus skipping multiple steps)*

Clear all selections  
SELECT \* FROM EnhWVWetland WHERE:  
"ATTRIBUTE" LIKE 'PFO%' OR "ATTRIBUTE" LIKE 'PSS%' OR "ATTRIBUTE" LIKE 'PEM%' OR "ATTRIBUTE" LIKE 'PAB%' OR "ATTRIBUTE" LIKE 'PML%'

### **## Create layer of all vegetation from selection**

R-click EnhWVWetland / Data / Export Data  
Export: Selected features  
Output feature class: "VegAll"

### **## Add field to store vegetation area**

Open attribute table of VegAll  
Add field VegArea (float)  
R-click VegArea and Field Calculator: VegArea = [SHAPE\_Area]

### **## Join forests to wetland units and sum the forest area**

Analysis Tools / Overlay / Spatial Join  
Target Features: WU\_20150514  
Join Features: VegPFO  
Output Feature Class: WUPFOjoin  
Join Operation: JOIN\_ONE\_TO\_ONE  
Check box "Keep all target features"  
Field Map of Join Features  
R-click PFOarea and select "Merge Rule", "Sum"  
Match Option: INTERSECT

### **## Join vegetated classes and sum area**

Analysis Tools / Overlay / Spatial Join

Target Features: WUPFOjoin  
Join Features: VegAll  
Output Feature Class: WU\_VegVerStr  
Join Operation: JOIN\_ONE\_TO\_ONE  
Check box "Keep all target features"  
Field Map of Join Features  
R-click VegArea and select "Merge Rule", "Sum"  
Match Option: INTERSECT

**## Add fields to store ratios of forest or vegetated area to total area**

In WU\_VegVerStr, add two fields: PFOratio (float) and VegRatio (float)

**## Calculate ratio of forest vegetation to Wetland Unit area.**

In WU\_VegVerStr, R-click attribute PFOratio  
Field Calculate PFOratio = [PFOarea] / [Shape\_Area]

**## Calculate ratio of vegetated classes to Wetland Unit area.**

In WU\_VegVerStr, R-click attribute VegRatio  
Field Calculate VegRatio = [VegArea] / [Shape\_Area]

### 5.6.81 VegWoody: Woody Vegetation

Version date: 14 February 2017

Strategy: completed 2/27/2016 EAB

GIS method: completed 3/3/2016 EAB & JCC; verified 3/5/2016 EAB; revision to include VegWoody4 and VegWoody2 on 4/13/2016; new point roll-up at end; verified 4/14/2016 EAB; revision to include VegWoodyFor on 2/14/2017

Python code: started & completed 3/15/2016 MCA; VegWoodyFor revision started & completed 2/15/2017 MCA

Final review by EAB: 3/15/2016; results of revision approved 10/4/2016; VegWoodyFor revision approved 2/15/2017

Purpose:

VegWoody: Input to Water Quality / Potential / Vegetation Factor. Max 5 points. Floodplain wetlands only.

VegWoody4: Input to Flood Attenuation / Potential / Vegetation Factor. Max 4 points. All wetland types.

VegWoody2: Input to Habitat and Ecological Integrity / Potential / Structural Patches. Max 2 points. All wetland types.

VegWoodyFor: Input to Habitat and Ecological Integrity / Potential / Vegetation Factor. Max 3 points. All wetland types.

Description:

Rationale for VegWoody (water quality): Plants in a riverine wetland will improve water quality by acting as a filter to trap sediments and associated pollutants. The plants also slow the velocity of water which results in the deposition of sediments. Persistent, multi-stemmed plants enhance sedimentation by offering frictional resistance to water flow (review in Adamus et al. 1991). Shrubs and trees are considered to be better at resisting water velocities than emergent plants during flooding and are scored higher. Aquatic bed species or grazed, herbaceous (non-woody) plants are not judged to provide much resistance to water flows.

Strategy for VegWoody: Assign points based on the ratio of forest and shrub cover to total area.

- 5 points: forested wetlands cover more than 2/3 of the Wetland Unit
- 4 points: forest > 1/3 AND shrub/forest > 90%
- 3 points: shrub/forest > 2/3
- 2 points: shrub/forest > 1/3
- 1 point: shrub/forest > 1/10
- 0 point: shrub/forest < 1/10

Rationale for VegWoody4 (flood attenuation): Woody vegetation provides high interception and evapotranspiration during rainfall events. Woody vegetation in a floodplain slows the velocity of water and offers frictional resistance to water flow (Adamus et al. 1991). Shrubs and trees are considered to be better at resisting water velocities than emergent plants during flooding.

Strategy for VegWoody4: Assign points based on the ratio of forest and shrub cover to total area.

- 4 points: forested wetlands cover more than 2/3 of the Wetland Unit
- 3 points: forest > 1/3 AND shrub/forest > 90%
- 2 points: shrub/forest > 1/2
- 1 point: shrub/forest > 1/10
- 0 point: shrub/forest < 1/10

Rationale for VegWoody2 (habitat and ecological integrity): Woody vegetation provides multiple layers for habitat niches to develop. It is one indicator of structural patch richness.

Strategy for VegWoody2: Assign points based on the ratio of forest and woody shrub cover to total Wetland Unit area.

- 2 points: forested wetlands cover more than 2/3 of the Wetland Unit
- 1 point: forested or shrub wetlands cover at least 10% of the Wetland Unit
- 0 point: shrub/forest < 1/10

Rationale for VegWoodyFor (habitat and ecological integrity): Forested wetlands include many of the highest-quality wetlands in the state, such as conifer peatlands, pin oak swamps, and blackgum swamps. Forested wetlands have many layers of habitat to support a large diversity of organisms. Forested wetlands take decades or centuries to develop and are not easily replaced. Woody vegetation in forested wetlands provides long-term carbon storage in roots, branches, and trunks. Large intact patches of forested wetland have greater habitat value than smaller or fragmented patches.

Strategy for VegWoodyFor: Assign points based on the ratio of forest cover to total wetland area, and size of forest patch.

- 3 points: forested wetlands cover more than 2/3 of the Wetland Unit AND forested wetlands total > 0.5 ha; OR forested wetlands comprise > 5 ha within the Wetland Unit
- 2 points: forested wetlands cover 1/3 to 2/3 of the Wetland Unit AND forested wetlands total > 0.2 ha; OR forested wetlands comprise 2-5 ha
- 1 point: forested wetlands cover 1/10 to 1/3 of the Wetland Unit OR forested wetlands comprise > 1 ha

Definitions:

Cowardin Classification:

PFO: Palustrine Forested

PSS: Palustrine Shrubland

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb (WU\_20150514)
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\EnhancedNWI\_20150511.gdb (EnhWVWetland)

Method:

**## Select all the woody vegetation, both forest and shrubland**

Clear all selections.

```
SELECT * FROM ENHWetland WHERE: "ATTRIBUTE" LIKE 'PFO%' OR  
"ATTRIBUTE" LIKE 'PSS%
```

### **## Create layer of woody vegetation from selection**

R-click EnhWetland / Data / Export Data

Export: Selected features

Output feature class: “VegPFOPSS”

### **## Add field to store woody area**

Open attribute table of VegPFOPSS

Add field PFOPSSarea (float)

R-click PFOPSSarea and Field Calculator: PFOPSSarea = [SHAPE\_Area]

### **## Select just the forest vegetation, not including the shrubs**

Clear Selection

```
SELECT * FROM ENHWetland WHERE: "ATTRIBUTE" LIKE 'PFO%
```

### **## Create layer of forest vegetation from selection.**

R-click EnhWetland / Data / Export Data

Export: Selected features

Output feature class: “VegPFO”

Clear Selection

### **## Add field to store forest area**

Open attribute table of VegPFO

Add field PFOarea (float)

R-click PFOarea and Field Calculator: PFOarea = [SHAPE\_Area]

### **## Join forests to wetland units and sum the forest area**

Analysis Tools / Overlay / Spatial Join

Target Features: WU\_20150514

Join Features: VegPFO

Output Feature Class: WUPFOjoin

Join Operation: JOIN\_ONE\_TO\_ONE

Check box “Keep all target features”

Field Map of Join Features

R-click PFOarea and select “Merge Rule”, “Sum”

Match Option: INTERSECT

### **## Join woody vegetation and sum area**

Analysis Tools / Overlay / Spatial Join  
Target Features: WUPFOjoin  
Join Features: VegPFOPSS  
Output Feature Class: WU\_VegWoody  
Join Operation: JOIN\_ONE\_TO\_ONE  
Check box "Keep all target features"  
Field Map of Join Features  
R-click PFOPSSarea and select "Merge Rule", "Sum"  
Match Option: INTERSECT

### **## Add fields to store ratios of forest or woody area to total area**

In WU\_VegWoody, add two fields: PFOratio (float) and PFOPSSratio (float)

### **## Calculate ratio of woody vegetation to Wetland Unit area.**

In WU\_VegWoody, R-click attribute PFOPSSratio  
Field Calculate PFOPSSratio = [PFOPSSarea] / [Shape\_Area]

### **## Calculate ratio of forest vegetation to Wetland Unit area.**

In WU\_VegWoody, R-click attribute PFOratio  
Field Calculate PFOratio = [PFOarea] / [Shape\_Area]

### **## Add new attribute field to store points for VegWoody and set initial value to zero.**

In WU\_VegWoody, add field: VegWoody (short integer)  
Field calculate VegWoody = 0

### **## Assign points to Wetland Units for VegWoody**

SELECT \* FROM WU\_VegWoody WHERE: "PFOPSSratio" > 0.1  
R-click VegWoody, Field Calculate VegWoody = 1

SELECT \* FROM WU\_VegWoody WHERE: "PFOPSSratio" > 0.333  
R-click VegWoody, Field Calculate VegWoody = 2

SELECT \* FROM WU\_VegWoody WHERE: "PFOPSSratio" > 0.667  
R-click VegWoody, Field Calculate VegWoody = 3

SELECT \* FROM WU\_VegWoody WHERE: "PFOPSSratio" > 0.667 AND "PFOratio" > 0.333  
R-click VegWoody, Field Calculate VegWoody = 4

SELECT \* FROM WU\_VegWoody WHERE: "PFOratio" > 0.667  
R-click VegWoody, Field Calculate VegWoody = 5

**## Add new attribute fields to store points for VegWoody4, VegWoody2, and VegWoodyFor and set initial values to zero.**

In WU\_VegWoody, add field: VegWoody4, VegWoody2, and VegWoodyFor (short integer)  
Field calculate VegWoody4 = 0  
Field calculate VegWoody2 = 0  
Field calculate VegWoodyFor = 0

**## Assign points to Wetland Units for VegWoody4, VegWoody2, and VegWoodyFor**

SELECT \* FROM WU\_VegWoody WHERE: "PFOPSSratio" > 0.1  
R-click VegWoody4, Field Calculate VegWoody4 = 1  
R-click VegWoody2, Field Calculate VegWoody2 = 1

SELECT \* FROM WU\_VegWoody WHERE: "PFOPSSratio" > 0.5  
R-click VegWoody4, Field Calculate VegWoody4 = 2

SELECT \* FROM WU\_VegWoody WHERE: "PFOPSSratio" > 0.667 AND "PFOratio" > 0.333  
R-click VegWoody4, Field Calculate VegWoody4 = 3

SELECT \* FROM WU\_VegWoody WHERE: "PFOratio" > 0.667  
R-click VegWoody4, Field Calculate VegWoody4 = 4  
R-click VegWoody2, Field Calculate VegWoody2 = 2

SELECT \* FROM WU\_VegWoody WHERE: "PFOratio" > 0.1 OR "PFOarea" > 10000  
R-click VegWoodyFor, Field Calculate VegWoodyFor = 1

SELECT \* FROM WU\_VegWoody WHERE: ("PFOratio" > 0.33 AND "PFOarea" > 2000) OR "PFOarea" > 20000  
R-click VegWoodyFor, Field Calculate VegWoodyFor = 2

SELECT \* FROM WU\_VegWoody WHERE: ("PFOratio" > 0.667 AND "PFOarea" > 5000) OR "PFOarea" > 50000  
R-click VegWoodyFor, Field Calculate VegWoodyFor = 3

## 5.6.82 VegWQ: Vegetation

Version date: 14 March 2016

Strategy: Completed 2/27/2016 EAB

GIS method: completed 2/27/2016 EAB, verified 3/14/2016

Python coding: Started 3/23/2016 MCA & completed 3/24/2016 MCA

Final review by EAB:

Purpose:

Input to Water Quality

Max 10 points for floodplain Wetland Units; 5 points for groundwater Wetland Units.

Rationale: Plants enhance sedimentation by acting as a filter, and cause sediment particles to drop to the wetland surface (review in Adamus and others 1991). Plants in wetlands can take on different forms and structures. The intent of this question is to characterize how much of the wetland is covered with plants that persist throughout the year and provide a vertical structure to trap or filter out pollutants (live or dead trees, shrubs, and persistent herbs). It is assumed, however, that the effectiveness at trapping sediments and pollutants is severely reduced if the plants are grazed. Aquatic bed plants are not considered important in sequestering toxic compounds because the toxics will be released in the fall when the plants decompose. NOTE: this question applies only to persistent plants that are not grazed or mowed (or if grazed or mowed, the plants are taller than 6 inches). NOTE for Level 1: To meet the "class" requirement for Cowardin, a polygon of plants within the wetland unit needs at least 30% cover of the specified plants type (forest, shrub, etc.). However, to count the Cowardin polygon as a "plants structure" in the rating system the Cowardin polygon itself has to represent at least 10% of the wetland unit in units that are smaller than 2.5 acres, or at least 1/4 acre in units that are larger. Summary of strategy: Sum the points for VegPerUng, VegWoody, VegByLP for each Wetland Unit. If the total is greater than the maximum allowed points, reduce to the allowed amount.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb (WU\_20150514)

Input Variables:

- VegPerUng (Persistent Ungrazed Vegetation)
- VegWoody (Woody Vegetation)
- VegByLP (Vegetation fronting Lakes and Ponds)
- Floodplain

Method:

**## Create feature class to store VegWQ factor**

R-click WU\_20150514 and select Data/Export Data

Output feature class: WU\_VegWQ

**## Add VegWQ field to Wetland Units and set initial point value to zero.**



Open attribute table of WU\_VegWQ  
Add field "VegWQ" (short integer)  
R-click VegWQ and Field Calculate VegWQ = 0

**## Spatial join to add input variables to attribute table**

Spatial join (contains) to add the following to the WU\_VegWQ: VegPerUng, VegWoody, VegByLP, Floodplain

**## Sum the points for VegPerUng, VegWoody, and VegByLP.**

R-click VegWQ and Field Calculate "VegWQ" = VegPerUng + VegWoody + VegByLP

**## Reduce any excess point scores to the maximum allowed.**

Clear all selections.  
SELECT \* FROM WU\_VegWQ WHERE: "VegWQ" > 10  
Field Calculate (selection only) "VegWQ" = 10

Clear all selections.  
SELECT \* FROM WU\_VegWQ WHERE: "VegWQ" > 5 AND "Floodplain" = 'N'  
Field Calculate (selection only) "VegWQ" = 5

### 5.6.83 WaterSupply: Wetland discharges to water supply intake area

Version date: 3 October 2016

Strategy: 2/14/2016 EAB

GIS method: completed and verified 3/17/2016 EAB, MCA, and Nate Gunn

Python coding: Nate Gunn 5/24/2016

Final review by EAB: 10/3/2016

Purpose:

Water Quality Function, WaterUse factor

Max 2 points

Description:

Wetland Unit is in the contributing watershed of known water supply, including either a surface water intake or groundwater intake under direct influence of surface water.

Summary of strategy:

- Assign 1 point if the Wetland Unit intersects a polygon in a Zone of Peripheral Concern or a Secondary Protection Area with surface water connections OR if the Wetland Unit makes up 0.1-1% of a Surface Intake Drainage Area.
- Assign 2 points if the Wetland Unit intersects a polygon in a Zone of Critical Concern, Protection Area, or Wellhead Protection Areas where the source is surface water or ground water under the influence of surface water OR if the Wetland Unit makes up more than 1% of a Surface Intake Drainage Area.

Definitions:

FAC\_SRC: Type of water source for facility.

SW surface water

GW ground water

GU ground water under the influence of surface water

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb (WU\_20150514)
- M:\environmental\CONFIDENTIAL-public surface water intakes\CONFIDENTIAL-source water assessment and protection.gdb
  - Feature Class: ZPC statewide 5hrabove (ZPC 5 hr travel)
  - Feature Class: ZCC statewide (Zone of Critical Concern)
  - Feature Class: Source Water Protection Areas (Conjunctive Delineation, Wellhead Protection Areas)
- M:\environmental\CONFIDENTIAL-public surface water intakes\pswi distance analysis 9m.gdb
  - Feature Class: pswi watersheds with out of state drainage (Surface Intake Drainage Area)
- Note that *data is also served publicly at <http://taqis.dep.wv.gov/WVWaterPlan/>*

Input Variables:

None

Method:

(Python method below documented by Nathan Gunn)

**## Create Original Area Field to the Surface Intake Drainage Area**

Add Field

Input Table: Surface Intake Drainage Area

Field Name: "OrigArea"

Type: "DOUBLE"

**## Store the Shape Area to the Original Area Field**

Input Table: Surface Intake Drainage Area

FieldName: "OrigArea"

Expression: "!SHAPE\_Area!"

Expression Type: "PYTHON\_9.3"

**## Intersect the Supplied Wetland Layer and the Surface Intake Drainage Area**

R-click WU\_20150514 and select Data/Export Data

Output feature class: WU\_WaterSupply1

**## Remove the OrigArea Field**

Input Table: Surface Intake Drainage Area

Delete Field: "OrigArea"

**## Calculate Intersection Ratios and Scores for Wetlands and Surface Intake Drainage Areas**

Pseudo Code:

Let  $W$  be all wetlands in the supplied wetland feature class

let  $A_w$  be wetland's area

let  $A_{wp}$  be an specific intersection between  $A_w$  and a particular public intake drainage area  $p$

let  $I$  be the set of intersections of wetlands and public intake drainage areas. For a wetland  $w$ ,  $w \in I$  if  $w$  intersects with a drainage area.

wetland list = { wetland  $\in W$  }

for each wetland in  $W$ :

    if wetland  $\in I$ :

        wetland.ratio = maximum( {  $A_{wp} / A_w$  } )

    else:

        wetland.ratio = 0

$$wetland.score(wetland.ratio) = \begin{cases} 0, & wetland.ratio \leq 0.001 \\ 1, & 0.001 < wetland.ratio \leq 0.01 \\ 2, & wetland.ratio > 0.01 \end{cases}$$

**Selection Subroutine: “score two by selection“**

(method continues with GIS instructions from Elizabeth Byers)

**## Select Secondary Protection Areas with surface water connections.**

Select by Attributes

Layer: Source\_Water\_Protection\_Areas (=Conjunctive Delineation)

Method: Create a new selection

SELECT \* FROM Source\_Water\_Protection\_Areas WHERE: "P\_TYPE" IN (NULL, 'Secondary Protection Area') AND "FAC\_SRC" IN ('GU', 'SW')

**## Select Wetland Units within a Secondary Protection Area.**

Select by location

Selection method: select features from

Target layer: WU\_WaterSupply1

Source layer: Source\_Water\_Protection\_Areas (=Conjunctive Delineation)

Check box “Use selected features”

Spatial selection method: intersect the source layer feature

**## Select Wetland Units within the 5-hour travel distance in a Zone of Peripheral Concern.**

Select by location

Selection method: add to the currently selected features in

Target layer: WU\_WaterSupply1

Source layer: ZPC\_statewide\_5hrabove

Spatial selection method: intersect the source layer feature

**(method continues with Python documentation by Nate Gunn)**

**## Assign 1 point to Wetland Units.**

This loop is done in memory to save time and steps.

Pseudo Code:

For each wetland\_unit in selection:

wetland\_list[ wetland\_unit ].score = max(wetland\_unit.score, 1)

This assigns 1 to each selected item, but does not overwrite scores of 2, if encountered in the previous step.

### **Selection Subroutine: “score one by selection”**

(method continues with GIS documentation by Elizabeth Byers)

#### **## Select Protection Areas and Wellhead Critical Areas with surface water connections**

Select by Attributes

Layer: Source\_Water\_Protection\_Areas (=Conjunctive Delineation)

Method: Create a new selection

```
SELECT * FROM Source_Water_Protection_Areas WHERE: "P_TYPE" IN ('Protection Area', 'rotection Area', 'Wellhead Critical Area') AND "FAC_SRC" IN ('GU', 'SW')
```

#### **## Select Wetland Units within Protection Areas or Wellhead Critical Areas with surface connections.**

Select by location

Selection method: select features from

Target layer: WU\_WaterSupply

Source layer: Source\_Water\_Protection\_Areas (=Conjunctive Delineation)

Check box “Use selected features” (38 features selected)

Spatial selection method: intersect the source layer feature

#### **## Select Wetland Units within Zone of Critical Concern.**

Select by location

Selection method: add to the currently selected features in

Target layer: WU\_WaterSupply

Source layer: ZCC\_statewide

Spatial selection method: intersect the source layer feature

**(method continues with Python method by Nate Gunn)**

#### **## Assign 2 points to Wetland Units within 1 km of special WaterSupply.**

This loop is done in memory to save time and steps.

Pseudo Code:

For each wetland\_unit in selection:

```
wetland_list[ wetland_unit .score = max(wetland_unit.score, 2)
```

Output Subroutine:

#### **##Create WU\_WATERSUPPLY Feature Class**

Create Feature Class

Feature Class Name: WU\_WATERSUPPLY

Template Feature Class: pws\_i\_scoring\_output\_template

Type: Polygon

SpatialReference: NAD\_1983\_UTM\_Zone\_17N ( 26917)

### **##Write Output to Feature Class**

Pseudocode:

For each supplied\_wetland in supplied\_wetland\_feature\_class:

    geometry = supplied\_wetland.geometry

    id = supplied\_wetland.object\_id

    new\_record = [id, geometry, wetland\_units[ id ][ratio], wetland\_units[id][score] ]

    WU\_WATERSUPPLY.insert(new\_record)

## 5.6.84 Wetland Units: Assigning Site Codes to updated statewide Wetland Units

Version date: 8 March 2019

Purpose:

Note that there is no national system for coding wetlands yet, probably because wetland mapping still in a state of flux nationwide. This is a WVDEP protocol based on the nearest stream code.

SiteCode =

1. Nearest stream FINALCODE (to assist with WAB visualization of location) +
2. “\_W” (for wetland) +
3. Sequential number based on size of wetland for initial statewide batch, then subsequently based on assessment order. Check existing Wetland Codes and codes assigned in the WVWRAM MS-Access database to ensure that the first available (unused) sequential number is assigned.
4. For replicates, add “\_R1” or “\_R2” (sequential number as needed)

Here are a few examples:

- PL-63\_W14 (unnamed wetland)
- BS-16-A\_W1 (unnamed wetland)
- MC-123-DI\_W1\_R1 (Whitmeadow Run Peatland, first replicate assessment)
- KG-103-BN\_W1 (Cranberry Glades on the South Fork Cranberry River)
- KG-103-BN\_W4 (unnamed wetland)

### Procedure for updating Site Codes for statewide Wetland Units

Create Wetland Units from the updated NWI\_WV polygons (see instructions to Create Wetland Units).

Spatial join with existing Wetland Unit Site Codes from

M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb\WU\_WetlCode

Update Site Codes from wetlands in the WVWRAM MS-Access database

For the remaining Wetland Units that do not have a Site Code, follow (or modify as necessary) the Feb 2018 instructions beginning at “Iterate”.

### Procedure for statewide dataset as done in Feb 2018:

#### Find nearest stream

ArcToolbox / Proximity / Near

Input: WU\_20150514

Proximity to:

M:\wr\WTRSHD\_BRANCH\NHD\_24K\_STREAM\_LINES\NHD\_StreamMerge\_20180202\_in WV.shp

Update to: **NHD\_WVStreams\_20210608**

(M:\wr\WTRSHD\_BRANCH\_INTERNAL\NHD\_AUID\_2021\NHD\_WVStreams\_20210608.shp)

*Note that this takes a long time to run on the statewide dataset – 4.5 hours*

Export Near to WUstream

Add field WetlandCode (text)

Link WUstream to stream FINALCODE and FINALNAME2 fields (NearFID linked to FID)

### **Iterate:**

In WUstream, summarize FINALCODE by Shape\_Area (Maximum)

Join Sum\_Output table back to WUstream via FINALCODE

Select by Attributes where Shape\_Area = Max\_Shape\_Area

Field Calculate WetlandCode = [FINALCODE]&"\_W1"

Select by Attributes where [WetlandCode] IS NULL

Remove all joins

**Return to “Iterate” until all wetlands are coded.**

### **Additional notes:**

From Chris Daugherty: the most recent updated, as correct as possible for now stream code/name file as of 2/7/2018.

- Most known issues are in Greenbrier and some Upper New areas where there is KARST. If you are working in these areas, we may need to take a look at what is going on there. Steve Stutler knows a little more about the issues there.
- ~~M:\wr\WTRSHD\_BRANCH\NHD\_24K\_STREAM\_LINES\NHD\_StreamMerge\_20180202\_inWV.shp~~
- **NHD\_WVStreams\_20210608**  
(M:\wr\WTRSHD\_BRANCH\_INTERNAL\NHD\_AUID\_2021\NHD\_WVStreams\_20210608.shp)
- FINALCODE field for the stream code, to use in building the Wetland Code, and
- include as additional descriptive fields in the attribute table:
  - FINALNAME2 field, and
  - WetlandName assigned by the field surveyor.



## 5.6.85 WetldBird: Wetland Breeding Bird Areas

Version date: 11 October 2017

Strategy: 3/16/2017 EAB

GIS method: 10/4/2017 EAB; results verified 10/4/2017 EAB; changed path to source data 10/11/2017

Python code: 10/9/2017 YH

Final review by EAB: 10/9/2017

Purpose:

Input to Habitat / Landscape Opportunity (LandEco: Landscape Ecological Connectivity)

Description:

*Maximum 3 points*

Rationale: Breeding Bird Atlas blocks with high occupancy by wetland-dependent birds provide a strong indicator of extant biodiversity and the presence of high quality wetland habitat.

Breeding Bird Atlas blocks comprise approximately 10 square miles, or one-sixth of a USGS topographic quadrangle.

GIS Method (no field method):

This metric is based on occupancy maps for wetland breeding birds from the WV Breeding Bird Atlas project 2017 (Rich Bailey, WVDNR Coordinator).

3 points: wetland intersects atlas block with upper 10% of values (WetBird > 0.493)

2 points: wetland intersects in atlas block with upper 10-50% of values (WetBird > 0.408)

1 point: wetland intersects atlas block in the upper 50-75% of values (WetBird > 0.354)

(Values of “WetBird” from table: upper 5% > 0.525, 20% > 0.466, 50% > 0.408)

Note that Breeding Bird Atlas blocks do not cover the entire state; slivers of the state are missing along the Maryland border.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb
  - Feature Class: WU\_20150514
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceFunctionalAssessment\HabitatData.gdb
  - Feature Class: WetlandBirds\_WetBirdColumnOnly

Method:

**## Create feature class to store results for WetldBird and set initial value to zero**

R-click WU\_20150514 and select Data / Export Data / All Features

Output feature class: WetlandFunction.gdb / WU\_WetlandBird1

Open attribute table of WU\_WetlandBird1

Add field “WetldBird” (short integer)

Field calculate WetldBird = 0

**## Select atlas blocks in the upper 75% of wetland bird occupancy values**

SELECT \* FROM WetlandBirds\_WetBirdColumnOnly WHERE: "WetBird" > 0.354

**## Select Wetland Units that intersect the selected atlas blocks**

Select by Location

Selection method: select features from

Target layer(s): WU\_WetlandBird1

Source layer: WetlandBirds\_WetBirdColumnOnly

Check "Use selected features"

Spatial selection method for target layer feature(s): intersect the source layer feature

**## Assign 1 point**

Open attribute table of WU\_WetlandBird1

Field Calculate WetldBird = 1

**## Select atlas blocks in the upper 50% of wetland bird occupancy values**

SELECT \* FROM WetlandBirds\_WetBirdColumnOnly WHERE: "WetBird" > 0.408

**## Select Wetland Units that intersect the selected atlas blocks**

Select by Location

Selection method: select features from

Target layer(s): WU\_WetlandBird1

Source layer: WetlandBirds\_WetBirdColumnOnly

Check "Use selected features"

Spatial selection method for target layer feature(s): intersect the source layer feature

**## Assign 2 points**

Open attribute table of WU\_WetlandBird1

Field Calculate WetldBird = 2

**## Select atlas blocks in the upper 10% of wetland bird occupancy values**

SELECT \* FROM WetlandBirds\_WetBirdColumnOnly WHERE: "WetBird" > 0.493

**## Select Wetland Units that intersect the selected atlas blocks**

Select by Location

Selection method: select features from

Target layer(s): WU\_WetlandBird1  
Source layer: WetlandBirds\_WetBirdColumnOnly  
Check “Use selected features”  
Spatial selection method for target layer feature(s): intersect the source layer feature

**## Assign 3 points and clear selections**

Open attribute table of WU\_WetlandBird1  
Field Calculate WetldBird = 3

Clear all selections

**## Select wetlands that fall outside the atlas block coverage**

Select by Location  
Selection method: select features from  
Target layer(s): WU\_WetlandBird1  
Source layer: WetlandBirds\_WetBirdColumnOnly (no features selected)  
Spatial selection method for target layer feature(s): intersect the source layer feature

Switch selection

**## Set temporary value of WetldBird for wetlands outside the atlas block coverage**

Open attribute table of WU\_WetlandBird1  
Field Calculate WetldBird = 99

**## Spatial Join to find the closest atlas block to each wetland**

Spatial Join  
Target Features: WU\_WetlandBird1  
Join Features: WetlandBirds\_WetBirdColumnOnly  
Output Feature Class: WU\_WetlandBird  
Join Operation: JOIN\_ONE\_TO\_ONE  
Check “Keep all target features”  
Field map of join features (retain the fields below):  
WUKey  
Shape\_Length  
Shape\_Area  
WetldBird  
WetBird  
Match Option: CLOSEST

**## Assign points based on WetBird value to wetlands outside the atlas blocks**

Open attribute table of WU\_WetlandBird

SELECT \* FROM WU\_WetlandBird WHERE: "WetlBird" = 99 AND "WetBird" <= 0.354  
Field Calculate WetldBird = 0

SELECT \* FROM WU\_WetlandBird WHERE: "WetlBird" = 99 AND "WetBird" > 0.354  
AND "WetBird" <= 0.408  
Field Calculate WetldBird = 1

SELECT \* FROM WU\_WetlandBird WHERE: "WetldBird" = 99 AND "WetBird" > 0.408  
AND "WetBird" <= 0.493  
Field Calculate WetldBird = 2

SELECT \* FROM WU\_WetlandBird WHERE: "WetldBird" = 99 AND "WetBird" > 0.493  
Field Calculate WetldBird = 3

## 5.6.86 WFlowPath: Water Flow Path

Version date: 20 April 2016

Strategy: completed 15 Feb 2016 EAB

GIS detailed method: completed, 3/10/2016 EAB & JCC; Verified 3/10/2016; Revised 4/20/2016 EAB

Python coding: completed for first iteration (MCA); unfortunately this must be re-coded for this version. There was almost no overlap in the procedure - EAB

April 11: Apologies, there has been yet another update, highlighted in yellow below, to this procedure. I also changed the interim file naming slightly to accommodate this change (files generated include interim files whose names are not important: WU\_WFlowPath1, WU\_WFlowPath2; and the final product whose name I did not change: WU\_WFlowPath). – EAB

This was completed on 6/14/2016 MCA. Part 1 takes around 2 hours to run and might need to be revisited.

EAB 10/3/16: The steps in part 2 below don't appear to have been added to the code yet:

```
## Join to add area of contributing watershed (CntrWshd)
```

```
## Export join to feature class
```

```
## Update isolated wetlands to outflow intermittent if contributing wshed > 40 acres
```

I missed adding this by using an older version of this document. The changes have been added and I was able to fix some other problems that were occurring. The total runtime with the Wetland Units and the input is now 22 minutes and 27 seconds. With 25 wetland units, the execute time is 2 minutes and 14 seconds.

Final review by EAB: 10/7/2016

Purpose:

Water Quality Function

Background:

Water Flow Path is part of the Tiner wetland functional classification is based on Tiner (2011) which describes and classifies wetlands by landscape position, landform, water flow path, and waterbody type (LLWW).

NHD Fcodes listed at:

[http://nhd.usgs.gov/userGuide/Robohelpfiles/NHD\\_User\\_Guide/Feature\\_Catalog/Hydrography\\_Dataset/Complete\\_FCode\\_List.htm](http://nhd.usgs.gov/userGuide/Robohelpfiles/NHD_User_Guide/Feature_Catalog/Hydrography_Dataset/Complete_FCode_List.htm)

Note on stream intersections:

In the method below, if a WU boundary intersects more than 1 perennial stream, then it is called throughflow perennial. Presumably one of the intersections will be an outflow, and the other(s) will be inflow. This assumption does not work for a small number of headwater wetlands on drainage divides with no inflows but two outflows. Future work might include adding the direction of flow to identify these wetlands.

Note on flow accumulation:

Paybins (2003) in southern WV noted that median watershed size to initiate intermittent flow is 14.5 +-3.4 acres, and for perennial flow is 40.8 +-18.0 acres. In the method below, wetlands that are tagged as “isolated” but have maximum flow accumulation values > 2000, which corresponds to a drainage area > 0.0625 mi or 40 acres), are updated from “isolated” to “outflow”. This threshold corresponds roughly to known outflow wetlands according to Elizabeth’s field knowledge. Note that the flow accumulation values are not very accurate. If Mike Shank is able to better calculate the contributing watershed, we should replace the flow accumulation below with the contributing watershed value.

Note for future work (karst):

In the future we may be able to identify Inflow Wetland Units (NHD “dangles”). There will be very few, mostly in karst areas.

Definitions:

Options for water flow path are: Paludified, Isolated, Throughflow, Inflow, Outflow, Bi-directional non-tidal. Modifiers are perennial, intermittent, and artificial. Not all of these can be accurately assigned via GIS, but the main codes (IS, OU, OP, OI, TH, TI, and BI) can be approximately assigned. Here is the full list of Tiner (2011) Water Flow Path codes potentially found in WV:

<b>Water Flow Path</b>
<b>PA Paludified</b>
<b>IS Isolated</b>
IT Isolated-throughflow (connected to other wetlands in an isolated complex)
IO Isolated-outflow (connected to other wetlands in an isolated complex)
II Isolated-inflow (connected to other wetlands in an isolated complex)
ITA Isolated-artificial throughflow (connected by ditches to other artificially isolated wetlands)
IOA Isolated-artificial outflow (connected by ditches to other artificially isolated wetlands)
IIA Isolated-artificial inflow (connected by ditches to other artificially isolated wetlands)
<b>IN Inflow</b>
<b>OU Outflow</b>
OA Outflow-artificial (wetland connected to stream by ditches)
OP Outflow-perennial
OI Outflow-intermittent
<b>TH Throughflow (=Throughflow-perennial)</b>
TA Throughflow-artificial (wetland connected to stream by ditches)
TN Throughflow-entrenched
TI Throughflow-intermittent
<b>BI Bidirectional-nontidal</b>
BIA Bidirectional-nontidal Artificial (e.g., diked wetland)
BO Bidirectional-nontidal/outflow (lake)
TB Bidirectional-nontidal/throughflow (lake)
IB Bidirectional-nontidal/isolated (lake)
NB Bidirectional-nontidal/inflow (lake)

#### Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb
  - Feature Class: WU\_20150514
  - Feature Class: DrainageArea27m
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\EnhancedNWI\_20150511.gdb (EnhWVWetland)
- M:\basemap\NHDH\_WV.gdb, Feature Dataset: Hydrography, Feature Class: NHDFlowline
  - Note that NHD data is incorrectly attributed (no ephemeral or intermittent streams) in Preston County and parts of Monongalia, Barbour, Morgan, Kanawha, Putnam, Wirt, Marshall, Tucker, and small parts of about 10 additional counties. Not much we can do about this for now.
- M:\LayerFiles\arcsde\_backup.gdb, Feature Dataset: basemap\_physical\_non\_replica, Feature Class: SDE\_NHD\_waterbodies\_24k\_rivers

#### Method:

##### # Create feature class to store Water Flow Path

R-click WU\_20150514 and select Data / Export Data.

Output feature class: WU\_WflowPath1

##### # Add text fields to the Wetland Units feature class, to allow computation of Water Flow Path (WFlowPath).

Add 3 text fields (4 characters wide) to WU\_WFlowPath1 attribute table: FlowPath, PerInt, WFlowPath.

##### ## PART 1: Intersect NHDflowlines and wetlands.

ArcToolbox/Analysis/Overlay/Intersect

Input features: NHDflowline, WU\_WflowPath1

Output Feature Class: NHDflowline\_Intersect

Join Attributes: ONLY\_FID

Output Type: POINT

##### ## Create multiple points for single line segments

ArcToolbox/Data Management Tools/Features/Multipart to Singlepart

Input Features: NHDflowline\_Intersect

Output Features: NHDFlowline\_IntMult

##### ## Remove doubles

ArcToolbox/Data Management Tools/Generalization/Dissolve

Input Features: NHDFlowline\_IntMult

Output Feature Class: NHDFlowline\_IntMultDiss

Uncheck Create Multipart Features box

**## Select the intermittent or ephemeral streams**

## FCode definitions: 46003 Stream/river/intermittent, 46007 Stream/river/ephemeral,  
## 33600 Canal/ditch/unattributed, 33601 Canal/ditch/aqueduct (the latter two are the C&O canal

## along the Potomac: artificial intermittent)

**## Select by Attribute, within attribute table of NHDFlowline**

Clear all selections.

SELECT \* FROM NHDFlowline WHERE: "FCODE" IN (46003, 46007, 33600, 33601, 33603)

**## Select the Wetland Units that intersect intermittent or ephemeral stream(s)**

Select by Location

Selection method: select features from

Target layer: WU\_WFlowPath1

Source layer: NHDFlowline

Check "Use selected features"

Spatial selection: intersect the source layer feature

**## Attribute the Wetland Units that intersect intermittent or ephemeral stream(s)**

Open Attribute table of WU\_WFlowPath1

R-click "PerInt" and Field Calculator PerInt = "I"

**## Select the perennial streams**

## FCode definitions: 33400 Connector, 46000 Stream/river/unattributed,

## 46006 Stream/river/perennial , 55800 Artificial path (most of these are incorrectly

## attributed perennial streams)

**## Select by Attribute, within attribute table of NHDFlowline**

Clear all selections.

SELECT \* FROM NHDFlowline WHERE: "FCODE" IN (33400, 46000, 46006, 55800)

**## Select the Wetland Units that intersect perennial stream(s)**

Select by Location

Selection method: select features from

Target layer: WU\_WFlowPath1

Source layer: NHDFlowline

Check "Use selected features"

Spatial selection: intersect the source layer feature

**## Attribute the Wetland Units that intersect perennial stream(s)**



Open Attribute table of WU\_WFlowPath1  
R-click "PerInt" and Field Calculate PerInt = "P"  
Clear all selections.

### **## Join Wetland Units to stream intersection points.**

Analysis Tools / Overlay / Spatial Join  
Target Features: WU\_WFlowPath1  
Join Features: NHDFlowline\_IntMultDiss  
Output Feature Class: WU\_WFlowPath2  
Join Operation: JOIN\_ONE\_TO\_ONE  
Check "Keep all target features"  
Match Option: INTERSECT

### **## Attribute FlowPath (Throughflow, Outflow, Isolated)**

Select by Attributes  
Select \* FROM WU\_WFlowPath2 WHERE: "Join\_Count" > 1  
R-click "FlowPath", Field Calculator = "TH"  
Select \* FROM WU\_WFlowPath2 WHERE: "Join\_Count" = 1  
R-click "FlowPath", Field Calculator = "OU"  
Select \* FROM WU\_WFlowPath2 WHERE: "Join\_Count" = 0  
R-click "FlowPath", Field Calculator = "IS"  
Clear Selections

### **## PART 2: Update FlowPath based on adjacent streams, rivers, and impoundments** **## Update FlowPath from isolated to outflow for wetlands within 30 m of a mapped stream**

Select by Location  
Selection method: select features from  
Target layers: WU\_WFlowPath2  
Source layer: NHDFlowline  
Spatial selection method: are within a distance of the source layer feature  
Apply a search distance: 30 meters

Select by attributes  
Method: select from current selection  
SELECT \* FROM WU\_WFlowPath2 WHERE: "FlowPath" = 'IS'

R-click "FlowPath", Field Calculator = "OU"  
R-click "PerInt", Field Calculator = "I"

### **## Update FlowPath from isolated to outflow for wetlands that contain an impoundment (NWI).**

Select by Attributes

Method: create a new selection

```
SELECT * FROM EnhWVWetland WHERE: "ATTRIBUTE" LIKE 'P%h%'
```

Select by Location

Selection method: select features from

Target layers: WU\_WFlowPath2

Source layer: EnhWVWetland

Check box "Use selected features"

Spatial selection method: contain the source layer feature

Select by attributes

Method: select from current selection

```
SELECT * FROM WU_WFlowPath2 WHERE: "FlowPath" = 'IS'
```

R-click "FlowPath", Field Calculator = "OU"

R-click "PerInt", Field Calculator = "I"

### **## Join to add area of contributing watershed (CntrWshd)**

ArcToolbox / Data Management Tools / Joins / Join Field

Input table: WU\_WFlowPath2

Input join field: OBJECTID

Join table: DrainageArea27m

Output Join Field: WUKey

Join Fields: WUKey, CntrWshd

### **## Export join to feature class**

R-click WU\_WFlowPath2 and select Data / Export Data

Output feature class: WU\_WFlowPath

### **## Update isolated wetlands to outflow intermittent if contributing watershed > 40 acres**

Select by Attributes from WU\_WFlowPath

```
SELECT * FROM WU_WFlowPath WHERE: "FlowPath" = 'IS' AND "CntrWshd" > 161874
```

R-click "FlowPath" field and select "Field Calculator". Set FlowPath = "OU"

R-click "PerInt" field and select "Field Calculator". Set PerInt = "I"

### **## Set Flow Path to throughflow perennial for wetlands adjacent to NWI rivers**

#### **## Select the NWI rivers.**

Clear selections.

Select by attributes.

```
SELECT * FROM EnhWVWetland WHERE: "WETLAND_TYPE" = 'Riverine'
```

Select by location.

Select method: select features from

Target layer: WU\_WFlowPath

Source layer: EnhWVWetland

Check box "Use selected features (1790 features selected)

Spatial selection method: share a line segment with the source layer feature

### **## Attribute Water Flow Path for Wetland Units adjacent to NWI rivers**

Open attribute table of WU\_WFlowPath. View selected records

R-click "FlowPath" field and select "Field Calculator". Set FlowPath = "TH"

R-click "PerInt" field and select "Field Calculator". Set PerInt = "P"

Clear selections.

### **## Select the NHD 24K Rivers and set intersecting wetlands to throughflow perennial.**

Select by location.

Selection method: select features from

Target layer: WU\_WFlowPath

Source layer: SDE\_NHD\_waterbodies\_24k\_rivers

Spatial selection method: intersect the source layer feature

### **## Attribute Flow Path for Wetland Units intersecting NHD 24K rivers**

Open attribute table of WU\_WFlowPath. View selected records.

R-click "FlowPath" field and select "Field Calculator". Set FlowPath = "TH"

R-click "PerInt" field and select "Field Calculator". Set PerInt = "P"

### **# PART 3: Attribute Water Flow Path for Outflow, Throughflow, and Isolated Wetland Units**

Clear selections. Select by Attributes in WU\_WFlowPath.

SELECT \* FROM WU\_WFlowPath WHERE: "FlowPath" = 'TH' AND "PerInt" = 'I'

R-click "WFlowPath", select Field calculator, and set WFlowPath = "TI"

SELECT \* FROM WU\_WFlowPath WHERE: "FlowPath" = 'TH' AND "PerInt" = 'P'

R-click "WFlowPath", select Field calculator, and set WFlowPath = "TP"

SELECT \* FROM WU\_WFlowPath WHERE: "FlowPath" = 'OU' AND "PerInt" = 'I'

R-click "WFlowPath", select Field calculator, and set WFlowPath = "OI"

SELECT \* FROM WU\_WFlowPath WHERE: "FlowPath" = 'OU' AND "PerInt" = 'P'

R-click "WFlowPath", select Field calculator, and set WFlowPath = "OP"

SELECT \* FROM WU\_WFlowPath WHERE: "FlowPath" = 'IS'  
R-click "WFlowPath", select Field calculator, and set WFlowPath = "IS"

**## PART 4: Update Water Flow Path based on adjacent lakes.  
## Select the lakes.**

Clear selections.

SELECT \* FROM EnhWVWetland WHERE: "WETLAND\_TYPE" = 'Lake'

**## Select wetlands in lake basins with bi-directional flow. This will over-write FlowPath.  
Note**

**## that there are some errors generated by over-writing: some wetlands that border a lake  
but are**

**## primarily stream wetlands are selected. However, the number of errors is smaller than  
if over-**

**## writing is not done. Future refinements could include measuring the perimeter  
bordering the lake,**

**## and if it is a small fraction of the total perimeter, then FlowPath "OU" or "TH" is not  
over-written.**

Select by location.

Selection method: select features from

Target layer: WU\_WFlowPath

Source layer: EnhWVWetland

Check box "Use selected features" (203 features selected)

Spatial selection method: intersect the source layer feature

**## Attribute Flow Path for Wetland Units adjacent to lakes.**

Open attribute table of WU\_WFlowPath. View selected records.

R-click "FlowPath" field and select "Field Calculator". Set FlowPath = "BI"

**## Attribute Water Flow Path for Wetland Units adjacent to lakes.**

Select by Attributes in WU\_WFlowPath.

SELECT \* FROM WU\_WFlowPath WHERE: "FlowPath" = 'BI' AND "WFlowPath" IN ('OP',  
'OI')

R-click "WFlowPath", select Field calculator, and set "WFlowPath" = 'BO'.

Select by Attributes in WU\_WFlowPath.

SELECT \* FROM WU\_WFlowPath WHERE: "FlowPath" = 'BI' AND "WFlowPath" IN ('TP',  
'TI')

R-click "WFlowPath", select Field calculator, and set WFlowPath = "TB".

Select by Attributes in WU\_WFlowPath.

```
SELECT * FROM WU_WFlowPath WHERE: "FlowPath" = 'BI' AND "WFlowPath" = 'IS'
```

R-click "WFlowPath", select Field calculator, and set WFlowPath = "IB".

## 5.6.87 WQFunction: Water Quality

Version date: 26 October 2016

Strategy: completed 3/12/2016 EAB

GIS method: completed 3/12/2016 EAB; needs verification once factors are available

Python code:

Final verification by EAB:

Purpose:

Water Quality Function

Maximum 25 points (floodplain wetlands); 24 points (groundwater wetlands)

Description:

Summary of strategy: For each Wetland Unit, sum the points for the three aspects (wetland potential to provide function, landscape offers opportunity to carry out function, and value to society)

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb (WU\_20150514)

Input Variables:

- WQPotential
- WQOpportun
- WQSociety

Method:

### **## Create feature class to store WQFunction**

R-click WU\_20150514 and select Data/Export Data

Output feature class: WU\_WQFunction

### **## Spatial join to bring in aspect values**

Spatial join (contains) to bring WQPotential, WQOpportun, and WQSociety into the same table

### **## Add WQFunction field to Wetland Units and set initial point value to zero.**

Open attribute table of WU\_WQFunction

Add field "WQFunction" (short integer)

R-click WQFunction and Field Calculate WQFunction = 0

**## Sum the points for each aspect of Water Quality Function for Wetland Units**

R-click WQFunction and Field Calculate  $WQFunction = [WQPotential] + [WQOpportun] + [WQSociety]$

## 5.6.88 WQOpportun: Water Quality Opportunity

Version date: 26 October 2016

Strategy: completed 3/12/2016 EAB

GIS method: completed 3/12/2016 EAB; verified 10/26/2016 EAB

Python code:

Final review by EAB:

Purpose:

Water Quality Function

Maximum 5 points (floodplain wetlands); 4 points (groundwater wetlands)

Description:

Summary of strategy: For each Wetland Unit, sum the points for all factors within the “Opportunity” aspect. Note that different point values for floodplain vs. groundwater wetlands are assigned at the factor level. After points have been summed, reduce any point values that exceed the maximum allowable points for this aspect of water quality function.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb (WU\_20150514)

Input Variables:

- Discharges
- ImpairedIn
- RoadRail
- Disturb50m
- DisturbWshd
- Floodplain

Method:

**## Create feature class to store WQOpportun**

R-click WU\_20150514 and select Data/Export Data

Output feature class: WU\_WQOpportun

**## Spatial join to bring in factor values**

Spatial join (contains) to add the following to the WU\_WQOpportun table: Discharges, ImpairedIn, RoadRail, Disturb50m, DisturbWshd, Floodplain

**## Add WQOpportun field and set initial point value to zero.**

Open attribute table of WU\_WQOpportun



Add field "WQOpportun" (short integer)

R-click WQOpportun and Field Calculate WQOpportun = 0

### **## Sum the factor points**

R-click WQOpportun and Field Calculate WQOpportun = [Discharges] + [ImpairedIn] + [RoadRail] + [Disturb50m] + [DisturbWshd]

### **## Reduce values that exceed the maximum allowable points**

Select by attributes

Layer: WU\_Opportun

Method: Create a new selection

SELECT \* FROM WU\_Opportun WHERE: "Floodplain" = 'Y' AND "WQOpportun" > 5

R-click WQOpportun and Field Calculate WQOpportun = 5

Select by attributes

Layer: WU\_Opportun

Method: Create a new selection

SELECT \* FROM WU\_Opportun WHERE: "Floodplain" = 'N' AND "WQOpportun" > 4

R-click WQOpportun and Field Calculate WQOpportun = 4

## 5.6.89 WQPlan : Watershed or Water Quality Plan Exists

Version date: 16 March 2016

Strategy: completed 3/12/2016 EAB

GIS method: completed and verified 3/16/2016 EAB

Python coding: started & complete 3/18/2016 MCA

Final review by EAB: 3/18/2016

Purpose:

Water Quality Function

Max 2 point

Description:

Rationale: Inclusion in a watershed plan, water quality plan, or having legal protected status are all indicators that society values the water quality function of a wetland highly.

Sum the points below, for a maximum of 2 points.

- Watershed Plan. Wetland has been identified in a watershed or local plan as important for maintaining water quality (2 points). Not all pollution and water quality problems are identified by state water quality monitoring program. Local and watershed planning efforts sometimes identify wetlands that are important in maintaining existing water quality. These wetlands provide a value to society at the local level.
- *TMDL. No longer used after 2022. A TMDL exists for the drainage in which the wetland is found (2 points). A Total Maximum Daily Load (TMDL) plan is a plan of action used to clean up streams that are not meeting water quality standards. The TMDL program is part of the Watershed Branch of the WVDEP.*
- NSPA. Wetland is in the contributing watershed of a stream reach protected by the Natural Streams Preservation Act (2 points). These include (a) Greenbrier River from its confluence with Knapps Creek to its confluence with the New River, (b) Anthony Creek from its headwaters to its confluence with the Greenbrier River, (c) Cranberry River from its headwaters to its confluence with the Gauley River, (d) Birch River from the Cora Brown bridge in Nicholas county to the confluence of the river with the Elk River, and (e) New River from its confluence with the Gauley River to its confluence with the Greenbrier River.
- Most federally-owned lands have watershed plans to protect water quality. This includes National Forests, National Wildlife Refuges, and National Parks.
- Conservation easements related to water quality (none known at this time)

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb (WU\_20150514)
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WaterQualityDatasets.gdb
  - Feature Class: WatershedPlan
  - ~~Feature Class: TMDL~~
  - Feature Class: NatStrProAct\_HUC10
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\DNR\_PublicLands\_20Aug2015\PublicLandsWVDN R20150820.shp

Input Variables:

None (but note that WshdPlan is already coded and can be added to this)

Method:

**## Create feature class to store WQPlan factor**

R-click WU\_20150514 and select Data/Export Data

Output feature class: WU\_WQPlan

**## Add field to Wetland Units and set initial point value to zero.**

Open attribute table of WU\_WQPlan

Add field "WQPlan" (short integer)

R-click WQPlan and Field Calculate WQPlan = 0

**## Select Wetland Units with Watershed Plan.**

Select by location

Selection method: select features from

Target layer: WU\_WQPlan

Source layer: WatershedPlan

Spatial selection method: Intersect the source layer feature

~~**## Select Wetland Units with TMDL Plan.**~~

~~Select by location~~

~~Selection method: add to the currently selected features in~~

~~Target layer: WU\_WQPlan~~

~~Source layer: TMDL~~

~~Spatial selection method: Intersect the source layer feature~~

**## Select Wetland Units in watersheds drained by National Streams Preservation Act streams.**

Select by location

Selection method: add to the currently selected features in

Target layer: WU\_WQPlan

Source layer: NatStrPreAct\_HUC10

Spatial selection method: Intersect the source layer feature

**## Select National Parks, Forests, and Wildlife Refuges**

Select by Attributes

Layer: PublicLandsWVDNR20150820.shp

Method: Create a new selection

SELECT \* FROM PublicLandsWVDNR20150820.shp WHERE: "Ownership\_" IN ('U.S Park Service', 'U.S. Fish and Wildlife Service', 'U.S. Forest Service')

**## Select Wetland Units in National Parks, Forests, and Wildlife Refuges.**

Select by location

Selection method: add to the currently selected features in

Target layer: WU\_WQPlan

Source layer: PublicLandsWVDNR20150820.shp

Check box "Use selected features" (137 features selected)

Spatial selection method: Intersect the source layer feature

**## Assign 2 points to Wetland Units that are included in a watershed plan of some kind.**

R-click "WQPlan" in WU\_WQPlan and Field Calculate WQPlan = 2

## 5.6.90 WQPotential: Water Quality Potential

Version date: 28 October 2016

Strategy: completed 3/12/2016 EAB

GIS method: completed 3/12/2016 EAB; verified 4/18/2016 EAB

Python code: Started & Complete 6/15/2016 MCA – Problem with point counts

EAB 10/25/16: I revised the point counts with the new values for Headwater and SWOutflow. Can you please re-run and see if they match?

Completed 10/28/2016 MCA

Final review by EAB: 10/28/2016

Purpose:

Water Quality Function

Maximum 16 points (all wetlands)

Description:

Rationale: Wetlands have an intrinsic potential to improve water quality, through filtering of contaminants, capture of sediment, absorption of nutrients, and chemical reactions that convert noxious compounds to benign ones (e.g., nitrates to nitrogen gas). This intrinsic capability is related to landscape position, vegetation, microtopography, drainage patterns, soils, wetland shape, and slope of the wetland.

Summary of strategy: For each Wetland Unit, sum the points for all factors within the “Potential” aspect. Note that different point values for floodplain vs. groundwater wetlands are assigned at the factor level.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb (WU\_20150514)

Input Variables:

- ChemTime (3 points GW)
- ClayOrganic (3 points GW)
- Depressions (5 points FL)
- Headwater (1 point – all types)
- SWOutflow (4 points GW)
- VegWQ (10 points FL, 5 points GW)

Method:

**## Spatial joins to bring together factor values**

ArcToolbox / Analysis Tools / Overlay / Spatial join

Target Feature: WU\_ChemTime

Join Feature: WU\_ClayOrganic

Output feature class: WU\_WQPotential1

Join Operation: JOIN\_ONE\_TO\_ONE  
Check box “Keep all target features”  
Field Map of Join Features: retain the following  
Shape-Length  
Shape\_Area  
ChemTime  
ClayOrganic  
Match Option: CONTAINS

ArcToolbox / Analysis Tools / Overlay / Spatial join  
Target Feature: WU\_WQPotential1  
Join Feature: WU\_Depressions  
Output feature class: WU\_WQPotential2  
Join Operation: JOIN\_ONE\_TO\_ONE  
Check box “Keep all target features”  
Field Map of Join Features: retain the following  
Shape-Length  
Shape\_Area  
ChemTime  
ClayOrganic  
Depressions  
Match Option: CONTAINS

ArcToolbox / Analysis Tools / Overlay / Spatial join  
Target Feature: WU\_WQPotential2  
Join Feature: WU\_Headwater  
Output feature class: WU\_WQPotential3  
Join Operation: JOIN\_ONE\_TO\_ONE  
Check box “Keep all target features”  
Field Map of Join Features: retain the following  
Shape-Length  
Shape\_Area  
ChemTime  
ClayOrganic  
Depressions  
Headwater  
Match Option: CONTAINS

ArcToolbox / Analysis Tools / Overlay / Spatial join  
Target Feature: WU\_WQPotential3  
Join Feature: WU\_SWOutflow  
Output feature class: WU\_WQPotential4  
Join Operation: JOIN\_ONE\_TO\_ONE  
Check box “Keep all target features”  
Field Map of Join Features: retain the following  
Shape-Length

Shape\_Area  
ChemTime  
ClayOrganic  
Depressions  
Headwater  
SWOutflow  
Match Option: CONTAINS

ArcToolbox / Analysis Tools / Overlay / Spatial join  
Target Feature: WU\_WQPotential4  
Join Feature: WU\_VegWQ  
Output feature class: WU\_WQPotential  
Join Operation: JOIN\_ONE\_TO\_ONE  
Check box "Keep all target features"  
Field Map of Join Features: retain the following  
Shape-Length  
Shape\_Area  
ChemTime  
ClayOrganic  
Depressions  
Headwater  
SWOutflow  
VegWQ  
Match Option: CONTAINS

**## Add WQPotential field to Wetland Units and set initial point value to zero.**

Open attribute table of WU\_WQPotential  
Add field "WQPotential" (short integer)  
R-click WQPotential and Field Calculate WQPotential = 0

**## Sum the factor points**

R-click WQPotential and Field Calculate WQPotential = [ChemTime]+ [ClayOrganic]+  
[Depressions]+ [Headwater]+ [SWoutflow]+ [VegWQ]

## 5.6.91 WQSociety: Water Quality Value to Society

Version date: 18 March 2016

Strategy: completed 3/12/2016 EAB

GIS method: completed and verified 3/18/2016 EAB

Python code: started & complete 5/26/2016 MCA

Final check by EAB: 10/3/2016

Purpose:

Water Quality Function

Maximum 4 points (all wetlands)

Description:

Rationale: Wetland discharges to (<1 km above) a stream, river, or lake that is on the 303d list, or a water body that is impacted by chronic algal blooms or power boat use. The term, "303(d) list," is short for the list of impaired waters (stream segments, lakes) that the Clean Water Act requires all states to submit to the Environmental Protection Agency (EPA) every two years. Wetlands that discharge directly to these polluted waters are judged to be more valuable than those that discharge to unpolluted bodies of water because their role at cleaning up the pollution is critical for reducing further degradation of water quality.

Summary of strategy: For each Wetland Unit, sum the points for all factors within the "Society" aspect. Reduce values that exceed the maximum allowable points for this aspect of water quality function. Note that floodplain and groundwater wetlands are treated the same for this aspect.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb (WU\_20150514)

Input Variables:

- HUC12WQ (1 point)
- ImpairedOut (1 point)
- WQPlan (up to 2 points)
- WQUse (up to 2 points)

Method:

**## Create feature class to store WQSociety**

R-click WU\_20150514 and select Data/Export Data

Output feature class: WU\_WQSociety1

**## Add WQSociety field to Wetland Units and set initial point value to zero.**

Open attribute table of WU\_WQSociety1



Add field “WQSociety” (short integer)  
R-click WQSociety and Field Calculate WQSociety = 0

### **## Spatial joins to bring in factor values**

ArcToolbox / Analysis Tools / Overlay / Spatial join  
Target Feature: WU\_WQSociety1  
Join Feature: HUC12WQ  
Output feature class: WU\_WQSociety2  
Join Operation: JOIN\_ONE\_TO\_ONE  
Field Map of Join Features: retain the following  
Shape-Length  
Shape\_Area  
WQSociety  
HUC12WQ  
Match Option: CONTAINS

ArcToolbox / Analysis Tools / Overlay / Spatial join  
Target Feature: WU\_WQSociety2  
Join Feature: ImpairedOut  
Output feature class: WU\_WQSociety3  
Join Operation: JOIN\_ONE\_TO\_ONE  
Field Map of Join Features: retain the following  
Shape-Length  
Shape\_Area  
WQSociety  
HUC12WQ  
ImpairedOut  
Match Option: CONTAINS

ArcToolbox / Analysis Tools / Overlay / Spatial join  
Target Feature: WU\_WQSociety3  
Join Feature: WQPlan  
Output feature class: WU\_WQSociety4  
Join Operation: JOIN\_ONE\_TO\_ONE  
Field Map of Join Features: retain the following  
Shape-Length  
Shape\_Area  
WQSociety  
HUC12WQ  
ImpairedOut  
WQPlan  
Match Option: CONTAINS

ArcToolbox / Analysis Tools / Overlay / Spatial join  
Target Feature: WU\_WQSociety4

Join Feature: WQUse  
Output feature class: WU\_WQSociety  
Join Operation: JOIN\_ONE\_TO\_ONE  
Field Map of Join Features: retain the following  
Shape-Length  
Shape\_Area  
WQSociety  
HUC12WQ  
ImpairedOut  
WQPlan  
WQUse  
Match Option: CONTAINS

### **## Sum the factor points**

R-click WQSociety and Field Calculate  $WQSociety = [HUC12WQ] + [ImpairedOut] + [WQPlan] + [WQUse]$

### **## Reduce values that exceed the maximum allowable points**

Select by attributes

Layer: WU\_Society

Method: Create a new selection

SELECT \* FROM WU\_WQSociety WHERE: "WQSociety" > 4

R-click WQSociety and Field Calculate  $WQSociety = 4$

## 5.6.92 WQUse: Water quality used by public

Version Date: 27 March 2016

Strategy: completed 3/12/2016 EAB

GIS method: 3/17/2016 completed and verified EAB

Python coding: started 3/17/2016 & completed 5/26/2016 MCA

Final review by EAB: 10/3/2016

Purpose:

Water Quality Function, Value to Society

Max 2 points

Description:

Rationale: Water quality is particularly important in areas where public use is high. Water supply intakes, swimming areas, and economically important fisheries are some of the uses that require good water quality. Wetlands can contribute to improved water quality if they are in the contributing watershed for these uses.

Summary of strategy: Sum the points for Water Supply and Fisheries. Add an additional point if the Wetland Unit is within 1 km of a swimming area, and 2 points if the Wetland Unit is within 50 meters of a swimming area. If the total points for a Wetland Unit exceeds the maximum allowable points for this factor, reduce the total points back to 2.

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandUnits.gdb (WU\_20150514)
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WaterQualityDatasets.gdb
  - Feature Class: SwimmingAreas2016

Input Variables:

- WaterSupply
- Fisheries

Method:

**## Create feature class to store WQUse factor**

R-click WU\_20150514 and select Data/Export Data

Output feature class: WU\_WQUse1

**## Add fields to Wetland Units and set initial values to zero.**

Open attribute table of WU\_WQUse1

Add field "WQUse" (short integer)

R-click WQUse and Field Calculate WQUse = 0

Add field "Swim" (short integer)  
R-click Swim and Field Calculate Swim = 0

**## Select Wetland Units within 1 km of Swimming Area.**

Select by location  
Selection method: select features from  
Target layer: WU\_WQUse1  
Source layer: SwimmingAreas2016  
Spatial selection method: are within a distance of the source layer feature  
Apply a search distance: 1000 meters

**## Assign 1 point to selected Wetland Units.**

R-click "Swim" in WU\_WQUse1 and Field Calculate Swim = 1

**## Select Wetland Units within 50 m of Swimming Area.**

Select by location  
Selection method: select features from  
Target layer: WU\_WQUse1  
Source layer: SwimmingAreas2016  
Spatial selection method: are within a distance of the source layer feature  
Apply a search distance: 50 meters

**## Assign 2 point to selected Wetland Units.**

R-click "Swim" in WU\_WQUse1 and Field Calculate Swim = 2

**## Spatial Join to add variables WaterSupply and Fisheries**

ArcToolbox / Analysis / Overlay / Spatial Join  
Target Feature: WU\_WQUse1  
Join Feature: WU\_WaterSupply  
Output Feature Class: WU\_WQUse2  
Join Operation: JOIN\_ONE\_TO\_ONE  
Field Map of Join Features: retain the following:  
Shape\_Length  
Shape\_Area  
WQUse  
Swim  
WaterSupply

ArcToolbox / Analysis / Overlay / Spatial Join  
Target Feature: WU\_WQUse2  
Join Feature: WU\_Fisheries

Output Feature Class: WU\_WQUse  
Join Operation: JOIN\_ONE\_TO\_ONE  
Field Map of Join Features: retain the following:  
Shape\_Length  
Shape\_Area  
WQUse  
Swim  
WaterSupply  
Fisheries

**## Sum the points for water quality use**

In WU\_WQUse, R-click WQUse and Field Calculate WQUse = [Swim] + [WaterSupply] + [Fisheries]

**## Reduce points to maximum allowed for WQUse**

Select by Attributes  
Layer: WU\_WQUse  
Method: Create a new selection  
SELECT \* FROM WU\_WQUse WHERE: "WQUse" > 2

In WU\_WQUse, R-click WQUse and Field Calculate WQUse = 2

## 5.6.93 WshdPos: Watershed Position, headwaters, major river floodplains, and karst

Version date: 2 October 2017

Strategy: 3/16/2017 EAB

GIS method: 10/2/2017 EAB; results verified 10/2/2017 EAB

Python code:

Final review by EAB:

Purpose:

Input to Habitat / Landscape Opportunity (LandHydro: Landscape Hydrologic Connectivity)

Description:

*Maximum 1 point*

Rationale: Headwater wetlands are upstream of all aquatic habitats and provide important protection to these ecosystems. Major river floodplains are an important and highly threatened habitat for toads, frogs, wetland birds, and dragonflies. Karst areas have a uniquely sensitive underground ecology and provide calcium-rich water to above-ground ecosystems.

GIS Method (no field method):

Assign 1 point if the wetland is a

- headwater wetland OR
- Amphibian habitat: wetland is in the floodplain of a major river, defined as having a drainage area > 5000 square miles, i.e., the Ohio, Kanawha, and lower Potomac (below Little Conococheague Creek, 1 mile downstream of Dam No 5, 7 miles upstream of Rt. 81 bridge).  
*Note: Don't include the Monongahela, New, Big Sandy, Greenbrier, Gauley, Elk, Guyandotte, Little Kanawha, N & S Branch Potomac? Check with Tom Pauley re: amphibian habitat* OR
- Odonates: \*Ohio, \*Kanawha, Meadow, Potomac, Cacapon, Tygart (higher elevation, but slower and sinuous), and lower portions of the North and South Branch. The Mon and Bluestone really don't have much in the way of wetlands because of the dams (except a few localized places Sue Olcott can think of on the Mon)(Note that amphibian habitat is included in Odonata habitat; since there is only one point available for this metric, these two categories can be combined) OR
- if the wetland occurs on karst (limestone/dolomite bedrock geology or SSURGO karst).

Source Data:

- M:\LayerFiles\arcsde\_backup.gdb
  - Feature Dataset: basemap\_physical\_non\_replica
    - Feature Class: SDE\_NHD\_reach\_24k\_gt\_50\_mi\_drainage
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandFunctionResults\WetlandFunction.gdb
  - Feature Class: WU\_FloodArea
    - Field: Floodplain
  - Feature Class: WU\_Headwater
    - Field: Headwater
  - Feature Class: WU\_Karst

- Field: Karst

Method:

**## STEP 1: Wetland Units in the Floodplain of a Major River**  
**## Create feature class to store WshdPos**

R-click WU\_FloodArea and select Data / Export Data / All features  
Output feature class: WetlandFunction.gdb / WU\_WshdPos1

**## Add field to store major river floodplain (MajorRiverFP) and set initial value to zero**

Open attribute table of WU\_WshdPos1  
Add field MajorRiverFP (short integer)  
Field calculate MajorRiverFP = 0

**## Select major rivers with floodplains**

```
SELECT * FROM SDE_NHD_reach_24k_gt_50_mi_drainage WHERE: "DA_sq_mi" > 1000  
OR "GNIS_Name" IN ('Meadow River', 'Cacapon River', 'Tygart Valley River') OR  
("GNIS_Name" IN ('South Branch Potomac River', 'North Branch Potomac River') AND  
"DA_sq_mi" > 1000)
```

**## Select wetlands that are within 500 meters of selected rivers**

Select by Location  
Selection method: select features from  
Target layer(s): WU\_WshdPos1  
Source layer: SDE\_NHD\_reach\_24k\_gt\_50\_mi\_drainage  
Use selected features (3107 features selected)  
Spatial selection method for the target layer feature(s): are within a distance of the source layer  
feature  
Apply a search distance: 500 meters

**## Remove from selection any wetlands not in the floodplain**

Select by Attributes  
Layer: WU\_WshdPos1  
Method: Remove from current selection  
SELECT \* FROM WU\_WshdPos1 WHERE: "Floodplain" = 'N'

**## Assign values to MajorRiverFP**

Open attribute table of WU\_WshdPos1  
Field calculate MajorRiverFP = 1

**## STEP 2: Join metrics and assign points**

**## Spatial Join MajorRiversFP to Headwater and Karst**  
*## Note that this can also be done with a "Join" on WUKey.*

ArcToolbox/ Spatial Join  
Target Features: WU\_WshdPos1  
Join Features: WU\_Headwater  
Output Feature Class: WU\_WshdPos2  
Join Operation: JOIN\_ONE\_TO\_ONE  
Check "Keep all target features"  
Field Map of Join Features:  
WUKey  
Shape\_Length  
Shape\_Area  
MajorRiverFP  
Headwater  
Match Option: Contains

ArcToolbox/ Spatial Join  
Target Features: WU\_WshdPos2  
Join Features: WU\_Karst  
Output Feature Class: WU\_WshdPos  
Join Operation: JOIN\_ONE\_TO\_ONE  
Check "Keep all target features"  
Field Map of Join Features:  
WUKey  
Shape\_Length  
Shape\_Area  
MajorRiverFP  
Headwater  
Karst  
Match Option: Contains

**## Add field WshdPos, set initial value to zero**

Open the attribute table to WU\_WshdPos  
Add field "WshdPos" (short integer) to attribute table  
Field Calculate "WshdPos" = 0

**## Assign points**

SELECT \* FROM WU\_WshdPos WHERE: "MajorRiverFP" > 0 OR "Headwater" > 0 OR  
"Karst" > 0  
Field Calculate WshdPos = 1



## 5.6.94 WshdUniq: Watershed Wetland Size and Uniqueness

Version date: 9 October 2017

Strategy: 3/16/2017 EAB

GIS method: 10/6/2017 EAB; results verified 10/6/2017 EAB

Python code: 10/10/20117 YH

Final review by EAB: 10/10/2017

Purpose:

Input to Habitat / Landscape Opportunity (LandEco: Landscape Ecological Connectivity)

Description:

*Maximum 2 points*

Rationale: Wetlands embedded in a dense or diverse network of nearby wetlands provide greater opportunities to species to thrive and disperse.

GIS Method (no field method):

Make heat map of 12-digit HUC watershed layer with the following fields, highlighting HUCs in the top 10% of the state. If wetland is within a “hot” HUC, award the points. Note that thresholds are based on the values for 772 HUCs in the layer “HUCWetlandSizeUniq”.

Type diversity: number of unique NWI codes in the watershed, not including spoil wetlands.

Density: number of vegetated NWI polygons; many of these polygons may be contiguous with each other, forming a single wetland.

Proportional Area: proportion of the watershed's total area occupied by vegetated wetlands as mapped by NWI.

Also, award points if the Wetland Unit is the largest vegetated wetland in its 12-digit HUC watershed (compare area of Wetland Unit with area of largest vegetated Wetland Unit (MaxVegArea) in the HUCWetlandSizeUniq attribute table created for this metric.

2 points: largest vegetated wetland in HUC, or HUC is in top 5% for type diversity, density, or proportional area

1 point: HUC is in top 10% for type diversity, density, or proportional area

0 points: none of the above criteria are met

Threshold value table

	<u>Top 5%</u>	<u>Top 10%</u>
<u>DiverseNWI</u>	28	22
<u>DensVegNWI</u>	70	45
<u>RatioVeg</u>	0.009	0.005

Source Data:

- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceFunctionalAssessment\Watershed.gdb
  - Feature Class: HUCWetlandSizeUniq
- M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandFunctionResults\WetlandFunction.gdb
  - Feature Class: WU\_VegAll

Method:

### **## Spatial Join of Wetland Units (including VegArea) and HUC characteristics**

ArcToolbox / Analysis Tools / Overlay / Spatial Join

Target Feature: WU\_VegAll

Join Feature: HUCWetlandSizeUniq

Output Feature Class: WU\_WshdUniq

Join operation: JOIN\_ONE\_TO\_ONE

Check box "Keep all target features"

Field Map of Join Features: retain the following:

WUKey

VegArea

Shape\_Length

Shape\_Area

HUC\_12

HU\_12\_NAME

MaxVegArea

DiverseNWI

DensVegNWI

RatioVeg

Match option: HAVE\_THEIR\_CENTER\_IN

### **## Create feature class to store results for WshdUniq and set initial value to zero**

Open attribute table of WU\_WshdUniq

Add field "WshdUniq" (short integer)

Field calculate WshdUniq = 0

### **## Select wetlands in top 10% of HUC watersheds based on**

**## the number of unique NWI codes, the number of vegetated NWI polygons, or**

**## the proportional area of vegetated wetlands**

```
SELECT * FROM WU_WshdUniq WHERE: "DiverseNWI" > 22 OR "DensVegNWI" > 45
OR "RatioVeg" > 0.005
```

### **## Assign 1 point**

Open attribute table of WU\_WshdUniq

Field Calculate WshdUniq = 1

**## Select largest vegetated wetland in each HUC AND wetlands in top 5% of HUC watersheds based on**

**## type diversity, density, or proportional area of vegetated wetlands**

```
SELECT * FROM WU_WshdUniq WHERE: "VegArea" >= "MaxVegArea" OR  
"DiverseNWI" > 28 OR "DensVegNWI" > 70 OR "RatioVeg" > 0.009
```

**## Assign 2 points**

Open attribute table of WU\_WshdUniq

Field Calculate WshdUniq = 2

Clear all selections

## 5.7 Python 2.7 Code

The following sections detail the open-source Python 2.7 code used in the GIS portion of the West Virginia Wetland Rapid Assessment Method.

### 5.7.1 Flood Attenuation Function

```
#####  
#  
# File Name: FAFunction.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 3/13/2017 (modified 10/32/2017)  
# Purpose:  
#   Flood Attenuation Function  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import arcpy  
from utilities import actions  
import logging  
  
def DetermineFAFunction(WetlandPoly):  
    logger = logging.getLogger("WFA.FloodAttn.FAFunction")  
  
    # Clean up if needed  
    if arcpy.Exists("WU_FAFunction"):  
        arcpy.Delete_management("WU_FAFunction")  
    if arcpy.Exists("WU_FAFunction1"):  
        arcpy.Delete_management("WU_FAFunction1")  
  
    # Setting python variables  
    arcpy.MakeFeatureLayer_management(r"WU_FAPotential","fcFAPotential")  
    arcpy.MakeFeatureLayer_management(r"WU_FAOpportun","fcFAOpportun")  
    arcpy.MakeFeatureLayer_management(r"WU_FASociety","fcFASociety")  
    logger.info("feature layers ready")  
  
#####  
#####  
    # SJ: FAPotential & FAOpportun  
  
#####  
#####
```

```

fmSJ = arcpy.FieldMappings()
fmSJ.addTable("fcFAPotential")
fmSJ.addTable("fcFAOpportun")

keepers = []
keepers = ["WUKey", "Shape_Length", "Shape_Area", "FAPotential", "FAOpportun"]

for field in fmSJ.fields:
    if field.name not in keepers:
        fmSJ.removeFieldMap(fmSJ.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis("fcFAPotential", "fcFAOpportun", "WU_FAFFunction1", "JOIN_ONE
_TO_ONE", "KEEP_ALL", fmSJ, "CONTAINS")
arcpy.MakeFeatureLayer_management("WU_FAFFunction1", "fcWUFAFunction1")
logger.info("spatial join FAPotential and FAOpportun completed")

#####
#####
# SJ: FASociety

#####
#####
fmSJ = arcpy.FieldMappings()
fmSJ.addTable("fcWUFAFunction1")
fmSJ.addTable("fcFASociety")

keepers = []
keepers =
["WUKey", "Shape_Length", "Shape_Area", "FAPotential", "FAOpportun", "FASociety"]

for field in fmSJ.fields:
    if field.name not in keepers:
        fmSJ.removeFieldMap(fmSJ.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis("fcWUFAFunction1", "fcFASociety", "WU_FAFFunction", "JOIN_ON
E_TO_ONE", "KEEP_ALL", fmSJ, "CONTAINS")
arcpy.MakeFeatureLayer_management("WU_FAFFunction", "fcWUFAFunction")
logger.info("spatial join FASociety completed")

## Add FAFuntion field to Wetland Units and set initial point value to zero
actions.DeleteField("fcWUFAFunction", "FAFunction")
arcpy.AddField_management("fcWUFAFunction", "FAFunction", "SHORT")
arcpy.CalculateField_management("fcWUFAFunction", "FAFunction", "0", "VB", "#")

```

```
logger.info("FAFunction field added to Wetland Units and initial point value set to zero")

## Sum the points for each aspect of Water Quality Function for Wetland Units
arcpy.CalculateField_management("fcWUFAFunction","FAFunction","[FAPotential] +
[FAOpportun] + [FASociety]","VB","#")
logger.info("field FAFunction calculated")

## Clean up
if arcpy.Exists("WU_FAFunction1"):
    arcpy.Delete_management("WU_FAFunction1")
```

## 5.7.2 Flood Attenuation Opportunity

```
#####  
#  
# File Name: FAOpportun.py  
# Developer: Yibing Han  
# Date: 12/13/2017  
# Purpose:  
# This script handles the execution of all the Flood Attenuation Opportunity metrics.  
#  
#####  
import datetime  
import logging  
import traceback  
import arcpy  
  
from Variable import Runoff50m, RunoffWshd, SlopeWshd, StreamEdge, FloodArea  
from Factor import FloodIn, ConnectFL  
from Aspects import FAOpportun  
  
def procFAOpportun(WetlandPoly):  
    logger = logging.getLogger("WFA.FloodAttn.FAOpportun")  
  
    #####  
    ## 1. Run Variables  
    #####  
  
    Runoff50m.DetermineRunoff50m(WetlandPoly)  
  
    RunoffWshd.DetermineRunoffWshd(WetlandPoly)  
  
    SlopeWshd.DetermineSlopeWshd(WetlandPoly)  
  
    StreamEdge.DetermineStreamEdge(WetlandPoly)  
  
    #FloodArea.DetermineFloodArea(WetlandPoly) #this should run first during initRequest  
  
    #####  
    ## 2. Run Factors  
    #####  
  
    FloodIn.DetermineFloodIn(WetlandPoly)  
  
    ConnectFL.DetermineConnectFL()  
  
    #####
```

## 3. Run Aspect

#####

FAOpportun.DetermineFAOpportun(WetlandPoly)



### 5.7.3 Flood Attenuation Opportunity Aspects

```
#####  
#  
# File Name: FAOpportun.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 3/7/2017 (modified 10/31/2017)  
# Purpose:  
#   Flood Attenuation Function  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import arcpy  
from utilities import actions  
import logging  
  
def DetermineFAOpportun(WetlandPoly):  
    logger = logging.getLogger("WFA.FloodAttn.FAOpportun.FAOpportun")  
  
    # Clean up if needed  
    if arcpy.Exists("WU_FAOpportun1"):  
        arcpy.Delete_management("WU_FAOpportun1")  
    if arcpy.Exists("WU_FAOpportun"):  
        arcpy.Delete_management("WU_FAOpportun")  
  
    # Setting python variables  
    arcpy.MakeFeatureLayer_management(r"WU_FloodIn", "fcFloodIn")  
    arcpy.MakeFeatureLayer_management(r"WU_Connect", "fcConnectFL")  
    arcpy.MakeFeatureLayer_management(r"WU_FloodArea", "fcFloodplain")  
    logger.info("feature layers ready")  
  
    ## Spatial joins to add input variables to Wetland Units attribute table  
  
#####  
#####  
    # SJ: FloodIn & ConnectFL  
  
#####  
#####  
    fmSJFICN = arcpy.FieldMappings()  
    fmSJFICN.addTable("fcFloodIn")  
    fmSJFICN.addTable("fcConnectFL")  
  
    keepers = []
```

```

keepers = ["WUKey","Shape_Length","Shape_Area","FloodIn","ConnectFL"]

for field in fmSJFICN.fields:
    if field.name not in keepers:
        fmSJFICN.removeFieldMap(fmSJFICN.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis("fcFloodIn","fcConnectFL","WU_FAOpportun1","JOIN_ONE_TO
_ONE","KEEP_ALL",fmSJFICN,"CONTAINS")
arcpy.MakeFeatureLayer_management("WU_FAOpportun1","fcWUFAOpportun1")
logger.info("spatial join FloodIn and ConnectFL completed")

#####
#####
# SJ: Floodplain

#####
#####
fmSJFL = arcpy.FieldMappings()
fmSJFL.addTable("fcWUFAOpportun1")
fmSJFL.addTable("fcFloodplain")

keepers = []
keepers = ["WUKey","Shape_Length","Shape_Area","FloodIn","ConnectFL","Floodplain"]

for field in fmSJFL.fields:
    if field.name not in keepers:
        fmSJFL.removeFieldMap(fmSJFL.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis("fcWUFAOpportun1","fcFloodplain","WU_FAOpportun","JOIN_O
NE_TO_ONE","KEEP_ALL",fmSJFL,"CONTAINS")
arcpy.MakeFeatureLayer_management("WU_FAOpportun","fcWUFAOpportun")
logger.info("spatial join Floodplain completed")

## Add FAOpportun field and set initial value to 0
actions.DeleteField("fcWUFAOpportun","FAOpportun")
arcpy.AddField_management("fcWUFAOpportun","FAOpportun","SHORT")
arcpy.CalculateField_management("fcWUFAOpportun","FAOpportun","0","VB","#")
logger.info("FAOpportun field added to Wetland Units and initial point value set to zero")

## Sum the factor points

arcpy.CalculateField_management("fcWUFAOpportun","FAOpportun","[FloodIn]+[ConnectF
L]","VB","#")

```

```

logger.info("field FAOpportun calculated")

## Reduce points for groudwater wetlands to a maximum of 2
strWHERE = """"FAOpportun" > 2 AND "Floodplain" = 'N'""""

arcpy.SelectLayerByAttribute_management("fcWUFAOpportun","NEW_SELECTION",strWH
ERE)
arcpy.CalculateField_management("fcWUFAOpportun","FAOpportun","2","VB","#")
logger.info("points for groudwater wetlands reduced to a maximum of 2")
arcpy.SelectLayerByAttribute_management("fcWUFAOpportun","CLEAR_SELECTION")

## Clean Up
if arcpy.Exists("WU_FAOpportun1"):
    arcpy.Delete_management("WU_FAOpportun1")

```

## 5.7.4 ConnectFL: Flood Attenuation Opportunity

```
#####  
#  
# File Name: ConnectFL.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 12/20/2016 (modified 10/31/2017)  
# Purpose:  
#   Input to Flood Attenuation / Opportunity  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def DetermineConnectFL():  
    logger = logging.getLogger("WFA.FloodAttn.FAOpportun.ConnectFL")  
  
    # Clean up if needed  
    if arcpy.Exists("WU_Connect"):  
        arcpy.Delete_management("WU_Connect")  
  
    # Setting python variables  
    arcpy.MakeFeatureLayer_management(r"WU_FloodArea","fcFloodArea")  
    arcpy.MakeFeatureLayer_management(r"WU_StreamEdge","fcStreamEdge")  
    logger.info("feature layers ready")  
  
    fmSJ = arcpy.FieldMappings()  
    fmSJ.addTable("fcFloodArea")  
    fmSJ.addTable("fcStreamEdge")  
    keepers = []  
    keepers = ["WUKey","Shape_Length","Shape_Area","FloodArea","StreamEdge"]  
    for field in fmSJ.fields:  
        if field.name not in keepers:  
            fmSJ.removeFieldMap(fmSJ.findFieldMapIndex(field.name))  
  
    arcpy.SpatialJoin_analysis("fcFloodArea","fcStreamEdge","WU_Connect","JOIN_ONE_TO_O  
NE","KEEP_ALL",fmSJ,"CONTAINS")  
    fcConnect = arcpy.mapping.Layer(r"WU_Connect")  
    logger.info("spatial join of StreamEdge to wetland units completed")
```

```

## Add ConnectFL field and set initial point value to 0
actions.DeleteField(fcConnect,"ConnectFL")
arcpy.AddField_management(fcConnect,"ConnectFL","SHORT")
arcpy.CalculateField_management(fcConnect,"ConnectFL","0","VB","#")
logger.info("field ConnectFL added and initial point value set to 0")

## Sum the points for FloodArea and StreamEdge.
arcpy.CalculateField_management(fcConnect,"ConnectFL","[FloodArea]+
[StreamEdge]","VB","#")
logger.info("point values calculated for field ConnectFL")

## Reduce the total points to a maximum of 2
strWHERE = """"ConnectFL" > 2""""
arcpy.SelectLayerByAttribute_management(fcConnect,"NEW_SELECTION",strWHERE)
arcpy.CalculateField_management(fcConnect,"ConnectFL","2","VB","#")
logger.info("total points reduced to a maximum of 2")

arcpy.SelectLayerByAttribute_management(fcConnect, "CLEAR_SELECTION")

## Clean Up

```

### 5.7.5 FloodIn: Flood Attenuation Opportunity

```
#####  
#  
# File Name: FloodIn.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 3/7/2017 (modified 12/05/2017)  
# Purpose:  
#   Input to Flood Attenuation / Potential  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def DetermineFloodIn(WetlandPoly):  
    logger = logging.getLogger("WFA.FloodAttn.FAOpportun.FloodIn")  
  
    # Clean up if needed  
    if arcpy.Exists("WU_FloodIn0"):  
        arcpy.Delete_management("WU_FloodIn0")  
    if arcpy.Exists("WU_FloodIn1"):  
        arcpy.Delete_management("WU_FloodIn1")  
    if arcpy.Exists("WU_FloodIn2"):  
        arcpy.Delete_management("WU_FloodIn2")  
    if arcpy.Exists("WU_FloodIn"):  
        arcpy.Delete_management("WU_FloodIn")  
  
    # Setting python variables  
    arcpy.MakeFeatureLayer_management(WetlandPoly,"WU_FloodIn0")  
    arcpy.MakeFeatureLayer_management(r"WU_SlopeWshd","fcSlopeWshd")  
    arcpy.MakeFeatureLayer_management(r"WU_Runoff50m","fcRunoff50m")  
    arcpy.MakeFeatureLayer_management(r"WU_RunoffWshd","fcRunoffWshd")  
    logger.info("feature layers ready")  
  
    ## Spatial joins to add input variables to Wetland Units attribute table  
  
#####  
#####  
# SJ: SlopeWshd
```

```

#####
#####
fmSJSW = arcpy.FieldMappings()
fmSJSW.addTable("WU_FloodIn0")
fmSJSW.addTable("fcSlopeWshd")

keepers = []
keepers = ["WUKey","Shape_Length","Shape_Area","SlopeWshd"]

for field in fmSJSW.fields:
    if field.name not in keepers:
        fmSJSW.removeFieldMap(fmSJSW.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis("WU_FloodIn0","fcSlopeWshd","WU_FloodIn1","JOIN_ONE_TO
_ONE","KEEP_ALL",fmSJSW,"CONTAINS")
arcpy.MakeFeatureLayer_management("WU_FloodIn1","fcWUFloodIn1")
logger.info("spatial join to add SlopeWshd completed")

#####
#####
# SJ: Runoff50m

#####
#####
fmSJR50M = arcpy.FieldMappings()
fmSJR50M.addTable("fcWUFloodIn1")
fmSJR50M.addTable("fcRunoff50m")

keepers = []
keepers = ["WUKey","Shape_Length","Shape_Area","SlopeWshd","Runoff50m"]

for field in fmSJR50M.fields:
    if field.name not in keepers:
        fmSJR50M.removeFieldMap(fmSJR50M.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis("fcWUFloodIn1","fcRunoff50m","WU_FloodIn2","JOIN_ONE_TO
_ONE","KEEP_ALL",fmSJR50M,"CONTAINS")
arcpy.MakeFeatureLayer_management("WU_FloodIn2","fcWUFloodIn2")
logger.info("spatial join to add Runoff50m completed")

```

```

#####
#####
# SJ: RunoffWshd

#####
#####
fmSJRWSHD = arcpy.FieldMappings()
fmSJRWSHD.addTable("fcWUFloodIn2")
fmSJRWSHD.addTable("fcRunoffWshd")

keepers = []
keepers =
["WUKey", "Shape_Length", "Shape_Area", "SlopeWshd", "Runoff50m", "RunoffWshd"]

for field in fmSJRWSHD.fields:
    if field.name not in keepers:
        fmSJRWSHD.removeFieldMap(fmSJRWSHD.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis("fcWUFloodIn2", "fcRunoffWshd", "WU_FloodIn", "JOIN_ONE_TO
_ONE", "KEEP_ALL", fmSJRWSHD, "CONTAINS")
arcpy.MakeFeatureLayer_management("WU_FloodIn", "fcWUFloodIn")
logger.info("spatial join to add RunoffWshd completed")

## Add FloodIn field and set initial value to 0
actions.DeleteField("fcWUFloodIn", "FloodIn")
arcpy.AddField_management("fcWUFloodIn", "FloodIn", "SHORT")
arcpy.CalculateField_management("fcWUFloodIn", "FloodIn", "0", "VB", "#")
logger.info("field FloodIn added and initial value set to 0")

## Calculate sum of SlopeWshd, Runoff50m, and RunoffWshd and assign points to FloodIn

arcpy.SelectLayerByAttribute_management("fcWUFloodIn", "NEW_SELECTION", """"("Slope
Wshd" + "RunoffWshd" + "Runoff50m") > 2""")
arcpy.CalculateField_management("fcWUFloodIn", "FloodIn", "1", "VB", "#")

arcpy.SelectLayerByAttribute_management("fcWUFloodIn", "NEW_SELECTION", """"("Slope
Wshd" + "RunoffWshd" + "Runoff50m") > 4""")
arcpy.CalculateField_management("fcWUFloodIn", "FloodIn", "2", "VB", "#")
logger.info("points assigned to certain Wetland Units")

## Clean up
if arcpy.Exists("WU_FloodIn0"):
    arcpy.Delete_management("WU_FloodIn0")

```



```
if arcpy.Exists("WU_FloodIn1"):
    arcpy.Delete_management("WU_FloodIn1")
if arcpy.Exists("WU_FloodIn2"):
    arcpy.Delete_management("WU_FloodIn2")
```

## 5.7.6 FloodArea: Flood Attenuation Opportunity

```
#####  
#  
# File Name: FloodArea.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 3/8/2017 (modified 11/10/2017)  
# Purpose:  
# Floodplain (Y/N): Input to numerous Water Quality and Flood Attenuation metrics  
# FloodArea: Input to Flood Attenuation / Opportunity; Max 2 points (all wetlands, but only  
Floodplain wetlands will score high enough to get points)  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def DetermineFloodArea(WetlandPoly):  
    logger = logging.getLogger("WFA.FloodAttn.FAOpportun.FloodArea")  
  
    ## Clean up if needed  
    if arcpy.Exists("WU_FloodArea1"):  
        arcpy.Delete_management("WU_FloodArea1")  
    if arcpy.Exists("WU_FloodArea"):  
        arcpy.Delete_management("WU_FloodArea")  
  
    ## Setting python variables  
    arcpy.MakeFeatureLayer_management(WetlandPoly,"fcWU")  
    arcpy.MakeFeatureLayer_management(globalvars.srcFPARAFEMA,"fcFPARAFEMA")  
    arcpy.MakeFeatureLayer_management(globalvars.srcPeatlands,"fcPeatlands")  
    logger.info("feature layers ready")  
  
    ## Intersect floodplain and Wetland Units  
    arInputs = ["fcFPARAFEMA","fcWU"]  
    arcpy.Intersect_analysis(arInputs,"WU_FloodArea1","ONLY_FID","#","INPUT")  
    arcpy.MakeFeatureLayer_management(r"WU_FloodArea1","fcWUFloodArea1")  
    logger.info("floodplain intersected with wetland units")  
  
    ## Add field to store floodplain area  
    actions.DeleteField("fcWUFloodArea1","FloodAreaAF")  
    arcpy.AddField_management("fcWUFloodArea1", "FloodAreaAF", "FLOAT")
```

```

arcpy.CalculateField_management("fcWUFloodArea1","FloodAreaAF","[Shape_Area]","VB",
"#")
logger.info("field FloodAreaAF added to store floodplain area")

#####
#####
## Spatial join floodplain selection to Wetland Units and sum floodplain area.

#####
#####
fieldmappings = arcpy.FieldMappings()
fieldmappings.addTable("fcWU")
fieldmappings.addTable("fcWUFloodArea1")

fldKeyIndex = fieldmappings.findFieldMapIndex("FloodAreaAF")
fieldmap = fieldmappings.getFieldMap(fldKeyIndex)
fieldmap.mergeRule = "sum"
fieldmappings.replaceFieldMap(fldKeyIndex, fieldmap)
keepers = ["Shape_Length","Shape_Area","WUKey","FloodAreaAF"]

for field in fieldmappings.fields:
    if field.name not in keepers:
        fieldmappings.removeFieldMap(fieldmappings.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis("fcWU","fcWUFloodArea1","WU_FloodArea","JOIN_ONE_TO_O
NE","KEEP_ALL",fieldmappings)
arcpy.MakeFeatureLayer_management("WU_FloodArea","fcWUFloodArea")
logger.info("spatuak join completed to sum floodplain area")

#####
#####
## Add fields to store Flood Area Ratio and Flood Area points
actions.DeleteField("fcWUFloodArea","FloodRatio")
arcpy.AddField_management("fcWUFloodArea", "FloodRatio", "FLOAT")
arcpy.CalculateField_management("fcWUFloodArea","FloodRatio","0","VB","#")
logger.info("field FloodRatio added and initial point value set to 0")

actions.DeleteField("fcWUFloodArea","FloodArea")
arcpy.AddField_management("fcWUFloodArea", "FloodArea", "SHORT")
arcpy.CalculateField_management("fcWUFloodArea","FloodArea","0","VB","#")
logger.info("field FloodArea added and initial point value set to 0")

```

```

## Calculate the ratio of floodplain are to total Wetland Units Area

arcpy.CalculateField_management("fcWUFloodArea","FloodRatio","[FloodAreaAF]/[Shape_Area]", "VB", "#")
logger.info("field FloodRation calculated")

## Assign Points

arcpy.SelectLayerByAttribute_management("fcWUFloodArea","NEW_SELECTION","""FloodRatio" > 0.1""")
arcpy.CalculateField_management("fcWUFloodArea","FloodArea","1","VB","#")

arcpy.SelectLayerByAttribute_management("fcWUFloodArea","NEW_SELECTION","""FloodRatio" > 0.5""")
arcpy.CalculateField_management("fcWUFloodArea","FloodArea","2","VB","#")
logger.info("points assigned to field FloodArea")
arcpy.SelectLayerByAttribute_management("fcWUFloodArea", "CLEAR_SELECTION")

## Select Wetland Units that contain peat deposits

arcpy.SelectLayerByLocation_management("fcWUFloodArea","INTERSECT","fcPeatlands", "#","NEW_SELECTION")
arcpy.CalculateField_management("fcWUFloodArea","FloodArea","0","VB","#")
logger.info("points assigned to wetland units that contain peat deposits")
arcpy.SelectLayerByAttribute_management("fcWUFloodArea", "CLEAR_SELECTION")

## Add field Floodplain to Wetland Units attribute table and set initial value to "N"
actions.DeleteField("fcWUFloodArea","Floodplain")
arcpy.AddField_management("fcWUFloodArea", "Floodplain", "TEXT",2)
arcpy.CalculateField_management("fcWUFloodArea","Floodplain","N","PYTHON","#")
logger.info("field Floodplain added and initial value set to 'N'")

## Select Wetland Units that have at least 10% of their area in a FEMA floodplain or Active River Area

arcpy.SelectLayerByAttribute_management("fcWUFloodArea","NEW_SELECTION","""FloodArea" > 0""")
arcpy.CalculateField_management("fcWUFloodArea","Floodplain","Y","PYTHON","#")
logger.info("field Floodplain identified in selected wetlanf units")
arcpy.SelectLayerByAttribute_management("fcWUFloodArea", "CLEAR_SELECTION")

## Clean up
if arcpy.Exists("WU_FloodArea1"):
    arcpy.Delete_management("WU_FloodArea1")

```

### 5.7.7 Runoff50: Flood Attenuation Opportunity

```
#####  
#  
# File Name: Runoff50m.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 6/16/2016 (modified 11/16/2017)  
# Purpose:  
# Flood Attenuation Function / Opportunity aspect  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def DetermineRunoff50m(WetlandPoly):  
    logger = logging.getLogger("WFA.FloodAttn.FAOpportun.Runoff50m")  
  
    # Clean up if needed  
    if arcpy.Exists("WU_Runoff50m1"):  
        arcpy.Delete_management("WU_Runoff50m1")  
    if arcpy.Exists("Buffer50mRun"):  
        arcpy.Delete_management("Buffer50mRun")  
    if arcpy.Exists("Buffer50mRun_diss"):  
        arcpy.Delete_management("Buffer50mRun_diss")  
    if arcpy.Exists("WU_Runoff50m"):  
        arcpy.Delete_management("WU_Runoff50m")  
  
    # Setting python variables  
    fcRunoffLand = arcpy.mapping.Layer(globalvars.srcRunoffLand)  
    fcBuffer50m = arcpy.mapping.Layer(globalvars.srcBuffer50m)  
    logger.info("feature layers ready")  
  
    ## Create feature class to store intermediate results for Runoff50m  
    arcpy.CopyFeatures_management(WetlandPoly,"WU_Runoff50m1","#","0","0","0")  
    arcpy.MakeFeatureLayer_management("WU_Runoff50m1", "fcWURunoff50m1")  
    logger.info("feature class WU_Runoff50m1 created")  
  
    # Intersect the 50m buffers and the runoff land uses  
    arInputData = [fcBuffer50m,fcRunoffLand]  
    arcpy.Intersect_analysis(arInputData,"Buffer50mRun","ALL",output_type="INPUT")  
    logger.info("intersected runoff land uses with 50m buffers")
```

```

fcBuffer50mRun = arcpy.mapping.Layer(r"Buffer50mRun")

# Dissolve runoff lands by wetland buffer
arcpy.Dissolve_management(fcBuffer50mRun,"Buffer50mRun_diss","WUKey","BufferArea
FIRST","MULTI_PART","DISSOLVE_LINES")
fcBuffer50mRun_diss = arcpy.mapping.Layer(r"Buffer50mRun_diss")
logger.info("dissolved runoff lands by wetland buffer")

# Add field and calculate ration of runoff are to total drainage
actions.DeleteField(fcBuffer50mRun_diss,"Run50mRat")
arcpy.AddField_management(fcBuffer50mRun_diss, "Run50mRat", "FLOAT")

arcpy.CalculateField_management(fcBuffer50mRun_diss,"Run50mRat","[Shape_Area]/[FIRST
_BufferArea]","VB","#")
logger.info("field Run50mRat added and calculated")

# Join ratio of runoff land to Wetland Units

arcpy.AddJoin_management("fcWURunoff50m1","WUKey","Buffer50mRun_diss","WUKey",
"KEEP_ALL")
logger.info("ratio of runoff land joined to Wetland Units")

# Export joined data
#arcpy.CopyFeatures_management("fcWURunoff50m1","WU_Runoff50m","#","0","0","0")

arcpy.FeatureClassToFeatureClass_conversion("fcWURunoff50m1",arcpy.env.workspace,"WU
_Runoff50m")
fcWURunoff50m = arcpy.mapping.Layer(r"WU_Runoff50m")
logger.info("joined data exported")

## Remove Join
arcpy.RemoveJoin_management("fcWURunoff50m1")
logger.info("joined removed")

# Update Null records to 0 in the Run50mRat field

arcpy.SelectLayerByAttribute_management(fcWURunoff50m,"NEW_SELECTION","""Buffe
r50mRun_diss_Run50mRat" IS NULL""")

arcpy.CalculateField_management(fcWURunoff50m,"Buffer50mRun_diss_Run50mRat","0",
"VB","#")
logger.info("Null records updated to 0 in the Run50mRat field")

# Add field to Wetland Units and set initial point value to zero
actions.DeleteField(fcWURunoff50m,"Runoff50m")

```

```
arcpy.AddField_management(fcWURunoff50m, "Runoff50m", "SHORT")
arcpy.CalculateField_management(fcWURunoff50m,"Runoff50m","0","VB","#")
logger.info("field Runoff50m added to Wetland Units and initial point value set to zero")
```

```
# Assign Points
```

```
arcpy.SelectLayerByAttribute_management(fcWURunoff50m,"NEW_SELECTION", """"Buffer50mRun_diss_Run50mRat" > 0.1""")
arcpy.CalculateField_management(fcWURunoff50m,"Runoff50m","1","VB","#")
```

```
arcpy.SelectLayerByAttribute_management(fcWURunoff50m,"NEW_SELECTION", """"Buffer50mRun_diss_Run50mRat" > 0.33""")
arcpy.CalculateField_management(fcWURunoff50m,"Runoff50m","2","VB","#")
arcpy.SelectLayerByAttribute_management(fcWURunoff50m, "CLEAR_SELECTION")
logger.info("points assigned to wetland units")
```

```
# Update NULL values with 0
```

```
arcpy.SelectLayerByAttribute_management(fcWURunoff50m,"NEW_SELECTION", """"Runoff50m" IS NULL""")
arcpy.CalculateField_management(fcWURunoff50m,"Runoff50m","0","VB","#")
logger.info("Null records updated to 0 in the Runoff50m field")
arcpy.SelectLayerByAttribute_management(fcWURunoff50m, "CLEAR_SELECTION")
```

```
if arcpy.Exists("WU_Runoff50m1"):
    arcpy.Delete_management("WU_Runoff50m1")
if arcpy.Exists("Buffer50mRun"):
    arcpy.Delete_management("Buffer50mRun")
if arcpy.Exists("Buffer50mRun_diss"):
    arcpy.Delete_management("Buffer50mRun_diss")
```

## 5.7.8 RunoffWshd: Flood Attenuation Opportunity

```
#####  
#  
# File Name: RunoffWshd.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 1/31/2017 (modified 11/10/2017)  
# Purpose:  
# Flood Attenuation Function / Opportunity aspect  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def DetermineRunoffWshd(WetlandPoly):  
    logger = logging.getLogger("WFA.FloodAttn.FAOpportun.RunoffWshd")  
  
    # Clean up if needed  
    if arcpy.Exists("DrainAreaRun"):  
        arcpy.Delete_management("DrainAreaRun")  
    if arcpy.Exists("DrainAreaRun_diss"):  
        arcpy.Delete_management("DrainAreaRun_diss")  
    if arcpy.Exists("WU_RunoffWshd"):  
        arcpy.Delete_management("WU_RunoffWshd")  
    if arcpy.Exists("WU_RunoffWshd1"):  
        arcpy.Delete_management("WU_RunoffWshd1")  
  
    # Setting python variables  
    fcDA27m = arcpy.mapping.Layer(globalvars.srcDrainageArea)  
    fcRL = arcpy.mapping.Layer(globalvars.srcRunoffLand)  
    logger.info("feature layers ready")  
  
    ## Create feature class to store intermediate results for Runoff50m  
    arcpy.CopyFeatures_management(WetlandPoly, "WU_RunoffWshd1", "#", "0", "0", "0")  
    arcpy.MakeFeatureLayer_management("WU_RunoffWshd1", "fcWURunoffWshd1")  
    logger.info("feature class WU_RunoffWshd1 created")  
  
    # Intersect the drainage areas and the runoff land uses (Takes 32 minutes 23 seconds to run)  
    arInputData = [fcDA27m, fcRL]  
    arcpy.Intersect_analysis(arInputData, "DrainAreaRun", "ALL", "#", "INPUT")  
    fcDrainAreaRun = arcpy.mapping.Layer(r"DrainAreaRun")
```



```

logger.info("drainage areas and the disturbed land uses intersected")

# Dissolve runoff lands by drainage area (Takes around 23 hours)
arcpy.Dissolve_management(fcDrainAreaRun,"DrainAreaRun_diss","WUKey","CntrWshd
FIRST","MULTI_PART","DISSOLVE_LINES")
fcDrainAreaRunDiss = arcpy.mapping.Layer(r"DrainAreaRun_diss")
logger.info("runoff lands dissolved by drainage area")

# Add field to DrainAreaRun_diss and calculate ratio of runoff area to total drainage
actions.DeleteField(fcDrainAreaRunDiss,"RunWshdRat")
arcpy.AddField_management(fcDrainAreaRunDiss, "RunWshdRat", "FLOAT")
arcpy.CalculateField_management(fcDrainAreaRunDiss, "RunWshdRat",
"[SHAPE_Area]/[FIRST_CntrWshd]", "VB")
logger.info("field RunWshdRat added to DrainAreaRun_diss and calculated")

# Join ratio of runoff land to Wetland Units

arcpy.AddJoin_management("fcWURunoffWshd1","WUKey",fcDrainAreaRunDiss,"WUKey",
"KEEP_ALL")
logger.info("ratio of runoff land joined to wetland units")

# Export joined data
#arcpy.CopyFeatures_management("fcWURunoffWshd1", "WU_RunoffWshd")

arcpy.FeatureClassToFeatureClass_conversion("fcWURunoffWshd1",arcpy.env.workspace,"W
U_RunoffWshd")
fcRunoffWshd = arcpy.mapping.Layer(r"WU_RunoffWshd")
logger.info("joined data exported")
arcpy.RemoveJoin_management("fcWURunoffWshd1")

# Set NULL values in the DistWshdRat to 0

arcpy.SelectLayerByAttribute_management(fcRunoffWshd,"NEW_SELECTION","""DrainAr
eaRun_diss_RunWshdRat" IS NULL""")

arcpy.CalculateField_management(fcRunoffWshd,"DrainAreaRun_diss_RunWshdRat","0","V
B","#")
logger.info("null values in DistWshdRat set to 0")
arcpy.SelectLayerByAttribute_management(fcRunoffWshd, "CLEAR_SELECTION")

# Add field to Wetland Units and set initial point value to zero
actions.DeleteField(fcRunoffWshd,"RunoffWshd")
arcpy.AddField_management(fcRunoffWshd, "RunoffWshd", "SHORT")
arcpy.CalculateField_management(fcRunoffWshd, "RunoffWshd", "0", "VB")
logger.info("field RunoffWshd added to Wetland Units and initial point value set to zero")

```

```

# Assign points

arcpy.SelectLayerByAttribute_management(fcRunoffWshd,"NEW_SELECTION", """"DrainAr
eaRun_diss_RunWshdRat" > 0.1""")
    arcpy.CalculateField_management(fcRunoffWshd, "RunoffWshd", "1", "VB")

arcpy.SelectLayerByAttribute_management(fcRunoffWshd,"NEW_SELECTION", """"DrainAr
eaRun_diss_RunWshdRat" > 0.25""")
    arcpy.CalculateField_management(fcRunoffWshd, "RunoffWshd", "2", "VB")
    logger.info("points assigned to field RunoffWshd")
    arcpy.SelectLayerByAttribute_management(fcRunoffWshd, "CLEAR_SELECTION")

# Clean up
if arcpy.Exists("DrainAreaRun"):
    arcpy.Delete_management("DrainAreaRun")
if arcpy.Exists("DrainAreaRun_diss"):
    arcpy.Delete_management("DrainAreaRun_diss")
if arcpy.Exists("WU_RunoffWshd1"):
    arcpy.Delete_management("WU_RunoffWshd1")

```

### 5.7.9 SlopeWshd: Flood Attenuation Opportunity

```
#####  
#  
# File Name: SlopeWshd.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 5/12/2016 (modified 12/07/2017)  
# Purpose:  
#   Input to Flood Attenuation Function / Opportunity aspect  
#  
#####  
#!/usr/bin/python  
import sys, os, gc  
sys.path.append("../..")  
gc.enable()  
  
import logging  
import arcpy  
from arcpy.sa import *  
from globalvars import globalvars  
from utilities import actions  
  
def Get_V(aKey, smallDict):  
    try:  
        return smallDict[aKey]  
    except:  
        return (-1)  
  
def DetermineSlopeWshd(WetlandPoly):  
    arcpy.CheckOutExtension("Spatial")
```

```

logger = logging.getLogger("WFA.FloodAttn.FAOpportun.SlopeWshd")

# Clean up if needed
if arcpy.Exists(r"WU_SlopeWshd"):
    arcpy.Delete_management(r"WU_SlopeWshd")
if arcpy.Exists(r"WU_SlopeWshd1"):
    arcpy.Delete_management(r"WU_SlopeWshd1")

# Setting python variables
parID = "WUKey"
parID2 = "WUKey_1"
dbf = "slope_wshd"
temp_dir =
"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\WorkingFiles\slope_wshd_temp"
if not os.path.exists(temp_dir):
    os.mkdir(temp_dir)
if arcpy.Exists(temp_dir + "\tempGDB.gdb"):
    arcpy.Delete_management(temp_dir + "\tempGDB.gdb")
arcpy.CreateFileGDB_management(temp_dir, "tempGDB")

#arcpy.CopyFeatures_management(globalvars.srcDrainageArea, "DrainageArea2")
fcDA = arcpy.mapping.Layer(globalvars.srcDrainageArea)

#arcpy.MakeRasterLayer_management(r"M:\dems\ned_slope_aspect.gdb\NED_3meter_meters
_augmented_slope_pct", "fcNED3mAugSlpPct")
logger.info("feature layers ready")

# Add field MEAN to store zonal statistics outputs
actions.DeleteField(fcDA,"MEAN")
arcpy.AddField_management(fcDA, "MEAN", "SHORT")

```

```

logger.info("field MEAN added to store zonal statistics outputs")
orig_dir = arcpy.env.workspace
arcpy.env.workspace = temp_dir + "\\tempGDB.gdb"
arcpy.env.overwriteOutput = True

# Zonal Statistics on DrainageArea, which contains multiple overlapping polygons
## Defining neighbors using spatial join
arcpy.SpatialJoin_analysis(fcDA, fcDA, "SD", "JOIN_ONE_TO_MANY")
#joinLR = arcpy.mapping.Layer(r"SD.shp")
logger.info("Spatial join completed to define neighbors")

## Creating empty dictionary and load data
dictFeatures = {}
with arcpy.da.SearchCursor(fcDA, parID) as cursor:
    for row in cursor:
        dictFeatures[row[0]]=()
    del row, cursor
logger.info("Empty dictionary created and data loaded")

## Assigning neighbors
with arcpy.da.SearchCursor(arcpy.env.workspace + "\\SD", (parID,parID2)) as cursor:
    for row in cursor:
        aKey=row[0]
        aList=dictFeatures[aKey]
        aList+=(row[1],)
        dictFeatures[aKey]=aList
    del row, cursor
logger.info("Neighbors assigned")

```

```

## Defining non-overlapping subsets and running zonal statistics on each
runNo=0
while (True):
    toShow,toHide=(),()
    nF=len(dictFeatures)
    for item in dictFeatures:
        if item not in toShow and item not in toHide:
            toShow+=(item,)
            toHide+=(dictFeatures[item])
    m=len(toShow)
    quer="WUKey" IN '+str(toShow)
    if m==1:
        quer="WUKey" = '+str(toShow[0])
    fcDA.definitionQuery=quer
    runNo+=1
    print("Run %i, %i polygon(s) found" % (runNo,m))
    print("Running Statistics...")
    arcpy.env.extent = fcDA.getExtent()
    zonalTable = ZonalStatisticsAsTable(fcDA, parID, globalvars.srcSlopePCT, dbf, "DATA",
"MEAN")
    print("Data transfer...")
    smallDict={}
    with arcpy.da.SearchCursor(dbf, ("WUKEY","MEAN")) as cursor:
        for row in cursor:
            smallDict[row[0]]=row[1]
        del row, cursor
    with arcpy.da.UpdateCursor(fcDA, (parID,"MEAN")) as cursor:
        for row in cursor:
            aKey=row[0]
            row[1]=Get_V(aKey, smallDict)

```

```

        cursor.updateRow(row)
    del row, cursor
for item in toShow:
    del dictFeatures[item]
m=len(dictFeatures)
if m==0:
    break
gc.collect()
fcDA.definitionQuery=""
arcpy.env.extent = fcDA.getExtent()
logger.info("zonal statistics completed and appended to DrainageArea")

arcpy.env.workspace = orig_dir

## Export the joined data to a Feature Class
arcpy.CopyFeatures_management(fcDA, "WU_SlopeWshd1")
fcSlopeWshd1 = arcpy.mapping.Layer(r"WU_SlopeWshd1")
logger.info("joined data exported as WU_SlopeWshd1")

## Rename MEAN field
actions.DeleteField(fcSlopeWshd1,"MnSlopeWshd")
arcpy.AddField_management(fcSlopeWshd1, "MnSlopeWshd", "SHORT")

#arcpy.CalculateField_management(fcSlopeWshd1,"MnSlopeWshd","[slope_wshd_MEAN]","
VB","#")

arcpy.CalculateField_management(fcSlopeWshd1,"MnSlopeWshd","[MEAN]","VB","#")
logger.info("MEAN field renamed as MnSlopeWshd")

## Join the slope values to Wetland Units

```

```
arcpy.AddJoin_management(WetlandPoly,"WUKey",fcSlopeWshd1,"WUKey","KEEP_ALL")
```

```
## Export joined data
```

```
arcpy.FeatureClassToFeatureClass_conversion(WetlandPoly,arcpy.env.workspace,"WU_SlopeWshd")
```

```
fcWUSlopeWshd = arcpy.mapping.Layer(r"WU_SlopeWshd")
```

```
logger.info("joined data exported")
```

```
arcpy.RemoveJoin_management(WetlandPoly)
```

```
## Add field to Wetland Unites and set initial point value to zero
```

```
actions.DeleteField(fcWUSlopeWshd,"SlopeWshd")
```

```
arcpy.AddField_management(fcWUSlopeWshd, "SlopeWshd", "SHORT")
```

```
arcpy.CalculateField_management(fcWUSlopeWshd,"SlopeWshd","0","VB","#")
```

```
logger.info("field SlopeWshd added to Wetland Unites and initial point set value to zero")
```

```
## Assign points
```

```
#arcpy.SelectLayerByAttribute_management(fcWUSlopeWshd,"NEW_SELECTION","""SlopeWshd1_MedSlopeWshd" > 5""")
```

```
arcpy.SelectLayerByAttribute_management(fcWUSlopeWshd,"NEW_SELECTION","""WU_SlopeWshd1_MnSlopeWshd" > 5""")
```

```
arcpy.CalculateField_management(fcWUSlopeWshd,"SlopeWshd","1","VB","#")
```

```
#arcpy.SelectLayerByAttribute_management(fcWUSlopeWshd,"NEW_SELECTION","""SlopeWshd1_MedSlopeWshd" > 15""")
```

```
arcpy.SelectLayerByAttribute_management(fcWUSlopeWshd,"NEW_SELECTION","""WU_SlopeWshd1_MnSlopeWshd" > 15""")
```



```
arcpy.CalculateField_management(fcWUSlopeWshd,"SlopeWshd","2","VB","#")
logger.info("points assigned to field SlopeWshd")
```

```
arcpy.SelectLayerByAttribute_management(fcWUSlopeWshd, "CLEAR_SELECTION")
```

```
if arcpy.Exists(r"WU_SlopeWshd1"):
    arcpy.Delete_management(r"WU_SlopeWshd1")
```

### 5.7.10 StreamEdge: Flood Attenuation Opportunity

```
#####  
#  
# File Name: StreamEdge.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 8/30/2016 (modified 10/31/2017)  
# Purpose:  
#   Used in Flood Attenuation Function / Potential aspect / Runoff  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def DetermineStreamEdge(WetlandPoly):  
    logger = logging.getLogger("WFA.FloodAttn.FAOpportun.StreamEdge")  
  
    # Clean up if needed  
    if arcpy.Exists("Rivers"):  
        arcpy.Delete_management("Rivers")  
    if arcpy.Exists("WUbyRivers"):  
        arcpy.Delete_management("WUbyRivers")  
    if arcpy.Exists("WURiverLines"):  
        arcpy.Delete_management("WURiverLines")  
    if arcpy.Exists("RiverEdges"):  
        arcpy.Delete_management("RiverEdges")  
    if arcpy.Exists("WUStream"):  
        arcpy.Delete_management("WUStream")  
    if arcpy.Exists("WU_StreamEdge1"):  
        arcpy.Delete_management("WU_StreamEdge1")  
    if arcpy.Exists("WU_StreamEdge"):  
        arcpy.Delete_management("WU_StreamEdge")  
  
    # Setting python variables  
    arcpy.MakeFeatureLayer_management(WetlandPoly,"fcWU")  
    #arcpy.MakeFeatureLayer_management(globalvars.srcInput,"fcENWI")  
    arcpy.MakeFeatureLayer_management(globalvars.srcNHDFlowline, "fcNHDFlowline")  
    arcpy.MakeFeatureLayer_management(globalvars.srcRivers,"fcRivers")  
    logger.info("feature layers ready")
```

```

#####
#####
# PART 1: RIVER LENGTH

#####
#####
# Select NWI Rivers
"strWHERE = """"ATTRIBUTE" LIKE 'R%""""
arcpy.SelectLayerByAttribute_management("fcENWI","NEW_SELECTION",strWHERE)

arcpy.CopyFeatures_management("fcENWI", "Rivers")
arcpy.MakeFeatureLayer_management(r"Rivers","fcRivers")
logger.info("NWI Rivers selected and exported")

# Select Wetland Units that share a boundary with a river and export them

arcpy.SelectLayerByLocation_management("fcWU","INTERSECT","fcRivers","#","NEW_SELECTION")
arcpy.CopyFeatures_management("fcWU", "WUbyRivers")
arcpy.MakeFeatureLayer_management(r"WUbyRivers","fcWUbyRivers")
logger.info("Wetland Units that share a boundary with a river selected and exported")

# Convert Wetland polygons to lines

arcpy.PolygonToLine_management("fcWUbyRivers","WURiverLines","IGNORE_NEIGHBORS")
arcpy.MakeFeatureLayer_management(r"WURiverLines","fcWURiverLines")
logger.info("Wetland polygons converted to lines")

# Retain only the wet perimeter lines
arLayers = ["fcWURiverLines", "fcRivers"]
arcpy.Intersect_analysis(arLayers,"RiverEdges","ONLY_FID","#","INPUT")
arcpy.MakeFeatureLayer_management("RiverEdges","fcRiverEdges")
logger.info("only the wet perimeter lines retained")

# Add field and calculate wet perimeter in RiverEdges
actions.DeleteField("fcRiverEdges","RiverPerim")
arcpy.AddField_management("fcRiverEdges", "RiverPerim", "FLOAT")

arcpy.CalculateField_management("fcRiverEdges","RiverPerim","[Shape_Length]","VB","#")
logger.info("field RiverPerim added and wet perimeter in RiverEdges calculated")

# Spatial Join Wetland Units to RiverEdges
arcpy.SelectLayerByAttribute_management("fcWURiverLines", "CLEAR_SELECTION")
arcpy.SelectLayerByAttribute_management("fcRivers", "CLEAR_SELECTION")

```

```

arcpy.SelectLayerByAttribute_management("fcWU", "CLEAR_SELECTION")
arcpy.SelectLayerByAttribute_management("fcRiverEdges", "CLEAR_SELECTION")

fmSJ = arcpy.FieldMappings()
fmSJ.addTable("fcWU")
fmSJ.addTable("fcRiverEdges")

keepers = []
keepers = ["WUKey", "Shape_Length", "Shape_Area", "RiverPerim"]
for field in fmSJ.fields:
    if field.name not in keepers:
        fmSJ.removeFieldMap(fmSJ.findFieldMapIndex(field.name))

fldKeyIndex = fmSJ.findFieldMapIndex("RiverPerim")
fieldmap = fmSJ.getFieldMap(fldKeyIndex)
fieldmap.mergeRule = "Sum"
fmSJ.replaceFieldMap(fldKeyIndex, fieldmap)

arcpy.SpatialJoin_analysis("fcWU", "fcRiverEdges", "WU_StreamEdge1", "JOIN_ONE_TO_ONE", "KEEP_ALL", fmSJ, "INTERSECT")
arcpy.MakeFeatureLayer_management("WU_StreamEdge1", "fcWUStreamEdge1")
logger.info("Spatial Join Wetland Units to RiverEdges completed")

#####
#####
# PART 2: STREAM LENGTH

#####
#####
# Intersect stream lengths with Wetland Units
arLayers = ["fcWUStreamEdge1", "fcNHDFlowline"]
arcpy.Intersect_analysis(arLayers, "WUStream", "ONLY_FID", "#", "INPUT")
arcpy.MakeFeatureLayer_management("WUStream", "fcWUStream")
logger.info("stream lengths intersected with Wetland Units")

# Add field to WUStream to store stream length
actions.DeleteField("fcWUStream", "StreamL")
arcpy.AddField_management("fcWUStream", "StreamL", "FLOAT")
arcpy.CalculateField_management("fcWUStream", "StreamL", "[Shape_Length]", "VB", "#")
logger.info("field StreamL created and calculated to store stream length")

## Sum the stream lengths within each WU
fmSJ = arcpy.FieldMappings()
fmSJ.addTable("fcWUStreamEdge1")

```

```

fmSJ.addTable("fcWUStream")

keepers = []
keepers = ["WUKey", "Shape_Length", "Shape_Area", "RiverPerim", "StreamL"]

for field in fmSJ.fields:
    if field.name not in keepers:
        fmSJ.removeFieldMap(fmSJ.findFieldMapIndex(field.name))

fldKeyIndex = fmSJ.findFieldMapIndex("StreamL")
fieldmap = fmSJ.getFieldMap(fldKeyIndex)
fieldmap.mergeRule = "Sum"
fmSJ.replaceFieldMap(fldKeyIndex, fieldmap)

arcpy.SpatialJoin_analysis("fcWUStreamEdge1", "fcWUStream", "WU_StreamEdge", "JOIN_O
NE_TO_ONE", "KEEP_ALL", fmSJ, "INTERSECT")
arcpy.MakeFeatureLayer_management("WU_StreamEdge", "fcWUStreamEdge")
logger.info("spatial join completed to sum the stream lengths within each WU")

#####
#####
# PART 3: Calculate ratio and assign points

#####
#####
## Convert Null values to 0
strWHERE = """"RiverPerim" IS NULL""""

arcpy.SelectLayerByAttribute_management("fcWUStreamEdge", "NEW_SELECTION", strWH
ERE)
arcpy.CalculateField_management("fcWUStreamEdge", "RiverPerim", "0", "VB", "#")

strWHERE = """"StreamL" IS NULL""""

arcpy.SelectLayerByAttribute_management("fcWUStreamEdge", "NEW_SELECTION", strWH
ERE)
arcpy.CalculateField_management("fcWUStreamEdge", "StreamL", "0", "VB", "#")
logger.info("Null values converted to 0")
arcpy.SelectLayerByAttribute_management("fcWUStreamEdge", "CLEAR_SELECTION")

## Create field StreamRatio and set initial values to 0
actions.DeleteField("fcWUStreamEdge", "StreamRatio")
arcpy.AddField_management("fcWUStreamEdge", "StreamRatio", "FLOAT")
arcpy.CalculateField_management("fcWUStreamEdge", "StreamRatio", "0", "VB", "#")

```

```

## Calculate field StreamRatio values

arcpy.CalculateField_management("fcWUStreamEdge","StreamRatio",("([RiverPerim]+[Stream
L])/([Shape_Area]^0.5)","VB","#"))
logger.info("field StreamRatio created and calculated for wetland units")

## Create field StreamEdge and set initial values to 0
actions.DeleteField("fcWUStreamEdge","StreamEdge")
arcpy.AddField_management("fcWUStreamEdge", "StreamEdge", "SHORT")
arcpy.CalculateField_management("fcWUStreamEdge","StreamEdge","0","VB","#")

## Assign StreamEdge point values
strWHERE = """"StreamRatio" > 1""""

arcpy.SelectLayerByAttribute_management("fcWUStreamEdge","NEW_SELECTION",strWH
ERE)
arcpy.CalculateField_management("fcWUStreamEdge","StreamEdge","1","VB","#")

strWHERE = """"StreamRatio" > 3.4""""

arcpy.SelectLayerByAttribute_management("fcWUStreamEdge","NEW_SELECTION",strWH
ERE)
arcpy.CalculateField_management("fcWUStreamEdge","StreamEdge","2","VB","#")
logger.info("field StreamEdge created and calculated for wetland units")
arcpy.SelectLayerByAttribute_management("fcWUStreamEdge", "CLEAR_SELECTION")

# Clean Up
if arcpy.Exists("Rivers"):
    arcpy.Delete_management("Rivers")
if arcpy.Exists("WUbyRivers"):
    arcpy.Delete_management("WUbyRivers")
if arcpy.Exists("WURiverLines"):
    arcpy.Delete_management("WURiverLines")
if arcpy.Exists("RiverEdges"):
    arcpy.Delete_management("RiverEdges")
if arcpy.Exists("WUStream"):
    arcpy.Delete_management("WUStream")
if arcpy.Exists("WU_StreamEdge1"):
    arcpy.Delete_management("WU_StreamEdge1")

```

### 5.7.11 Flood Attenuation Potential

```
#####  
#  
# File Name: FAPotential.py  
# Developer: Yibing Han  
# Date: 12/13/2017  
# Purpose:  
# This script handles the execution of all the Flood Attenuation Potential metrics.  
#  
#####  
import datetime  
import logging  
import traceback  
import arcpy  
  
from Variables import VegAll, VegPerUng, VegWoody  
from Factors import VegFA, Runoff  
from Aspects import FAPotential  
  
def procFAPotential(WetlandPoly):  
    logger = logging.getLogger("WFA.FloodAttn.FAPotential")  
  
    #####  
    ## 1. Run Variables  
    #####  
  
    VegAll.DetermineVegAll(WetlandPoly)  
  
    VegWoody.CalcVegWoody(WetlandPoly)  
  
    #SeasonPond, Microtopo, SLOPE, WFlowPath, VegPerUng were executed with WQuality  
  
    #####  
    ## 2. Run Factors  
    #####  
  
    #Headwater: executed with WQuality  
  
    #LowSlope: executed with WQuality  
  
    VegFA.DetermineVegFA(WetlandPoly)  
  
    Runoff.DetermineRunoff(WetlandPoly)  
  
    #SWoutflow: executed with WQuality
```

```
#####  
## 3. Run Aspect  
#####
```

FAPotential.DetermineFAPotential(WetlandPoly)



5.7.12 Flood Attenuation Potential Aspects

```
#####
#
# File Name: FAPotential.py
# Developer: Chad Ashworth (modified by Yibing Han)
# Date: 12/21/2016 (modified 10/31/2017)
# Purpose:
#   Flood Attenuation Function
#
#####
#!/usr/bin/python
import sys
sys.path.append("../..")

import arcpy
from utilities import actions
import logging

def DetermineFAPotential(WetlandPoly):
    logger = logging.getLogger("WFA.FloodAttn.FAPotential.FAPotential")

    # Clean up if needed
    if arcpy.Exists("WU_FAPotential"):
        arcpy.Delete_management("WU_FAPotential")
    if arcpy.Exists("WU_FAPotential1"):
        arcpy.Delete_management("WU_FAPotential1")
    if arcpy.Exists("WU_FAPotential2"):
        arcpy.Delete_management("WU_FAPotential2")
    if arcpy.Exists("WU_FAPotential3"):
        arcpy.Delete_management("WU_FAPotential3")

    # Setting python variables
    arcpy.MakeFeatureLayer_management(r"WU_Headwater","fcHeadwater")
    arcpy.MakeFeatureLayer_management(r"WU_LowSlope","fcLowSlope")
    arcpy.MakeFeatureLayer_management(r"WU_VegFA","fcVegFA")
    arcpy.MakeFeatureLayer_management(r"WU_Runoff","fcRunoff")
    arcpy.MakeFeatureLayer_management(r"WU_SWOutflow","fcSWOutflow")
    logger.info("feature layers ready")

#####
#####
# SJ: Headwater & LowSlope
#####
#####
```

```

fmSJHWLS = arcpy.FieldMappings()
fmSJHWLS.addTable("fcHeadwater")
fmSJHWLS.addTable("fcLowSlope")

keepers = []
keepers = ["WUKey", "Shape_Length", "Shape_Area", "Headwater", "LowSlope"]

for field in fmSJHWLS.fields:
    if field.name not in keepers:
        fmSJHWLS.removeFieldMap(fmSJHWLS.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis("fcHeadwater", "fcLowSlope", "WU_FAPotential1", "JOIN_ONE_TO_ONE", "KEEP_ALL", fmSJHWLS, "CONTAINS")
arcpy.MakeFeatureLayer_management("WU_FAPotential1", "fcFAPotential1")
logger.info("spatial join Headwater and LowSlope completed")

#####
#####
# SJ: VegFA

#####
#####
fmSJVFA = arcpy.FieldMappings()
fmSJVFA.addTable("fcFAPotential1")
fmSJVFA.addTable("fcVegFA")

keepers = []
keepers = ["WUKey", "Shape_Length", "Shape_Area", "Headwater", "LowSlope", "VegFA"]

for field in fmSJVFA.fields:
    if field.name not in keepers:
        fmSJVFA.removeFieldMap(fmSJVFA.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis("fcFAPotential1", "fcVegFA", "WU_FAPotential2", "JOIN_ONE_TO_ONE", "KEEP_ALL", fmSJVFA, "CONTAINS")
arcpy.MakeFeatureLayer_management("WU_FAPotential2", "fcFAPotential2")
logger.info("spatial join VegFA completed")

#####
#####
# SJ: Runoff

```

```

#####
#####
fmSJRO = arcpy.FieldMappings()
fmSJRO.addTable("fcFAPotential2")
fmSJRO.addTable("fcRunoff")

keepers = []
keepers =
["WUKey","Shape_Length","Shape_Area","Headwater","LowSlope","VegFA","Runoff"]

for field in fmSJRO.fields:
    if field.name not in keepers:
        fmSJRO.removeFieldMap(fmSJRO.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis("fcFAPotential2","fcRunoff","WU_FAPotential3","JOIN_ONE_TO_ONE",
"KEEP_ALL",fmSJRO,"CONTAINS")
arcpy.MakeFeatureLayer_management("WU_FAPotential3","fcFAPotential3")
logger.info("spatial join Runoff completed")

#####
#####
# SJ: SWOutflow2

#####
#####
fmSJSWOF2 = arcpy.FieldMappings()
fmSJSWOF2.addTable("fcFAPotential3")
fmSJSWOF2.addTable("fcSWOutflow")

keepers = []
keepers =
["WUKey","Shape_Length","Shape_Area","Headwater","LowSlope","VegFA","Runoff","SW
Outflow2"]

for field in fmSJSWOF2.fields:
    if field.name not in keepers:
        fmSJSWOF2.removeFieldMap(fmSJSWOF2.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis("fcFAPotential3","fcSWOutflow","WU_FAPotential","JOIN_ONE_TO_ONE",
"KEEP_ALL",fmSJSWOF2,"CONTAINS")
arcpy.MakeFeatureLayer_management("WU_FAPotential","fcWUFAPotential")
logger.info("spatial join SWOutflow2 completed")

```

```
## Add FAPotential field to Wetland Units and set initial point value to 0
actions.DeleteField("fcWUFAPotential","FAPotential")
arcpy.AddField_management("fcWUFAPotential", "FAPotential", "SHORT")
arcpy.CalculateField_management("fcWUFAPotential","FAPotential","0","VB","#")
logger.info("FAPotential field added to Wetland Units and initial point value set to zero")
```

```
## Sum the factor points
```

```
arcpy.CalculateField_management("fcWUFAPotential","FAPotential","[Headwater]+[LowSlope]+[VegFA]+[Runoff]+[SWOutflow2]","VB","#")
logger.info("field FAPotential calculated")
```

```
## Clean Up
```

```
if arcpy.Exists("WU_FAPotential1"):
    arcpy.Delete_management("WU_FAPotential1")
if arcpy.Exists("WU_FAPotential2"):
    arcpy.Delete_management("WU_FAPotential2")
if arcpy.Exists("WU_FAPotential3"):
    arcpy.Delete_management("WU_FAPotential3")
```

### 5.7.13 Runoff: Flood Attenuation Potential

```
#####  
#  
# File Name: Runoff.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 12/19/2016 (modified 12/01/2017)  
# Purpose:  
#   Input to Flood Attenuation / Potential  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def DetermineRunoff(WetlandPoly):  
    logger = logging.getLogger("WFA.FloodAttn.FAPotential.Runoff")  
  
    # Clean up if needed  
    if arcpy.Exists("WU_Runoff1"):  
        arcpy.Delete_management("WU_Runoff1")  
    if arcpy.Exists("WU_Runoff2"):  
        arcpy.Delete_management("WU_Runoff2")  
    if arcpy.Exists("WU_Runoff3"):  
        arcpy.Delete_management("WU_Runoff3")  
    if arcpy.Exists("WU_Runoff"):  
        arcpy.Delete_management("WU_Runoff")  
  
    # Setting python variables  
    arcpy.MakeFeatureLayer_management(WetlandPoly,"fcWU")  
    arcpy.MakeFeatureLayer_management(r"WU_StreamEdge","fcStreamEdge")  
    arcpy.MakeFeatureLayer_management(r"WU_SeasonPond","fcSeasonPond")  
    arcpy.MakeFeatureLayer_management(r"WU_Microtopo","fcMicrotopo")  
    arcpy.MakeFeatureLayer_management(r"WU_FloodArea","fcFloodplain")  
    logger.info("feature layers ready")  
  
    ## Spatial Joins to add input variables to Wetland Units attribute table  
  
#####  
#####  
# SJ: StreamEdge
```

```

#####
#####
fmSJSR = arcpy.FieldMappings()
fmSJSR.addTable("fcWU")
fmSJSR.addTable("fcStreamEdge")

keepers = []
keepers = ["WUKey","Shape_Length","Shape_Area","StreamEdge"]

for field in fmSJSR.fields:
    if field.name not in keepers:
        fmSJSR.removeFieldMap(fmSJSR.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis("fcWU","fcStreamEdge","WU_Runoff1","JOIN_ONE_TO_ONE",
KEEP_ALL",fmSJSR,"CONTAINS")
arcpy.MakeFeatureLayer_management("WU_Runoff1","fcRunoff1")
logger.info("spatial join to add StreamEdge completed")

#####
#####
# SJ: SeasonPond

#####
#####
fmSJSP = arcpy.FieldMappings()
fmSJSP.addTable("fcRunoff1")
fmSJSP.addTable("fcSeasonPond")

keepers = []
keepers = ["WUKey","Shape_Length","Shape_Area","StreamEdge","SeasonPond"]

for field in fmSJSP.fields:
    if field.name not in keepers:
        fmSJSP.removeFieldMap(fmSJSP.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis("fcRunoff1","fcSeasonPond","WU_Runoff2","JOIN_ONE_TO_ON
E","KEEP_ALL",fmSJSP,"CONTAINS")
arcpy.MakeFeatureLayer_management("WU_Runoff2","fcRunoff2")
logger.info("spatial join to add SeasonPond completed")

```

```

#####
#####
# SJ: Microtopo

#####
#####
fmSJMicro = arcpy.FieldMappings()
fmSJMicro.addTable("fcRunoff2")
fmSJMicro.addTable("fcMicrotopo")

keepers = []
keepers =
["WUKey","Shape_Length","Shape_Area","StreamEdge","SeasonPond","Microtopo"]

for field in fmSJMicro.fields:
    if field.name not in keepers:
        fmSJMicro.removeFieldMap(fmSJMicro.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis("fcRunoff2","fcMicrotopo","WU_Runoff3","JOIN_ONE_TO_ONE",
"KEEP_ALL",fmSJMicro,"CONTAINS")
arcpy.MakeFeatureLayer_management("WU_Runoff3","fcRunoff3")
logger.info("spatial join to add Microtopo completed")

#####
#####
# SJ: Floodplain

#####
#####
fmSJFP = arcpy.FieldMappings()
fmSJFP.addTable("fcRunoff3")
fmSJFP.addTable("fcFloodplain")

keepers = []
keepers =
["WUKey","Shape_Length","Shape_Area","StreamEdge","SeasonPond","Microtopo","Floodpl
ain"]

for field in fmSJFP.fields:
    if field.name not in keepers:
        fmSJFP.removeFieldMap(fmSJFP.findFieldMapIndex(field.name))

```

```

arcpy.SpatialJoin_analysis("fcRunoff3","fcFloodplain","WU_Runoff","JOIN_ONE_TO_ONE",
"KEEP_ALL",fmSJFP,"CONTAINS")
    arcpy.MakeFeatureLayer_management("WU_Runoff","fcRunoff")
    logger.info("spatial join to add Floodplain completed")

# Add Runoff field to Wetland Units ans set initial point value to zero
actions.DeleteField("fcRunoff","Runoff")
arcpy.AddField_management("fcRunoff", "Runoff", "SHORT")
arcpy.CalculateField_management("fcRunoff","Runoff","0","VB","#")
logger.info("field Runoff added and initial value set to 0")

# Sum the points of StreamEdge, SeasonPond, Microtopo

arcpy.CalculateField_management("fcRunoff","Runoff","[StreamEdge]+[SeasonPond]+[Microt
opo]","VB","#")
    logger.info("points of StreamEdge, SeasonPond, Microtopo summed")

# Reduce the total points to 5 (floodplain) or 4 (groundwater).
arcpy.SelectLayerByAttribute_management("fcRunoff","NEW_SELECTION","""Runoff" >
5""")
    arcpy.CalculateField_management("fcRunoff","Runoff","5","VB","#")
    arcpy.SelectLayerByAttribute_management("fcRunoff","NEW_SELECTION","""Runoff" >
4 AND "Floodplain" = 'N'""")
    arcpy.CalculateField_management("fcRunoff","Runoff","4","VB","#")
    logger.info("total maximum points reduced to 5 for floodplain and 4 for groundwater")

arcpy.SelectLayerByAttribute_management("fcRunoff", "CLEAR_SELECTION")

# Clean Up
if arcpy.Exists("WU_Runoff1"):
    arcpy.Delete_management("WU_Runoff1")
if arcpy.Exists("WU_Runoff2"):
    arcpy.Delete_management("WU_Runoff2")
if arcpy.Exists("WU_Runoff3"):
    arcpy.Delete_management("WU_Runoff3")

```



### 5.7.14 VegFA: Flood Attenuation Potential

```
#####  
#  
# File Name: VegFA.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 6/10/2016 (modified 11/03/2017)  
# Purpose:  
#   Input to Flood Attenuation / Potential  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def DetermineVegFA(WetlandPoly):  
    logger = logging.getLogger("WFA.FloodAttn.FAPotential.VegFA")  
  
    # Clean up if needed  
    if arcpy.Exists("WU_VegFA1"):  
        arcpy.Delete_management("WU_VegFA1")  
    if arcpy.Exists("WU_VegFA2"):  
        arcpy.Delete_management("WU_VegFA2")  
    if arcpy.Exists("WU_VegFA3"):  
        arcpy.Delete_management("WU_VegFA3")
```

```

if arcpy.Exists("WU_VegFA"):
    arcpy.Delete_management("WU_VegFA")

# Setting python variables
arcpy.MakeFeatureLayer_management(WetlandPoly,"fcWU")
arcpy.MakeFeatureLayer_management(r"WU_VegAll","fcVegAll")
arcpy.MakeFeatureLayer_management(r"WU_VegPerUng","fcVegPerUng")
arcpy.MakeFeatureLayer_management(r"WU_VegWoody","fcVegWoody")
arcpy.MakeFeatureLayer_management(r"WU_FloodArea","fcFloodplain")
logger.info("feature layers ready")

# Spatial joins to add input variables to Wetland Units attribute table

#####
#####

# SJ: Floodplain

#####
#####

fmSJ1 = arcpy.FieldMappings()
fmSJ1.addTable("fcWU")
fmSJ1.addTable("fcFloodplain")

keepers = []
keepers = ["WUKey","Shape_Length","Shape_Area","Floodplain"]

for field in fmSJ1.fields:
    if field.name not in keepers:
        fmSJ1.removeFieldMap(fmSJ1.findFieldMapIndex(field.name))

```

```
arcpy.SpatialJoin_analysis("fcWU","fcFloodplain","WU_VegFA1","JOIN_ONE_TO_ONE",  
KEEP_ALL",fmSJ1,"CONTAINS")
```

```
arcpy.MakeFeatureLayer_management("WU_VegFA1","fcWUVegFA1")
```

```
logger.info("spatial join of Floodplain completed")
```

```
#####  
#####
```

```
# SJ: VegAll
```

```
#####  
#####
```

```
fmSJ2 = arcpy.FieldMappings()
```

```
fmSJ2.addTable("fcWUVegFA1")
```

```
fmSJ2.addTable("fcVegAll")
```

```
keepers = []
```

```
keepers = ["WUKey","Shape_Length","Shape_Area","Floodplain","VegAll"]
```

```
for field in fmSJ2.fields:
```

```
    if field.name not in keepers:
```

```
        fmSJ2.removeFieldMap(fmSJ2.findFieldMapIndex(field.name))
```

```
arcpy.SpatialJoin_analysis("WU_VegFA1","fcVegAll","WU_VegFA2","JOIN_ONE_TO_ON  
E","KEEP_ALL",fmSJ2,"CONTAINS")
```

```
arcpy.MakeFeatureLayer_management("WU_VegFA2","fcWUVegFA2")
```

```
logger.info("spatial join of VegAll completed")
```

```
#####  
#####
```

```
# SJ: VegPerUng
```

```
#####  
#####
```

```
fmSJ3 = arcpy.FieldMappings()  
fmSJ3.addTable("fcWUVegFA2")  
fmSJ3.addTable("fcVegPerUng")
```

```
keepers = []
```

```
keepers = ["WUKey", "Shape_Length", "Shape_Area", "Floodplain", "VegAll", "VegPerUng4"]
```

```
for field in fmSJ3.fields:
```

```
    if field.name not in keepers:
```

```
        fmSJ3.removeFieldMap(fmSJ3.findFieldMapIndex(field.name))
```

```
arcpy.SpatialJoin_analysis("fcWUVegFA2", "fcVegPerUng", "WU_VegFA3", "JOIN_ONE_TO  
_ONE", "KEEP_ALL", fmSJ3, "CONTAINS")
```

```
arcpy.MakeFeatureLayer_management("WU_VegFA3", "fcWUVegFA3")
```

```
logger.info("spatial join of VegPerUng completed")
```

```
#####  
#####
```

```
# SJ: VegWoody
```

```
#####  
#####
```

```
fmSJ4 = arcpy.FieldMappings()
```

```

fmSJ4.addTable("fcWUVegFA3")
fmSJ4.addTable("fcVegWoody")

keepers = []
keepers =
["WUKey","Shape_Length","Shape_Area","Floodplain","VegAll","VegPerUng4","VegWoody
4"]

for field in fmSJ4.fields:
    if field.name not in keepers:
        fmSJ4.removeFieldMap(fmSJ4.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis("fcWUVegFA3","fcVegWoody","WU_VegFA","JOIN_ONE_TO_
ONE","KEEP_ALL",fmSJ4,"CONTAINS")

arcpy.MakeFeatureLayer_management("WU_VegFA","fcWUVegFA")
logger.info("spatial join of VegWoody completed")

# Add VegFA field to Wetland Units ans set initial point value to zero
actions.DeleteField("fcWUVegFA","VegFA")
arcpy.AddField_management("fcWUVegFA", "VegFA", "SHORT")
arcpy.CalculateField_management("fcWUVegFA","VegFA","0","VB","#")
logger.info("field VegWoodyFor added to store points for VegFA and initial value set to
zero")

# Sum the points for VegALL, VegPerUng4, VegWoody4
arcpy.CalculateField_management("fcWUVegFA","VegFA","[VegAll] + [VegPerUng4] +
[VegWoody4]","VB","#")
logger.info("the points for VegALL, VegPerUng4, VegWoody4 summed")

# Reduce any excess point scores to the maximum allowed

```

```

arcpy.SelectLayerByAttribute_management("fcWUVegFA", "CLEAR_SELECTION")

arcpy.SelectLayerByAttribute_management("fcWUVegFA","NEW_SELECTION","""VegFA
"> 5 AND "Floodplain" = 'N'""")

arcpy.CalculateField_management("fcWUVegFA","VegFA","5","VB","#")
logger.info("excess point scores reduced to the maximum allowed")

# Clean up
if arcpy.Exists("WU_VegFA1"):
    arcpy.Delete_management("WU_VegFA1")
if arcpy.Exists("WU_VegFA2"):
    arcpy.Delete_management("WU_VegFA2")
if arcpy.Exists("WU_VegFA3"):
    arcpy.Delete_management("WU_VegFA3")

```

### 5.7.15 VegAll: Flood Attenuation Potential

```
#####  
#  
# File Name: VegAll.py  
# Developer: Chad Ashworth (modifications by Yibing Han)  
# Date: 5/12/2016 (modified 11/02/2017, modified 2/3/2022 to include vegetated lacustrine  
littoral and vegetated riverine polygons in selection)  
# Purpose:  
# Input to Flood Attenuation / Potential / Vegetation Factor  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def DetermineVegAll(WetlandPoly):  
    logger = logging.getLogger("WFA.FloodAttn.FAPotential.VegAll")  
  
    # Clean up if needed  
    if arcpy.Exists("WU_VegAll"):  
        arcpy.Delete_management("WU_VegAll")  
  
    # Setting python variables  
    arcpy.MakeFeatureLayer_management(WetlandPoly, "fcWU")  
    #arcpy.MakeFeatureLayer_management(globalvars.srcInput,"fcENWI")  
    arcpy.MakeFeatureLayer_management(r"VegAll","fcVegAll")  
    logger.info("feature layers ready")  
  
    # Select the forest, shrubland, emergent, moss, and aquatic bed vegetation  
    strWHERE = """"ATTRIBUTE" LIKE 'PEM%' OR "ATTRIBUTE" LIKE 'PFO%' OR  
"ATTRIBUTE" LIKE 'PSS%' OR "ATTRIBUTE" LIKE 'PAB%' OR "ATTRIBUTE" LIKE  
'PML%' OR "ATTRIBUTE" LIKE 'L2AB%' OR "ATTRIBUTE" LIKE 'L2US5%' OR  
"ATTRIBUTE" LIKE 'L2EM%' OR "ATTRIBUTE" LIKE 'R2AB%' OR "ATTRIBUTE" LIKE  
'R3AB%' OR "ATTRIBUTE" LIKE 'R2US5%' OR "ATTRIBUTE" LIKE 'R3US5%' OR  
"ATTRIBUTE" LIKE 'R2EM%' OR "ATTRIBUTE" LIKE 'R3EM%' OR "ATTRIBUTE"  
LIKE 'R4SB7%'""""  
    arcpy.SelectLayerByAttribute_management("fcENWI", "NEW_SELECTION", strWHERE)  
    logger.info("the forest, shrubland, emergent, moss, and aquaitc bed vegetation selected")  
  
    # Create layer of all vegetation area  
    arcpy.CopyFeatures_management("fcENWI", "WU_VegAll1")
```

```

arcpy.MakeFeatureLayer_management(r"WU_VegAll1","fcWUVegAll1")
logger.info("layer of all vegetation area created")

# Add field to store vegetation area
actions.DeleteField("fcVegAll","VegArea")
arcpy.AddField_management("fcVegAll", "VegArea", "FLOAT")
arcpy.CalculateField_management("fcVegAll","VegArea",[Shape_Area],"VB","#")
logger.info("field VegArea added to store vegetation area")

# Join vegetation to wetland units and sum the vegetation area

#####
#####
# SJ: FloodIn

#####
#####
fmSJFLIN = arcpy.FieldMappings()
fmSJFLIN.addTable("fcWU")
fmSJFLIN.addTable("fcVegAll")

keepers = []
keepers = ["WUKey","Shape_Length","Shape_Area","VegArea"]

for field in fmSJFLIN.fields:
    if field.name not in keepers:
        fmSJFLIN.removeFieldMap(fmSJFLIN.findFieldMapIndex(field.name))

fldKeyIndex = fmSJFLIN.findFieldMapIndex("VegArea")
fieldmap = fmSJFLIN.getFieldMap(fldKeyIndex)
fieldmap.mergeRule = "Sum"
fmSJFLIN.replaceFieldMap(fldKeyIndex, fieldmap)

arcpy.SpatialJoin_analysis("fcWU","fcVegAll","WU_VegAll","JOIN_ONE_TO_ONE","KEEP
_ALL",fmSJFLIN,"INTERSECT")
arcpy.MakeFeatureLayer_management("WU_VegAll","fcWUVegAll")
logger.info("vegetation joined to wetland units and the vegetation area summed up")

# Add field to store ratio of vegetated area to total area
actions.DeleteField("fcWUVegAll","VegRatio")
arcpy.AddField_management("fcWUVegAll", "VegRatio", "FLOAT")

# Calculate ratio of vegetation to Wetland Units area

```



```

arcpy.CalculateField_management("fcWUVegAll","VegRatio","[VegArea]/[Shape_Area]","VB", "#")
    logger.info("field VegRatio added and calculated")

# Add new attribute field to store points for VegAll and set initial value to zero
actions.DeleteField("fcWUVegAll","VegAll")
arcpy.AddField_management("fcWUVegAll", "VegAll", "SHORT")
arcpy.CalculateField_management("fcWUVegAll","VegAll","0","VB", "#")
    logger.info("field VegAll added and initial value set to 0")

# Assign points to Wetland Units for vegetation
strWHERE = """"VegRatio" > 0.5""""
arcpy.SelectLayerByAttribute_management("fcWUVegAll", "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management("fcWUVegAll","VegAll","1","VB", "#")
    logger.info("points assigned to Wetland Units for woody vegetation")
arcpy.SelectLayerByAttribute_management("fcWUVegAll", "CLEAR_SELECTION")

# Clean up
if arcpy.Exists("VegAll"):
    arcpy.Delete_management("VegAll")

```

### 5.7.16 VegPerUng: Flood Attenuation Potential

```
#####  
#  
# File Name: VegPerUng.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 7/17/2015 (modified 11/08/2017)  
# Purpose:  
#   VegPerUng: Used in Water Quality Function / Potential / Vegetation. Max 5 points.  
#   VegPerUng4: Used in Flood Attenuation Function / Potential / Vegetation. Max 4 points.  
#   VegPerUng1: Used in Habitat and Ecological Integrity Function / Potential / Vegetation.  
Max 1 point.  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcVegPerUng(WetlandPoly):  
    logger = logging.getLogger("WFA.FloodAttn.FAPotential.VegPerUng")  
  
    # Clean up if needed  
    if arcpy.Exists("VegPFOPSSPEM"):  
        arcpy.Delete_management("VegPFOPSSPEM")  
    if arcpy.Exists("VegPerUng"):  
        arcpy.Delete_management("VegPerUng")  
    if arcpy.Exists("WUVegPerUngIntersect"):  
        arcpy.Delete_management("WUVegPerUngIntersect")  
    if arcpy.Exists("WUVegPerUngIntersect_SUM_STAT"):  
        arcpy.Delete_management("WUVegPerUngIntersect_SUM_STAT")  
    if arcpy.Exists("WU_VegPerUng"):  
        arcpy.Delete_management("WU_VegPerUng")  
    if arcpy.Exists("WU_VegPerUng1"):  
        arcpy.Delete_management("WU_VegPerUng1")  
  
    # setting the variables  
    arcpy.MakeFeatureLayer_management(globalvars.srcPasturesNotHayfields,  
"fcPasturesNotHayfields")  
    arcpy.MakeFeatureLayer_management(globalvars.srcEnhWetland, "fcEnhWVWetland")  
    logger.info("feature layers ready")  
  
    # Create feature class to store VegPerUng variables
```

```

arcpy.CopyFeatures_management(WetlandPoly, "WU_VegPerUng1")
arcpy.MakeFeatureLayer_management("WU_VegPerUng1", "fcWUVegPerUng1")
logger.info("feature layer WU_VegPerUng1 created")

# selecting and creating a feature class of forests, shrublands, and persistent emergent
vegetation sites within EnhWVWetland
strWHERE = """"ATTRIBUTE" NOT LIKE 'PEM2%' AND ("ATTRIBUTE" LIKE
'PEM%' OR "ATTRIBUTE" LIKE 'PFO%' OR "ATTRIBUTE" LIKE 'PSS%')""""
arcpy.SelectLayerByAttribute_management("fcEnhWVWetland", "NEW_SELECTION",
strWHERE)
arcpy.CopyFeatures_management("fcEnhWVWetland", "VegPFOPSSPEM")
arcpy.MakeFeatureLayer_management("VegPFOPSSPEM", "fcVegPFOPSSPEM")
logger.info("feature class of forests, shrublands, and persistent emergent vegetation sites
within EnhWVWetland created")

# Erase the known grazed pastures from the intermediate vegetation layer
arcpy.Erase_analysis("fcVegPFOPSSPEM", "fcPasturesNotHayfields", "VegPerUng", "#")
arcpy.MakeFeatureLayer_management("VegPerUng", "fcVegPerUng")
logger.info("known grazed pastures from the intermediate vegetation layer erased")

# Calculate the percentage of each Wetland Unit that is persistent ungrazed vegetation
(VegPerUng)
# Attribute each Wetland Unit with the percentage of VerPerUng
actions.DeleteField("fcWUVegPerUng1", "OrigArea")
arcpy.AddField_management("fcWUVegPerUng1", "OrigArea", "DOUBLE")
arcpy.CalculateField_management("fcWUVegPerUng1", "OrigArea", "!SHAPE_Area!",
"PYTHON")
logger.info("field OrigArea created and calculated")

# intersect "fcWUVegPerUng1" with VegPerUng
arInputData = ["fcWUVegPerUng1", "fcVegPerUng"]
arcpy.Intersect_analysis(arInputData, "WUVegPerUngIntersect", "ALL", "#", "INPUT")
arcpy.MakeFeatureLayer_management("WUVegPerUngIntersect",
"fcWUVegPerUngIntersect")
logger.info("Wetland units intersected with VegPerUng")

# add and calculate PctIntersect field
actions.DeleteField("fcWUVegPerUngIntersect", "PctIntersect")
arcpy.AddField_management("fcWUVegPerUngIntersect", "PctIntersect", "FLOAT")
arcpy.CalculateField_management("fcWUVegPerUngIntersect", "PctIntersect",
"!SHAPE_Area!/!OrigArea!*100", "PYTHON")
logger.info("field PctIntersect added and calculated")

# Execute the Summary Statistics function

```

```

    arcpy.Statistics_analysis("fcWUVegPerUngIntersect",
"WUVegPerUngIntersect_SUM_STAT", [{"PctIntersect", "SUM"}],
["FID_WU_VegPerUng1"])
    arcpy.MakeTableView_management(r"WUVegPerUngIntersect_SUM_STAT",
"tvWUVegPerUngIntersectSumm")
    logger.info("summary table WUVegPerUngIntersect_SUM_STAT created")

# Add new field (VegPerUngPct) to attribute table to store the percentage of persistent
ungrazed vegetation
actions.DeleteField("fcWUVegPerUng1","VegPerUngPct")
arcpy.AddField_management("fcWUVegPerUng1", "VegPerUngPct", "FLOAT")
arcpy.CalculateField_management("fcWUVegPerUng1", "VegPerUngPct", "0", "VB")
logger.info("field VegPerUngPct added and initial value set to 0")

# Add new field (VegPerUng) to attribute table to store the score in relation to the percentage
of persistent ungrazed vegetation
actions.DeleteField("fcWUVegPerUng1","VegPerUng")
arcpy.AddField_management("fcWUVegPerUng1", "VegPerUng", "SHORT")
arcpy.CalculateField_management("fcWUVegPerUng1", "VegPerUng", "0", "VB")
logger.info("field VegPerUng added and initial value set to 0")

# Join Wetland Units to the WUVegPerUngIntersect_SUM_STAT table
arcpy.AddJoin_management( "fcWUVegPerUng1", "WUKey",
"tvWUVegPerUngIntersectSumm", "FID_WU_VegPerUng1")
logger.info("joined added to the WUVegPerUngIntersect_SUM_STAT table")

arcpy.FeatureClassToFeatureClass_conversion("fcWUVegPerUng1",arcpy.env.workspace,"W
U_VegPerUng")
arcpy.MakeFeatureLayer_management(r"WU_VegPerUng", "fcWUVegPerUng")
arcpy.CalculateField_management("fcWUVegPerUng", "VegPerUngPct",
"!WUVegPerUngIntersect_SUM_STAT_SUM_PctIntersect!", "PYTHON")
logger.info("field VegPerUngPct calculated")

# Remove Join
arcpy.RemoveJoin_management("fcWUVegPerUng1")
logger.info("join removed")

# Replace null values with 0
strWHERE = """"VegPerUngPct" IS NULL""""

arcpy.SelectLayerByAttribute_management("fcWUVegPerUng","NEW_SELECTION",strWH
ERE)
arcpy.CalculateField_management("fcWUVegPerUng", "VegPerUngPct", "0", "VB")

# Assign points to Wetland Units for VegPerUng
strWHERE = """"VegPerUngPct" > 66.7""""

```

```

arcpy.SelectLayerByAttribute_management("fcWUVegPerUng","NEW_SELECTION",strWHERE)
arcpy.CalculateField_management("fcWUVegPerUng", "VegPerUng", "5", "VB")

strWHERE = """"VegPerUngPct" < 66.701 AND "VegPerUngPct" > 33.3""""

arcpy.SelectLayerByAttribute_management("fcWUVegPerUng","NEW_SELECTION",strWHERE)
arcpy.CalculateField_management("fcWUVegPerUng", "VegPerUng", "3", "VB")

strWHERE = """"VegPerUngPct" < 33.301 AND "VegPerUngPct" > 10""""

arcpy.SelectLayerByAttribute_management("fcWUVegPerUng","NEW_SELECTION",strWHERE)
arcpy.CalculateField_management("fcWUVegPerUng", "VegPerUng", "1", "VB")

strWHERE = """"VegPerUngPct" < 10.001""""

arcpy.SelectLayerByAttribute_management("fcWUVegPerUng","NEW_SELECTION",strWHERE)
arcpy.CalculateField_management("fcWUVegPerUng", "VegPerUng", "0", "VB")
logger.info("points assigned to field VegPerUng")
arcpy.SelectLayerByAttribute_management("fcWUVegPerUng","CLEAR_SELECTION")

# add VegPerUng4 field
actions.DeleteField("fcWUVegPerUng","VegPerUng4")
arcpy.AddField_management("fcWUVegPerUng", "VegPerUng4", "SHORT")
arcpy.CalculateField_management("fcWUVegPerUng", "VegPerUng4", "0", "VB")
logger.info("field VegPerUng4 added and initial value set to 0")

# add VegPerUng1 field
actions.DeleteField("fcWUVegPerUng","VegPerUng1")
arcpy.AddField_management("fcWUVegPerUng", "VegPerUng1", "SHORT")
arcpy.CalculateField_management("fcWUVegPerUng", "VegPerUng1", "0", "VB")
logger.info("field VegPerUng1 added and initial value set to 0")

# Assign points to Wetland Units for VegPerUng4 and VegPerUng1
strWHERE = """"VegPerUngPct" > 10""""

arcpy.SelectLayerByAttribute_management("fcWUVegPerUng","NEW_SELECTION",strWHERE)
arcpy.CalculateField_management("fcWUVegPerUng", "VegPerUng4", "1", "VB")

strWHERE = """"VegPerUngPct" > 33.3""""

```

```

arcpy.SelectLayerByAttribute_management("fcWUVegPerUng","NEW_SELECTION",strWHERE)
arcpy.CalculateField_management("fcWUVegPerUng", "VegPerUng4", "2", "VB")

strWHERE = """"VegPerUngPct" > 50""""

arcpy.SelectLayerByAttribute_management("fcWUVegPerUng","NEW_SELECTION",strWHERE)
arcpy.CalculateField_management("fcWUVegPerUng", "VegPerUng4", "3", "VB")
arcpy.CalculateField_management("fcWUVegPerUng", "VegPerUng1", "1", "VB")

strWHERE = """"VegPerUngPct" > 66.7""""

arcpy.SelectLayerByAttribute_management("fcWUVegPerUng","NEW_SELECTION",strWHERE)
arcpy.CalculateField_management("fcWUVegPerUng", "VegPerUng4", "4", "VB")
logger.info("points assigned to fields VegPerUng1 and VegPerUng4")
arcpy.SelectLayerByAttribute_management("fcWUVegPerUng","CLEAR_SELECTION")

# Clean up
if arcpy.Exists("VegPFOPSSPEM"):
    arcpy.Delete_management("VegPFOPSSPEM")
if arcpy.Exists("VegPerUng"):
    arcpy.Delete_management("VegPerUng")
if arcpy.Exists("WUVegPerUngIntersect"):
    arcpy.Delete_management("WUVegPerUngIntersect")
if arcpy.Exists("WUVegPerUngIntersect_SUM_STAT"):
    arcpy.Delete_management("WUVegPerUngIntersect_SUM_STAT")
if arcpy.Exists("WU_VegPerUng1"):
    arcpy.Delete_management("WU_VegPerUng1")

```

### 5.7.17 VegWoody: Flood Attenuation Potential

```
#####  
#  
# File Name: VegWoody.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 3/15/2016 (modified 11/03/2017)  
# Purpose:  
#   Input to Water Quality / Potential / Vegetation Factor  
#  
#####  
#!/usr/: Input to Water Quality / Potential / Vegetation Factor.bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcVegWoody(WetlandPoly):  
    logger = logging.getLogger("WFA.FloodAttn.FAPotential.VegWoody")  
  
    # Clean up if needed  
    if arcpy.Exists("VegPFOPSS"):  
        arcpy.Delete_management("VegPFOPSS")  
    if arcpy.Exists("VegPFO"):  
        arcpy.Delete_management("VegPFO")  
    if arcpy.Exists("WUPFOJoin"):  
        arcpy.Delete_management("WUPFOJoin")  
    if arcpy.Exists("WU_VegWoody"):  
        arcpy.Delete_management("WU_VegWoody")  
  
    # Setting python variables  
    arcpy.MakeFeatureLayer_management(WetlandPoly, "fcWU")  
    arcpy.MakeFeatureLayer_management(globalvars.srcInput, "fcENWI")  
    logger.info("feature layers ready")  
  
    # Select all woody vegetation, both forest and shrubland  
    strWHERE = """"ATTRIBUTE" LIKE 'PFO%' OR "ATTRIBUTE" LIKE 'PSS%""""  
    arcpy.SelectLayerByAttribute_management("fcENWI", "NEW_SELECTION", strWHERE)  
    logger.info("all woody vegetation, both forest and shrubland selected")  
  
    # Create layer of woody vegetation from selection  
    arcpy.CopyFeatures_management("fcENWI", "VegPFOPSS")  
    arcpy.MakeFeatureLayer_management(r"VegPFOPSS", "fcVegPFOPSS")  
    logger.info("layer VegPFOPSS created of woody vegetation from selection")
```

```

arcpy.SelectLayerByAttribute_management("fcENWI", "CLEAR_SELECTION")

# Add field to store woody area
actions.DeleteField("fcVegPFOPSS", "PFOPSSarea")
arcpy.AddField_management("fcVegPFOPSS", "PFOPSSarea", "FLOAT")

arcpy.CalculateField_management("fcVegPFOPSS", "PFOPSSarea", "[SHAPE_Area]", "VB", "#"
)
logger.info("field PFOPSSarea to store woody area")

# Select just the forest vegetation, not including the shrubs
strWHERE = """"ATTRIBUTE" LIKE 'PFO%""""
arcpy.SelectLayerByAttribute_management("fcENWI", "NEW_SELECTION", strWHERE)
logger.info("the forest vegetation, not including the shrubs selected")

# Create layer of forest vegetation from selection
arcpy.CopyFeatures_management("fcENWI", "VegPFO")
arcpy.MakeFeatureLayer_management(r"VegPFO", "fcVegPFO")
logger.info("layer VegPFO created of forest vegetation from selection")
arcpy.SelectLayerByAttribute_management("fcENWI", "CLEAR_SELECTION")

# Add field to store forest area
actions.DeleteField("fcVegPFO", "PFOarea")
arcpy.AddField_management("fcVegPFO", "PFOarea", "FLOAT")
arcpy.CalculateField_management("fcVegPFO", "PFOarea", "[SHAPE_Area]", "VB", "#")
logger.info("field PFOarea added to store forest area")

# Join forests to Wetland Units and sum the forest area

#####
# SJ: VegPFO

#####
fmSJPFO = arcpy.FieldMappings()
fmSJPFO.addTable("fcWU")
fmSJPFO.addTable("fcVegPFO")

fldKeyIndex1 = fmSJPFO.findFieldMapIndex("PFOarea")
fieldmap1 = fmSJPFO.getFieldMap(fldKeyIndex1)
fieldmap1.mergeRule = "Sum"
fmSJPFO.replaceFieldMap(fldKeyIndex1, fieldmap1)

arcpy.SpatialJoin_analysis("fcWU", "fcVegPFO", "WUPFOjoin", "JOIN_ONE_TO_ONE", "KEEP_ALL", fmSJPFO, "INTERSECT")
arcpy.MakeFeatureLayer_management("WUPFOjoin", "fcWUPFOjoin")

```



```

logger.info("forests joined to wetland units and the forest area summed up")

#####
# SJ: VegPFOPSS

#####
fmSJPSS = arcpy.FieldMappings()
fmSJPSS.addTable("fcWUPFOjoin")
fmSJPSS.addTable("fcVegPFOPSS")

fldKeyIndex2 = fmSJPSS.findFieldMapIndex("PFOPSSarea")
fieldmap2 = fmSJPSS.getFieldMap(fldKeyIndex2)
fieldmap2.mergeRule = "Sum"
fmSJPSS.replaceFieldMap(fldKeyIndex2, fieldmap2)

arcpy.SpatialJoin_analysis("fcWUPFOjoin","fcVegPFOPSS","WU_VegWoody","JOIN_ONE_
TO_ONE","KEEP_ALL",fmSJPSS,"INTERSECT")
fcWUVegWoody = arcpy.mapping.Layer(r"WU_VegWoody")
logger.info("woody vegetation joined to wetland units and the woody area summed up")

# Add fields to store rations of forest and woody area to total area
actions.DeleteField(fcWUVegWoody,"PFOratio")
arcpy.AddField_management(fcWUVegWoody, "PFOratio", "FLOAT")
actions.DeleteField(fcWUVegWoody,"PFOPSSratio")
arcpy.AddField_management(fcWUVegWoody, "PFOPSSratio", "FLOAT")
logger.info("fields PFOratio and PFOPSSratio added to store rations of forest and woody area
to total area")

# Calculate ratio of woody vegetation to Wetland Unit area

arcpy.CalculateField_management(fcWUVegWoody,"PFOPSSratio","[PFOPSSarea]/[Shape_A
rea]","VB","#")
logger.info("ratio of woody vegetation calculated to Wetland Unit area")

# Calculate ratio of forest vegetation to Wetland Unit area

arcpy.CalculateField_management(fcWUVegWoody,"PFOratio","[PFOarea]/[Shape_Area]","V
B","#")
logger.info("ratio of forest vegetation calculated to Wetland Unit area")

#####
# Add new attribute field to store points for VegWoody and set initial value to zero

```

```

#####
actions.DeleteField(fcWUVegWoody,"VegWoody")
arcpy.AddField_management(fcWUVegWoody, "VegWoody", "SHORT")
arcpy.CalculateField_management(fcWUVegWoody,"VegWoody","0","VB","#")
logger.info("field VegWoody added to store points for VegWoody and initial value set to
zero")

actions.DeleteField(fcWUVegWoody,"VegWoody4")
arcpy.AddField_management(fcWUVegWoody, "VegWoody4", "SHORT")
arcpy.CalculateField_management(fcWUVegWoody,"VegWoody4","0","VB","#")
logger.info("field VegWoody4 added to store points for VegWoody and initial value set to
zero")

actions.DeleteField(fcWUVegWoody,"VegWoody2")
arcpy.AddField_management(fcWUVegWoody, "VegWoody2", "SHORT")
arcpy.CalculateField_management(fcWUVegWoody,"VegWoody2","0","VB","#")
logger.info("field VegWoody2 added to store points for VegWoody and initial value set to
zero")

actions.DeleteField(fcWUVegWoody,"VegWoodyFor")
arcpy.AddField_management(fcWUVegWoody, "VegWoodyFor", "SHORT")
arcpy.CalculateField_management(fcWUVegWoody,"VegWoodyFor","0","VB","#")
logger.info("field VegWoodyFor added to store points for VegWoody and initial value set to
zero")

# Assign points to Wetland Units for woody vegetation
strWHERE = "PFOPSSratio" > 0.1
arcpy.SelectLayerByAttribute_management(fcWUVegWoody, "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management(fcWUVegWoody,"VegWoody","1","VB","#")
arcpy.CalculateField_management(fcWUVegWoody,"VegWoody4","1","VB","#")
arcpy.CalculateField_management(fcWUVegWoody,"VegWoody2","1","VB","#")

strWHERE = "PFOPSSratio" > 0.5
arcpy.SelectLayerByAttribute_management(fcWUVegWoody, "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management(fcWUVegWoody,"VegWoody4","2","VB","#")

strWHERE = "PFOPSSratio" > 0.333
arcpy.SelectLayerByAttribute_management(fcWUVegWoody, "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management(fcWUVegWoody,"VegWoody","2","VB","#")

strWHERE = "PFOPSSratio" > 0.667

```

```

    arcpy.SelectLayerByAttribute_management(fcWUVegWoody, "NEW_SELECTION",
strWHERE)
    arcpy.CalculateField_management(fcWUVegWoody,"VegWoody","3","VB","#")

    strWHERE = """"PFOPSSratio" > 0.667 AND "PFOratio" > 0.333""""
    arcpy.SelectLayerByAttribute_management(fcWUVegWoody, "NEW_SELECTION",
strWHERE)
    arcpy.CalculateField_management(fcWUVegWoody,"VegWoody","4","VB","#")
    arcpy.CalculateField_management(fcWUVegWoody,"VegWoody4","3","VB","#")

    strWHERE = """"PFOratio" > 0.667""""
    arcpy.SelectLayerByAttribute_management(fcWUVegWoody, "NEW_SELECTION",
strWHERE)
    arcpy.CalculateField_management(fcWUVegWoody,"VegWoody","5","VB","#")
    arcpy.CalculateField_management(fcWUVegWoody,"VegWoody4","4","VB","#")
    arcpy.CalculateField_management(fcWUVegWoody,"VegWoody2","2","VB","#")

    strWHERE = """"PFOratio" > 0.1 OR "PFOarea" > 10000""""
    arcpy.SelectLayerByAttribute_management(fcWUVegWoody, "NEW_SELECTION",
strWHERE)
    arcpy.CalculateField_management(fcWUVegWoody,"VegWoodyFor","1","VB","#")

    strWHERE = """"("PFOratio" > 0.33 AND "PFOarea" > 2000) OR "PFOarea" > 20000""""
    arcpy.SelectLayerByAttribute_management(fcWUVegWoody, "NEW_SELECTION",
strWHERE)
    arcpy.CalculateField_management(fcWUVegWoody,"VegWoodyFor","2","VB","#")

    strWHERE = """"("PFOratio" > 0.667 AND "PFOarea" > 5000) OR "PFOarea" > 50000""""
    arcpy.SelectLayerByAttribute_management(fcWUVegWoody, "NEW_SELECTION",
strWHERE)
    arcpy.CalculateField_management(fcWUVegWoody,"VegWoodyFor","3","VB","#")
    logger.info("points assigned to Wetland Units for woody vegetation")
    arcpy.SelectLayerByAttribute_management(fcWUVegWoody, "CLEAR_SELECTION")

# Clean up
if arcpy.Exists("VegPFOPSS"):
    arcpy.Delete_management("VegPFOPSS")
if arcpy.Exists("VegPFO"):
    arcpy.Delete_management("VegPFO")
if arcpy.Exists("WUPFOJoin"):
    arcpy.Delete_management("WUPFOJoin")

```

### 5.7.18 Flood Attenuation Society

```
#####  
#  
# File Name: FASociety.py  
# Developer: Yibing Han  
# Date: 12/13/2017  
# Purpose:  
# This script handles the execution of all the Flood Attenuation Value to Society metrics.  
#  
#####  
import datetime  
import logging  
import traceback  
import arcpy  
  
from Factors import Floodway, EconRisk  
from Aspects import FASociety  
  
def procFASociety(WetlandPoly):  
    logger = logging.getLogger("WFA.FloodAttn.FASociety")  
  
    #####  
    ## 1. Run Variables  
    #####  
  
    # None  
  
    #####  
    ## 2. Run Factors  
    #####  
  
    Floodway.DetermineFloodway(WetlandPoly)  
  
    EconRisk.DetermineEconRisk(WetlandPoly)  
  
    #####  
    ## 3. Run Aspect  
    #####  
  
    FASociety.DetermineFASociety(WetlandPoly)
```

### 5.7.19 Flood Attenuation Society Aspects

```
#####  
#  
# File Name: FASociety.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 11/10/2016 (modified 10/31/2017)  
# Purpose:  
#   Flood Attenuation Function  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import arcpy  
from utilities import actions  
import logging  
  
def DetermineFASociety(WetlandPoly):  
    logger = logging.getLogger("WFA.FloodAttn.FASociety.FASociety")  
  
    # Clean up if needed  
    if arcpy.Exists("WU_FASociety"):  
        arcpy.Delete_management("WU_FASociety")  
  
    # Setting python variables  
    arcpy.MakeFeatureLayer_management(r"WU_Floodway","fcFloodway")  
    arcpy.MakeFeatureLayer_management(r"WU_EconRisk","fcEconRisk")  
    logger.info("feature layers ready")  
  
    # Spatial join Floodway & EconRisk to bring in factor values  
    fmSJE = arcpy.FieldMappings()  
    fmSJE.addTable("fcFloodway")  
    fmSJE.addTable("fcEconRisk")  
  
    keepers = []  
    keepers = ["WUKey","Shape_Length","Shape_Area","Floodway","EconRisk"]  
  
    for field in fmSJE.fields:  
        if field.name not in keepers:  
            fmSJE.removeFieldMap(fmSJE.findFieldMapIndex(field.name))  
  
    arcpy.SpatialJoin_analysis("fcFloodway","fcEconRisk","WU_FASociety","JOIN_ONE_TO_O  
NE","KEEP_ALL",fmSJE,"CONTAINS")  
    arcpy.MakeFeatureLayer_management("WU_FASociety","fcWUFASociety")
```

```

logger.info("spatial join Floodway and EconRisk completed")

# Add FASociety field to Wetland Units and set initial point value to zero
actions.DeleteField("fcWUFASociety","FASociety")
arcpy.AddField_management("fcWUFASociety", "FASociety", "SHORT")
arcpy.CalculateField_management("fcWUFASociety","FASociety","0","VB","#")
logger.info("FASociety field added to Wetland Units and initial point value set to zero")

# Sum the factor points

arcpy.CalculateField_management("fcWUFASociety","FASociety","[Floodway]+[EconRisk]",
"VB","#")
logger.info("field FASociety calculated")

# Reduce the values that exceed the maximum allowable points
strWHERE = """"FASociety" > 4""""

arcpy.SelectLayerByAttribute_management("fcWUFASociety","NEW_SELECTION",strWHERE)
arcpy.CalculateField_management("fcWUFASociety","FASociety","4","VB","#")
logger.info("points for wetlands reduced to a maximum of 4")
arcpy.SelectLayerByAttribute_management("fcWUFASociety","CLEAR_SELECTION")

```

### 5.7.20 EconRisk: Flood Attenuation Society

```
#####  
#  
# File Name: EconRisk.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 5/12/2016 (modified 12/04/2017)  
# Purpose:  
# Flood Attenuation / Value to Society  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def DetermineEconRisk(WetlandPoly):  
    logger = logging.getLogger("WFA.FloodAttn.FASociety.EconRisk")  
  
    # Clean up if needed  
    if arcpy.Exists("WU_EconRisk"):  
        arcpy.Delete_management("WU_EconRisk")  
  
    # Setting python variables  
    fcTotalLossRP100 = arcpy.mapping.Layer(globalvars.srcTotalLossRP100)  
    fcWS12digit = arcpy.mapping.Layer(globalvars.srcWS12digit)  
  
    # Create new feature class to store EconRisk data  
    arcpy.CopyFeatures_management(WetlandPoly, "WU_EconRisk")  
    fcWUEconRisk = arcpy.mapping.Layer(r"WU_EconRisk")  
    logger.info("feature layers ready")  
  
    # Add field to store EconRisk and set initial value to zero  
    actions.DeleteField(fcWUEconRisk,"EconRisk")  
    arcpy.AddField_management(fcWUEconRisk, "EconRisk", "SHORT")  
    arcpy.CalculateField_management(fcWUEconRisk,"EconRisk","0","VB","#")  
    logger.info("field EconRisk added and intital value set to 0")  
  
    # Select Census blocks and assign point to Wetland Units  
    # Assign 1 point to wetland in socond lowest quintile or within HUC12 with loss areas  
  
arcpy.SelectLayerByAttribute_management(fcTotalLossRP100,"NEW_SELECTION", """"Total  
LossRP100" > 0""")
```

```
arcpy.SelectLayerByLocation_management(fcWS12digit,"INTERSECT",fcTotalLossRP100,"#",
"NEW_SELECTION")
```

```
arcpy.SelectLayerByLocation_management(fcWUEconRisk,"INTERSECT",fcWS12digit,"#",
NEW_SELECTION)
```

```
arcpy.CalculateField_management(fcWUEconRisk,"EconRisk","1","VB","#")
```

```
logger.info("1 point assigned to wetland in socond lowest quintile or within HUC12 with loss
areas")
```

```
arcpy.SelectLayerByAttribute_management(fcWUEconRisk, "CLEAR_SELECTION")
```

```
arcpy.SelectLayerByAttribute_management(fcTotalLossRP100, "CLEAR_SELECTION")
```

```
arcpy.SelectLayerByAttribute_management(fcWS12digit, "CLEAR_SELECTION")
```

```
# Assign 2 points to wetlands in middle quintile or within 1km of second highest quintile
```

```
arcpy.SelectLayerByAttribute_management(fcTotalLossRP100,"NEW_SELECTION", """"Tota
lLossRP100" > 42""")
```

```
arcpy.SelectLayerByLocation_management(fcWUEconRisk,"INTERSECT",fcTotalLossRP100
,"#", "NEW_SELECTION")
```

```
arcpy.CalculateField_management(fcWUEconRisk,"EconRisk","2","VB","#")
```

```
logger.info("2 points assigned to wetland in middle quintile")
```

```
arcpy.SelectLayerByAttribute_management(fcWUEconRisk, "CLEAR_SELECTION")
```

```
arcpy.SelectLayerByAttribute_management(fcTotalLossRP100, "CLEAR_SELECTION")
```

```
arcpy.SelectLayerByAttribute_management(fcTotalLossRP100,"NEW_SELECTION", """"Tota
lLossRP100" > 200""")
```

```
arcpy.SelectLayerByLocation_management(fcWUEconRisk,"INTERSECT",fcTotalLossRP100
,"1000 Meters", "NEW_SELECTION")
```

```
arcpy.CalculateField_management(fcWUEconRisk,"EconRisk","2","VB","#")
```

```
logger.info("2 points assigned to wetland within 1km of second highest quintile")
```

```
arcpy.SelectLayerByAttribute_management(fcWUEconRisk, "CLEAR_SELECTION")
```

```
arcpy.SelectLayerByAttribute_management(fcTotalLossRP100, "CLEAR_SELECTION")
```

```
arcpy.SelectLayerByAttribute_management(fcWS12digit, "CLEAR_SELECTION")
```

```
# Assign 3 points to wetlands in second highest quintile or within 2km of highest quintile
```

```
arcpy.SelectLayerByAttribute_management(fcTotalLossRP100,"NEW_SELECTION", """"Tota
lLossRP100" > 200""")
```

```
arcpy.SelectLayerByLocation_management(fcWUEconRisk,"INTERSECT",fcTotalLossRP100
,"#", "NEW_SELECTION")
```

```
arcpy.CalculateField_management(fcWUEconRisk,"EconRisk","3","VB","#")
```

```
logger.info("3 points assigned to wetland in second highest quintile")
```



```
arcpy.SelectLayerByAttribute_management(fcWUEconRisk, "CLEAR_SELECTION")
arcpy.SelectLayerByAttribute_management(fcTotalLossRP100, "CLEAR_SELECTION")
```

```
arcpy.SelectLayerByAttribute_management(fcTotalLossRP100,"NEW_SELECTION", """"Tota
lLossRP100" > 1204""")
```

```
arcpy.SelectLayerByLocation_management(fcWUEconRisk,"INTERSECT",fcTotalLossRP100
,"1000 Meters","NEW_SELECTION")
arcpy.CalculateField_management(fcWUEconRisk,"EconRisk","3","VB","#")
logger.info("3 points assigned to wetland within 2km of highest quintile")
arcpy.SelectLayerByAttribute_management(fcWUEconRisk, "CLEAR_SELECTION")
arcpy.SelectLayerByAttribute_management(fcTotalLossRP100, "CLEAR_SELECTION")
arcpy.SelectLayerByAttribute_management(fcWS12digit, "CLEAR_SELECTION")
```

# Assign 4 points to wetlands in highest quintile

```
arcpy.SelectLayerByAttribute_management(fcTotalLossRP100,"NEW_SELECTION", """"Tota
lLossRP100" > 1204""")
```

```
arcpy.SelectLayerByLocation_management(fcWUEconRisk,"INTERSECT",fcTotalLossRP100
,"#", "NEW_SELECTION")
arcpy.CalculateField_management(fcWUEconRisk,"EconRisk","4","VB","#")
logger.info("4 points assigned to wetland in highest quintile")
arcpy.SelectLayerByAttribute_management(fcWUEconRisk, "CLEAR_SELECTION")
arcpy.SelectLayerByAttribute_management(fcTotalLossRP100, "CLEAR_SELECTION")
arcpy.SelectLayerByAttribute_management(fcWS12digit, "CLEAR_SELECTION")
```

### 5.7.21 Floodway: Flood Attenuation Society

```
#####  
#  
# File Name: Floodway.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 5/27/2016 (modified 12/04/2017)  
# Purpose:  
# Flood Attenuation Function / Value to Society  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def DetermineFloodway(WetlandPoly):  
    logger = logging.getLogger("WFA.FloodAttn.FASociety.Floodway")  
  
    # Clean up if needed  
    if arcpy.Exists("WU_Floodway"):  
        arcpy.Delete_management("WU_Floodway")  
  
    # Setting python variables  
    fcFHFloodway = arcpy.mapping.Layer(globalvars.srcFHFloodway)  
  
    # Create feature class to store Floodway points  
    arcpy.CopyFeatures_management(WetlandPoly, "WU_Floodway")  
    fcWUFloodway = arcpy.mapping.Layer(r"WU_Floodway")  
    logger.info("feature layers ready")  
  
    # Create field to store Floodway points and set initial value to zero  
    actions.DeleteField(fcWUFloodway, "Floodway")  
    arcpy.AddField_management(fcWUFloodway, "Floodway", "SHORT")  
    arcpy.CalculateField_management(fcWUFloodway, "Floodway", "0", "PYTHON_9.3")  
    logger.info("field Floodway created and initial value set to zero")  
  
    # Select Wetland Units that intersect a Floodway  
  
arcpy.SelectLayerByLocation_management(fcWUFloodway, "INTERSECT", fcFHFloodway, "#  
", "NEW_SELECTION")  
    logger.info("Wetland Units that intersect a Floodway selected")
```

```
# Assign Points
arcpy.CalculateField_management(fcWUFloodway, "Floodway", "4", "VB")
logger.info("4 points assigned to Wetland Units that intersect a Floodway")
arcpy.SelectLayerByAttribute_management(fcWUFloodway, "CLEAR_SELECTION")
```

## 5.7.22 Globalvars

```
#####  
#  
# File Name: globalvar.py  
# Developer: Yibing Han @ West Virginia GIS Tech Center  
# Date: 02/2018  
# Purpose:  
# Stores source data paths that are used by all the metrics involved in the Wetland Functional  
# Assessment  
#  
#####  
#!/usr/bin/python  
  
# Input wetlands polygon  
srcInput = ""  
  
# Log file directory  
srcLogFolder = "Q:\\\\WATER RESOURCES\\WAB\\WETLANDS\\Functional  
Assessment\\3_Code\\FunctionalAssessmentFramework\\logs"  
  
# Results geodatabase directory  
srcGDBFolder =  
"M:\\\\wr\\WTRSHD_BRANCH_INTERNAL\\WETLAND\\WetlandFunctionResults\\test\\"  
  
# Working file directory  
srcTempFolder = "M:\\\\wr\\WTRSHD_BRANCH_INTERNAL\\WETLAND\\WorkingFiles"  
  
# Final Database location  
srcFinalDatabase =  
"M:\\\\wr\\WTRSHD_BRANCH_INTERNAL\\WETLAND\\WetlandFunctionResults\\test\\WV  
WRAMGISresults.mdb"
```

```

# AquaAbund, Histosol, HydSW, IrrEdge, LandPos, MarlPEM, Microtopo, Organic,
SeasonPond, StreamEdge, VegAll, VegByLP, VegPerUng, VegWoody, WFlowPath
#srcEnhWetland =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\EnhancedNWI_20150511.gdb\CON
US_WVWetlandsProj\EnhWVWetland"
srcEnhWetland =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\NWI_WV_20190304.gdb\NWI_WV
_20190304"

# Basic Geometries
srcWUPoint = r"WUPoint"
srcBuffer10m = r"Buffer10m"
srcBuffer50m = r"Buffer50m"
srcBuffer300m = r"Buffer300m"
srcBuffer1km = r"Buffer1km"
srcDrainageArea = r"DrainageArea"

# AquaAbund
srcStreams = r"M:\basemap\NHD_H_West_VirginiaTransfer2022.gdb\NHDFlowline"

# BRank
srcBRankInput =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceFunctionalAssessment\Habitat
Data.gdb\BRankInput"

# BRankHUC
srcBRHUC =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceAsReceived\BRankHUC"

# BufferContig, BufferPerim, Disturb50m, DisturbWshd

```

```

srcDisturbedLand =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceFunctionalAssessment\Water
QualityDatasets.gdb\DisturbedLand"

# BufferContig
#srcBuffer300m =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\WetlandUnits.gdb\Buffer300m"

# BufferPerim
#srcBuffer10m =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\WetlandUnits.gdb\Buffer10m"
srcInterstates = r"M:\basemap\tiger_2013\WV_Transportation_UTM.gdb\Interstates"
srcPrimaryRoads = r"M:\basemap\tiger_2013\WV_Transportation_UTM.gdb\Primary_Roads"
srcLocalRoads = r"M:\basemap\tiger_2013\WV_Transportation_UTM.gdb\Local_Roads"
srcOtherRoads =
r"M:\basemap\tiger_2013\WV_Transportation_UTM.gdb\Other_Roads_And_Trails"
srcRailway =
r"M:\LayerFiles\arcsde_backup.gdb\basemap_cultural_non_replica\SDE_railway_tiger" # Also:
RoadRail

# Clay
srcPalustrinePlots =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\WetlandsGeodatasets.gdb\PalustrineP
lots"
srcSSURGO =
"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceFunctionalAssessment\SsurgoE
xports.gdb\SsurgoClay"

# ConsFocus
srcCFArea =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceFunctionalAssessment\Habitat
Data.gdb\ConsFocusArea"

```

```

# Discharges

srcSeptic =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceFunctionalAssessment\Water
QualityDatasets.gdb\Septic"

srcOWRNPDES = r"M:\wr\owrnpdes_.shp" # Also: Septic

srcOWRNPDESOutlets = r"M:\wr\owrnpdes_outlets.shp"

srcHPU = r"M:\mr\hpu.shp"

srcAMLAMD =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceFunctionalAssessment\Water
QualityDatasets.gdb\AMLAMDFeb2016"

srcWellPads =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceFunctionalAssessment\Water
QualityDatasets.gdb\WellPads_20160325"

srcNPLPoint =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceFunctionalAssessment\Water
QualityDatasets.gdb\NPL_point_20160406"

srcNPLBndry =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceFunctionalAssessment\Water
QualityDatasets.gdb\NPL_Bndry_20160406"

# DisturbWshd, LandPos, RunoffWshd, SlopeWshd, WFlowPath, ImpairedIn

#srcDrainageArea =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\WetlandUnits.gdb\DrainageArea27m
"

# DrainageArea

srcFlowDir =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceFunctionalAssessment\Waters
hed.gdb\hydrogrid_16U_flowdir_27m"

# EconRisk

srcTotalLossRP100 =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceFunctionalAssessment\Floodpl
ainData.gdb\TotalLossRP100"

```

```
srcWS12digit = r"M:\basemap\watersheds_12digit.shp"
```

```
# Fisheries
```

```
srcTrout = r"M:\wr\WTRSHD_BRANCH\TROUT\Trout_Streams.shp"
```

```
srcHQSFisheries =
```

```
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceAsReceived\DNR_Fishing\HighQualityStreamFisheriesWVDNR20150820.shp"
```

```
srcTroutStreams =
```

```
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceAsReceived\DNR_Fishing\TrStStreams.shp"
```

```
# FloodArea
```

```
srcFPARAFEMA =
```

```
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceFunctionalAssessment\FloodplainData.gdb\FloodplainARAFEMA"
```

```
srcPeatlands =
```

```
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\WetlandsGeodatasets.gdb\Peatlands_20160228" # Also: Histosol, Organic, SoilRunoff, WFlowPath
```

```
# Floodway
```

```
srcFHFloodway =
```

```
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceFunctionalAssessment\FloodplainData.gdb\FEMA_NFHL_Floodway_20231207_wmA84\FEMA_NFHL_Floodway_20231207_wmA84"
```

```
# HInvest, OwnerAccess, PublicUse
```

```
srcLocalPark =
```

```
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceAsReceived\Boundaries2017\countyCityParkBoundaries_20107731_utm83.gdb\countyCityParkBoundaries_20170731_utm83"
```

```
srcNF =
```

```
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceAsReceived\Boundaries2017\nationalForestOwnership_USFWS_20170803_utm83.gdb\nationalForestOwnership_USFWS_20170803_utm83" # Also: WQPlan
```



srcNP =  
r"M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceAsReceived\Boundaries2017\nationalParkBoundaries\_nationalParkService\_20170802.gdb\nationalParkBoundaries\_nationalParkService\_20170802" # Also: WQPlan

srcNWR =  
r"M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceAsReceived\Boundaries2017\nationalWildlifeRefuge\_USFWS\_20170803\_utm83.gdb\nationalWildlifeRefuge\_USFWS\_20170803\_utm83" # Also: WQPlan

srcWMA =  
r"M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceAsReceived\Boundaries2017\wvdnrManagedLands\_wvdnr\_20170731\_utm83.gdb\wvdnrManagedLands\_wvdnr\_20170731\_utm83"

srcSP =  
r"M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceAsReceived\Boundaries2017\stateParkBoundaries\_WVDNR\_20170927\_utm83.gdb\stateParkBoundaries\_WVDNR\_20170927\_utm83"

srcSF =  
r"M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceAsReceived\Boundaries2017\wvStateForestBoundaries\_wvdof\_20171003\_utm83.gdb\wvStateForestBoundaries\_wvdof\_20171003\_utm83"

srcBotanicalAreas =  
r"M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceAsReceived\USFS\botanical\_areas\_MNF.shp"

srcProtectedLands =  
r"M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceAsReceived\WV\_Protected\_Lands\_2015\_PUBLIC\WV\_Protected\_Lands\_2015\_PUBLIC.shp"

srcNatStrPreAct =  
r"M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceFunctionalAssessment\Watershed.gdb\NatStrPreAct\_HUC10" # Also: WQPlan

srcILF =  
r"M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandsGeodatasets.gdb\ILF\_banks"

srcRestoredWetlands =  
r"M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\WetlandsGeodatasets.gdb\RestoredWetlands"

```

srcInfrastructure =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\WetlandsGeodatasets.gdb\InfrastructureWetlands"

srcFishAccess =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceAsReceived\DNR_Fishing\PublicFishingAccessSites_2017_10.shp"

srcPropertyBoundary =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceAsReceived\201710_WVDNR_property_boundary.gdb\PropertyBoundaries_WVDNR_20171011"

srcEBird =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceFunctionalAssessment\HabitatData.gdb\EBirdHotspots"

srcTrails =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceAsReceived\trails_Sep_27_2017_webmercator.shp" #also: BufferPerim

srcExempBranked =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\WetlandsGeodatasets.gdb\ExemplaryOrBrankedWetlands31Mar2015"

# Histosol, Organic

srcPalustrineplots =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\WetlandsGeodatasets.gdb\PalustrinePlots"

srcHisticEpipedon =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceFunctionalAssessment\SsurgoExports.gdb\HisticEpipedon"

srcHistosol =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceFunctionalAssessment\SsurgoExports.gdb\Histosol"

srcSSURGOWV = r"M:\basemap\ssurgo\SSURGO.gdb\ssurgo_wv"

srcSsurgoOrganic =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceFunctionalAssessment\SsurgoExports.gdb\SsurgoOrganic"

```

```

# HUC12WQ, ImpairedIn, ImpairedOut
srcHUC12s = r"M:\basemap\watersheds_12digit.shp"

srcPublicFishingLakes =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceAsReceived\DNR_Fishing\PublicFishingLakesWVDNR20150820.shp"

srcAlgalStreams =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceFunctionalAssessment\WaterQualityDatasets.gdb\AlgalStreams"

srcAlgalLakes =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceFunctionalAssessment\WaterQualityDatasets.gdb\AlgalLakes"

srcImpairedStreams =
r"M:\wr\WTRSHD_BRANCH\303D_TMDL_IMPAIRED\WV2016_ImpairedStreams_24KNHD.shp"

srcLimeStone = r"M:\basemap\geology_shapefiles\type\geology-TYPE-limestone.shp"
srcDolostone = r"M:\basemap\geology_shapefiles\type\geology-TYPE-dolostone.shp"

# HydSW

srcNWIOpenWater =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceFunctionalAssessment\NWIEExports.gdb\NWIOpenWater"

# IrrEdge

srcRiversLakes =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceFunctionalAssessment\NWIEExports.gdb\RiversLakes"

# Karst

srcKarstComp =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceFunctionalAssessment\WaterQualityDatasets.gdb\KarstComposite"

# LandInteg

```

```

srcForestPatches =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceAsReceived\forest_patches_ove
r50acres_WVplus10mi.shp"

#srcResilientConnected =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceAsReceived\Resilient_and_Con
nected_Landscapes\Resilient_and_Connected_Data.gdb\Resilient_and_Connected"

srcResilientConnected =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceFunctionalAssessment\Res_C
onnected"

srcLIIndex =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceAsReceived\landscapeIntegrit
yIndex_WVDNR_2008_utm83_img\landscapeIntegrityIndex_WVDNR_2008_utm83.img"

#srcWUPoint =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\WetlandUnits.gdb\WUpoint"

srcIEI =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceFunctionalAssessment\Habitat
Data.gdb\IEIUMa2010v32"

# LandPos

srcWBRivers = r"M:\basemap\national_hydrology_dataset\wb-rivers.shp"

srcFSOFlow =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceFunctionalAssessment\Water
QualityDatasets.gdb\FirstSecondOrderFlowlines"

# MarIPEM

srcMarlSoils =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceFunctionalAssessment\Ssurgo
Exports.gdb\MarlSoils"

# RoadRail

srcTransUTMAllRoads = r"M:\basemap\tiger_2013\WV_Transportation_UTM.gdb\All_Roads"

# Runoff50m, RunoffWshd

```

```

srcRunoffLand =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceFunctionalAssessment\Water
QualityDatasets.gdb\Runoffland"

#srcBuffer50m =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\WetlandUnits.gdb\Buffer50m"

# Septic
srcSAMBPoints = r"M:\basemap\WVSAMB\structures_SAMB_points_UTM83.shp"
srcSeweredAreas =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceFunctionalAssessment\Water
QualityDatasets.gdb\SeweredAreas"
srcSepticFailed =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceFunctionalAssessment\Water
QualityDatasets.gdb\SepticFailureRiskStatsgo"
srcUrbanized = r"M:\LayerFiles\arcsde_backup.gdb\tiger2010\urbanized_areas"

# Slope, SlopeWshd
srcSlopePCT = r"M:\elevation\statewide_slope_pct.tif"

# StreamEdge
srcRivers =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceFunctionalAssessment\NWIEx
ports.gdb\Rivers"

# VegByLP
srcLakes =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceFunctionalAssessment\NWIEx
ports.gdb\Lakes"

# VegPerUng
srcPasturesNotHayfields =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceFunctionalAssessment\Water
QualityDatasets.gdb\PasturesNotHayfields"

```

```

# WatershedPlan, WQPlan

srcWatershedPlan =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceFunctionalAssessment\Water
QualityDatasets.gdb\WatershedPlan"

# WaterSupply

PSWI_WATERSHEDS = r"M:\environmental\CONFIDENTIAL-
public_surface_water_intakes\pswi_distance_analysis_9m.gdb\pswi_watersheds_with_out_of_s
tate_drainage"

ZPC_5HR = r"M:\environmental\CONFIDENTIAL-
public_surface_water_intakes\CONFIDENTIAL-
source_water_assessment_and_protection.gdb\ZPC_statewide_5hrabove"

ZCC_WV = r"M:\environmental\CONFIDENTIAL-
public_surface_water_intakes\CONFIDENTIAL-
source_water_assessment_and_protection.gdb\ZCC_statewide"

PROTECTION_AREAS = r"M:\environmental\CONFIDENTIAL-
public_surface_water_intakes\CONFIDENTIAL-
source_water_assessment_and_protection.gdb\Source_Water_Protection_Areas"

PSWI_TEMPLATE =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceFunctionalAssessment\templat
es.gdb\pws_i_scoring_output_template"

# WetlandBird

srcWetBird =
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\SourceFunctionalAssessment\Habitat
Data.gdb\WetlandBirds_WetBirdColumnOnly"

# WFlowPath

srcNHDWB24kRivers =
r"M:\LayerFiles\arcsde_backup.gdb\basemap_physical_non_replica\SDE_NHD_waterbodies_2
4k_rivers"

srcNHDFlowline = r"M:\basemap\NHD_H_West_Virginia.gdb\Hydrography\NHDFlowline" #
Also: StreamEdge

```

# WshdPos

srcDrainage =

r"M:\LayerFiles\arcsde\_backup.gdb\basemap\_physical\_non\_replica\SDE\_NHD\_reach\_24k\_gt\_50\_mi\_drainage"

# WshdUniq

srcHUCWetSizeUniq =

r"M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceFunctionalAssessment\Watershed.gdb\HUCWetlandSizeUniq"

# WQUse

srcSwimmingAreas =

r"M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceFunctionalAssessment\WaterQualityDatasets.gdb\SwimmingAreas2016"

# WQPlan

srcTMDL =

r"M:\wr\WTRSHD\_BRANCH\_INTERNAL\WETLAND\SourceFunctionalAssessment\WaterQualityDatasets.gdb\TMDL"

### 5.7.23 Habitat and Ecological Integrity

```
#####  
#  
# File Name: HabEco.py  
# Developer: Yibing Han  
# Date: 12/13/2017  
# Purpose:  
# This script handles the execution of all metrics within the Habitat & Ecological Integrity  
# module.  
#  
#####  
#!/usr/bin/python  
import sys  
import arcpy  
import datetime  
import logging  
import traceback  
  
from HPotential import HPotential  
from HOpportun import HOpportun  
from HSociety import HSociety  
from HFunction import HFuncNoBR, BRank, HFunction  
  
logger = logging.getLogger("WFA.HabEco")  
  
def RunHabEco(WetlandPoly):  
  
    ## 1. Run Habitat and Ecological Integrity Opportunity Variables/Aspects/Factors  
    logger.info("Running Habitat and Ecological Integrity Opportunity  
Variables/Aspects/Factors...")
```



```

try:
    HOportun.procHOportun(WetlandPoly)
    logger.info("Habitat and Ecological Integrity Opportunity Variables/Aspects/Factors
completed")
except arcpy.ExecuteError:
    msgs = "EXECUTE ERRORS:\n" + arcpy.GetMessages(2) + "\n"
    arcpy.AddError(msgs)
    logger.error(msgs)
    sys.exit(1)
except:
    tb = sys.exc_info()[2]
    tbinfo = traceback.format_tb(tb)[0]
    pymsg = "PYTHON ERRORS:\nTraceback info:\n" + tbinfo + "\nError Info:\n" +
str(sys.exc_info()[1])
    msgs = "ArcPy ERRORS:\n" + arcpy.GetMessages(2) + "\n"

    arcpy.AddError(pymsg)
    arcpy.AddError(msgs)
    logger.error(pymsg)
    logger.error(msgs)
    sys.exit(1)

```

## 2. Run Habitat and Ecological Integrity Potential Variables/Aspects/Factors

```

logger.info("Running Habitat and Ecological Integrity Potential
Variables/Aspects/Factors...")
try:
    HPotential.procHPotential(WetlandPoly)
    logger.info("Habitat and Ecological Integrity Potential Variables/Aspects/Factors
completed")
except arcpy.ExecuteError:
    msgs = "EXECUTE ERRORS:\n" + arcpy.GetMessages(2) + "\n"

```

```

    arcpy.AddError(msgs)
    logger.error(msgs)
    sys.exit(1)
except:
    tb = sys.exc_info()[2]
    tbinfo = traceback.format_tb(tb)[0]
    pymsg = "PYTHON ERRORS:\nTraceback info:\n" + tbinfo + "\nError Info:\n" +
str(sys.exc_info()[1])
    msgs = "ArcPy ERRORS:\n" + arcpy.GetMessages(2) + "\n"

    arcpy.AddError(pymsg)
    arcpy.AddError(msgs)
    logger.error(pymsg)
    logger.error(msgs)
    sys.exit(1)

```

## 3. Run Habitat and Ecological Integrity Society Variables/Aspects/Factors

```

logger.info("Running Habitat and Ecological Integrity Society Variables/Aspects/Factors...")
try:
    HSociety.procHSociety(WetlandPoly)
    logger.info("Habitat and Ecological Integrity Society Variables/Aspects/Factors
completed")
except arcpy.ExecuteError:
    msgs = "EXECUTE ERRORS:\n" + arcpy.GetMessages(2) + "\n"
    arcpy.AddError(msgs)
    logger.error(msgs)
    sys.exit(1)
except:
    tb = sys.exc_info()[2]
    tbinfo = traceback.format_tb(tb)[0]

```

```
pymsg = "PYTHON ERRORS:\nTraceback info:\n" + tbinfo + "\nError Info:\n" +  
str(sys.exc_info()[1])
```

```
msgs = "ArcPy ERRORS:\n" + arcpy.GetMessages(2) + "\n"
```

```
arcpy.AddError(pymsg)
```

```
arcpy.AddError(msgs)
```

```
logger.error(pymsg)
```

```
logger.error(msgs)
```

```
sys.exit(1)
```

## 4. Run Habitat and Ecological Integrity Function to roll up Variables/Aspects/Factors  
excluding BRank

```
logger.info("Running Habitat and Ecological Integrity Function to roll up  
Variables/Aspects/Factors excluding BRank...")
```

```
try:
```

```
    HFuncNoBR.CalcHFuncNoBR()
```

```
    logger.info("Habitat and Ecological Integrity Function to roll up Variables/Aspects/Factors  
excluding BRank completed")
```

```
except arcpy.ExecuteError:
```

```
    msgs = "EXECUTE ERRORS:\n" + arcpy.GetMessages(2) + "\n"
```

```
    arcpy.AddError(msgs)
```

```
    logger.error(msgs)
```

```
    sys.exit(1)
```

```
except:
```

```
    tb = sys.exc_info()[2]
```

```
    tbinfo = traceback.format_tb(tb)[0]
```

```
    pymsg = "PYTHON ERRORS:\nTraceback info:\n" + tbinfo + "\nError Info:\n" +  
str(sys.exc_info()[1])
```

```
    msgs = "ArcPy ERRORS:\n" + arcpy.GetMessages(2) + "\n"
```

```
    arcpy.AddError(pymsg)
```

```
arcpy.AddError(msgs)
logger.error(pymsg)
logger.error(msgs)
sys.exit(1)
```

### ## 5. Run BRank Function

```
logger.info("Running BRank Function...")
try:
    BRank.CalcBRank(WetlandPoly)
    logger.info("BRank Function completed")
except arcpy.ExecuteError:
    msgs = "EXECUTE ERRORS:\n" + arcpy.GetMessages(2) + "\n"
    arcpy.AddError(msgs)
    logger.error(msgs)
    sys.exit(1)
except:
    tb = sys.exc_info()[2]
    tbinfo = traceback.format_tb(tb)[0]
    pymsg = "PYTHON ERRORS:\nTraceback info:\n" + tbinfo + "\nError Info:\n" +
str(sys.exc_info()[1])
    msgs = "ArcPy ERRORS:\n" + arcpy.GetMessages(2) + "\n"

    arcpy.AddError(pymsg)
    arcpy.AddError(msgs)
    logger.error(pymsg)
    logger.error(msgs)
    sys.exit(1)
```

### ## 6. Run Habitat and Ecological Integrity Function to roll up Variables/Aspects/Factors

```

logger.info("Running Habitat and Ecological Integrity Function to roll up
Variables/Aspects/Factors...")

try:
    HFunction.CalcHFunction()

    logger.info("Habitat and Ecological Integrity Function to roll up Variables/Aspects/Factors
completed")

except arcpy.ExecuteError:
    msgs = "EXECUTE ERRORS:\n" + arcpy.GetMessages(2) + "\n"
    arcpy.AddError(msgs)
    logger.error(msgs)
    sys.exit(1)

except:
    tb = sys.exc_info()[2]
    tbinfo = traceback.format_tb(tb)[0]
    pymsg = "PYTHON ERRORS:\nTraceback info:\n" + tbinfo + "\nError Info:\n" +
str(sys.exc_info()[1])
    msgs = "ArcPy ERRORS:\n" + arcpy.GetMessages(2) + "\n"

    arcpy.AddError(pymsg)
    arcpy.AddError(msgs)
    logger.error(pymsg)
    logger.error(msgs)
    sys.exit(1)

```

### 5.7.24 BRank: Habitat and Ecological Integrity Function

```
#####  
#  
# File Name: BRank.py  
# Developer: Yibing Han  
# Date: 10/17/2017 (revised 11/6/2017)  
# Purpose:  
#   Input to Habitat / Value to Society / HUse  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import arcpy  
from utilities import actions  
from globalvars import globalvars  
import logging  
  
def CalcBRank(WetlandPoly):  
    logger = logging.getLogger("WFA.HabEco.BRank")  
  
    # Clean up if needed  
    if arcpy.Exists("WU_BRank"):  
        arcpy.Delete_management("WU_BRank")  
    if arcpy.Exists("WU_BRank_join"):  
        arcpy.Delete_management("WU_BRank_join")  
    if arcpy.Exists("WU_BRank_summ"):  
        arcpy.Delete_management("WU_BRank_summ")  
    if arcpy.Exists("WU_BRank_summB5"):  
        arcpy.Delete_management("WU_BRank_summB5")  
    if arcpy.Exists("WU_BRank_summB4"):  
        arcpy.Delete_management("WU_BRank_summB4")  
    if arcpy.Exists("WU_BRank_summB3"):  
        arcpy.Delete_management("WU_BRank_summB3")  
    if arcpy.Exists("WU_BRank_summB2"):  
        arcpy.Delete_management("WU_BRank_summB2")  
    if arcpy.Exists("WU_BRank_summB1"):  
        arcpy.Delete_management("WU_BRank_summB1")  
  
    # Setting python variables  
    arcpy.MakeFeatureLayer_management(WetlandPoly, "fcWU")  
    arcpy.MakeFeatureLayer_management(globalvars.srcBRankInput, 'fcBRankInput')  
    logger.info("feature layers ready")
```

```

## STEP 1: Create feature class and add fields to store BRank values
arcpy.CopyFeatures_management("fcWU","WU_BRank","#","0","0","0")
arcpy.MakeFeatureLayer_management(r"WU_BRank", "fcBRank")
logger.info("feature class WU_BRank created")

## Add fields to store partial B-Rank based on single elements, concentrations, and final
BRank
actions.DeleteField("fcBRank", "BSing")
actions.DeleteField("fcBRank", "BConc")
actions.DeleteField("fcBRank", "BRank")
arcpy.AddField_management("fcBRank", "BSing", "TEXT", field_length = 10)
arcpy.AddField_management("fcBRank", "BConc", "TEXT", field_length = 10)
arcpy.AddField_management("fcBRank", "BRank", "TEXT", field_length = 10)
logger.info("fields added to store partial B-Rank based on single elements, concentrations,
and final BRank")

## STEP 2: Assign Site Biodiversity Ranks based on single element occurrences
## Rank B6 selection
strWHERE = """"Srank" = 'S3' AND "OQrank" IN ( 'B', 'C')""""
arcpy.SelectLayerByAttribute_management("fcBRankInput", "NEW_SELECTION",
strWHERE)
arcpy.SelectLayerByLocation_management("fcBRank", "INTERSECT", "fcBRankInput")
arcpy.CalculateField_management("fcBRank", "BSing", "B6", "PYTHON")
logger.info("B6 selection ranked")

## Rank B5 selection
strWHERE = """"("Grank" = 'G3' AND "OQrank" = 'D' AND ("EO_Count" = 1 OR "Flag" =
'BestState')) OR
("Srank" = 'S1' AND "OQrank" = 'C') OR ("Srank" = 'S2' AND "OQrank" IN
('B','C')) OR
("Srank" = 'S3' AND "OQrank" = 'A') OR ("SpecComm" = 'C' AND "Grank" IN
('G4', 'G5') AND "OQrank" = 'C')""""
arcpy.SelectLayerByAttribute_management("fcBRankInput", "NEW_SELECTION",
strWHERE)
arcpy.SelectLayerByLocation_management("fcBRank", "INTERSECT", "fcBRankInput")
arcpy.CalculateField_management("fcBRank", "BSing", "B5", "PYTHON")
logger.info("B5 selection ranked")

## Rank B4 selection
strWHERE = """"("Grank" = 'G2' AND "OQrank" = 'D' AND ("EO_Count" = 1 OR "Flag" =
'BestState')) OR
("Grank" = 'G3' AND "OQrank" = 'C') OR ("Srank" = 'S1' AND "OQrank" IN ('A',
'B')) OR
("Srank" = 'S1' AND "OQrank" = 'C' AND ("EO_Count" = 1 OR "Flag" =
'BestState')) OR

```

```

        ("Srank" = 'S2' AND "OQrank" = 'A') OR ("Grank" IN ('G4', 'G5') AND "OQrank"
IN ('A', 'B', 'C')
        AND "Flag" = 'Disjunct') OR ("SpecComm" = 'C' AND "Grank" IN ('G4', 'G5')
AND "OQrank" IN ('A', 'B'))""
    arcpy.SelectLayerByAttribute_management("fcBRankInput", "NEW_SELECTION",
strWHERE)
    arcpy.SelectLayerByLocation_management("fcBRank", "INTERSECT", "fcBRankInput")
    arcpy.CalculateField_management("fcBRank", "BSing", "B4", "PYTHON")
    logger.info("B4 selection ranked")

## Rank B3 selection
strWHERE = """"("Grank" = 'G1' AND "OQrank" = 'D' AND ("EO_Count" = 1 OR "Flag" =
'BestState') ) OR
        ("Grank" = 'G2' AND "OQrank" = 'C') OR ("Grank" = 'G3' AND "OQrank" IN ('A',
'B')) OR
        ("Srank" = 'S1' AND "OQrank" IN ('A', 'B') AND "Flag" = 'Disjunct') OR
        ("SpecComm" = 'C' AND "Grank" IN ('G4', 'G5')) AND "OQrank" IN ('A', 'B')
AND "Flag" = 'Best5Ecoregion')""
    arcpy.SelectLayerByAttribute_management("fcBRankInput", "NEW_SELECTION",
strWHERE)
    arcpy.SelectLayerByLocation_management("fcBRank", "INTERSECT", "fcBRankInput")
    arcpy.CalculateField_management("fcBRank", "BSing", "B3", "PYTHON")
    logger.info("B3 selection ranked")

## Rank B2 selection
strWHERE = """"("Grank" = 'G1' AND "OQrank" IN ('B', 'C')) OR ("Grank" = 'G2' AND
"OQrank" IN ('A', 'B')) OR
        ("Grank" = 'G3' AND "OQrank" IN ('A', 'B') AND "Flag" = 'Best5Range')""
    arcpy.SelectLayerByAttribute_management("fcBRankInput", "NEW_SELECTION",
strWHERE)
    arcpy.SelectLayerByLocation_management("fcBRank", "INTERSECT", "fcBRankInput")
    arcpy.CalculateField_management("fcBRank", "BSing", "B2", "PYTHON")
    logger.info("B2 selection ranked")

## Rank B1 selection
strWHERE = """"("Flag" = 'OnlyRange') OR ("Grank" = 'G1' AND "OQrank" = 'A') OR
        ("Grank" = 'G1' AND "OQrank" IN ('B', 'C') AND ("EO_Count" = 1 OR "Flag" =
'BestState'))""
    arcpy.SelectLayerByAttribute_management("fcBRankInput", "NEW_SELECTION",
strWHERE)
    arcpy.SelectLayerByLocation_management("fcBRank", "INTERSECT", "fcBRankInput")
    arcpy.CalculateField_management("fcBRank", "BSing", "B1", "PYTHON")
    logger.info("B1 selection ranked")
    arcpy.SelectLayerByAttribute_management("fcBRankInput", "CLEAR_SELECTION")
    arcpy.SelectLayerByAttribute_management("fcBRank", "CLEAR_SELECTION")

```



```

## STEP 3: Join Wetland Units with BRankInput
fmSJ = arcpy.FieldMappings()
fmSJ.addTable('fcWU')
fmSJ.addTable('fcBRankInput')
#removeFields = []
#removeFields = ['Shape_Length1','Shape_Area1']
#for field in fmSJ.fields:
    #if field.name in removeFields:
        #fmSJ.removeFieldMap(fmSJ.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis('fcWU', 'fcBRankInput', 'WU_BRank_join',
'JOIN_ONE_TO_MANY', 'KEEP_ALL', fmSJ, 'INTERSECT')
arcpy.MakeFeatureLayer_management('WU_BRank_join', 'fcBRankJoin')
logger.info("Wetland Units joined with BRankInput")

## STEP 4: Find the highest occurrence quality rank for each element in each Wetland Unit
## Set null values of RandID to zero to allow summarize function to work
strWHERE = """"RandID" IS NULL""""
arcpy.SelectLayerByAttribute_management("fcBRankJoin", "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management("fcBRankJoin","RandID","0","VB","#")
arcpy.SelectLayerByAttribute_management("fcBRankJoin", "CLEAR_SELECTION")
logger.info("null values of RandID set to zero to allow summarize function to work")

## Add field to hold integer transformation of OQRank
actions.DeleteField("fcBRankJoin", "OQrankInt")
arcpy.AddField_management("fcBRankJoin", "OQrankInt", "SHORT")
strWHERE = """"OQrank" IS NULL""""
arcpy.SelectLayerByAttribute_management("fcBRankJoin", "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management("fcBRankJoin","OQrankInt","0","VB","#")

strWHERE = """"OQrank" = 'D'""""
arcpy.SelectLayerByAttribute_management("fcBRankJoin", "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management("fcBRankJoin","OQrankInt","1","VB","#")

strWHERE = """"OQrank" = 'C'""""
arcpy.SelectLayerByAttribute_management("fcBRankJoin", "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management("fcBRankJoin","OQrankInt","2","VB","#")

strWHERE = """"OQrank" = 'B'""""
arcpy.SelectLayerByAttribute_management("fcBRankJoin", "NEW_SELECTION",
strWHERE)

```

```

arcpy.CalculateField_management("fcBRankJoin","OQrankInt","3","VB","#")

strWHERE = """"OQrank" = 'A'""""
arcpy.SelectLayerByAttribute_management("fcBRankJoin", "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management("fcBRankJoin", "OQrankInt", "4", "VB", "#")
logger.info("field added to hold integer transformation of OQRank")
arcpy.SelectLayerByAttribute_management("fcBRankJoin", "CLEAR_SELECTION")

## Find the highest OQrank for each WUKey |RandID pair
actions.DeleteField("fcBRankJoin", "Concat")
arcpy.AddField_management("fcBRankJoin", "Concat", "TEXT", field_length = 20)
arcpy.CalculateField_management("fcBRankJoin","Concat","""[WUKey]&" | "&
[RandID]"""","VB","#")
arcpy.Statistics_analysis("fcBRankJoin", "WU_BRank_summ", [{"WUKey", "MIN"},
["RandID", "MIN"], ["Srank", "FIRST"], ["Grank", "FIRST"], ["SpecComm", "FIRST"],
["OQrankInt", "MAX"]], ["Concat"])
arcpy.MakeTableView_management(r"WU_BRank_summ", "tvBRankSumm")
logger.info("the highest OQrank for each WUKey |RandID pair found")

## STEP 5: Assign Site Biodiversity Rank based on concentrations of elements
## Rank B5 selection (Rank B6 does not have a criterion for concentrations)
## Select B- or C-ranked occurrences of S3 elements
strWHERE = """"First_Srank" = 'S3' AND "Max_OQrankInt" IN (2,3)""""
arcpy.SelectLayerByAttribute_management("tvBRankSumm", "NEW_SELECTION",
strWHERE)
arcpy.Statistics_analysis("tvBRankSumm", "WU_BRank_summB5", [{"MIN_WUKey",
"COUNT"}], ["MIN_WUKey"])
arcpy.MakeTableView_management(r"WU_BRank_summB5", "tvBRankSummB5")
logger.info("all unique elements within a wetland unit counted")

## Join table back to WU_BRank
arcpy.AddJoin_management("fcBRank", "WUKey", "tvBRankSummB5", "MIN_WUKey")
logger.info("table WU_BRank_summB5 joined back to WU_BRank")

## Select records with 4 or more elements and assign value to BConc
strWHERE = """"WU_BRank_summB5.COUNT_MIN_WUKey > 3""""
arcpy.SelectLayerByAttribute_management("fcBRank", "NEW_SELECTION", strWHERE)
arcpy.CalculateField_management("fcBRank", "BConc", ""B5"", "PYTHON")
logger.info("records with 4 or more elements selected and value assigned to BConc")

## Remove Join
arcpy.RemoveJoin_management("fcBRank")
logger.info("join removed")

```

```

## Rank B4 selection
## Select C-ranked S1, B- or C-ranked S2, and A-ranked S3 element occurrences and C-
ranked G4 or G5 communities
strWHERE = """"( "First_Srank" = 'S1' AND "Max_OQrankInt" = 2) OR ("First_Srank" = 'S2'
AND "Max_OQrankInt" IN (2,3)) OR
      ("First_Srank" = 'S3' AND "Max_OQrankInt" = 4) OR ("First_SpecComm" = 'C'
AND
      "First_Grank" IN ('G4', 'G5') AND "Max_OQrankInt" = 2)""""
arcpy.SelectLayerByAttribute_management("tvBRankSumm", "NEW_SELECTION",
strWHERE)
arcpy.Statistics_analysis("tvBRankSumm", "WU_BRank_summB4", [{"MIN_WUKey",
"COUNT"}], [{"MIN_WUKey"}])
arcpy.MakeTableView_management(r"WU_BRank_summB4", "tvBRankSummB4")
logger.info("C-ranked S1, B- or C-ranked S2, and A-ranked S3 element occurrences and C-
ranked G4 or G5 communities selected")

## Join table back to WU_BRank
arcpy.AddJoin_management( "fcBRank", "WUKey", "tvBRankSummB4", "MIN_WUKey")
logger.info("table WU_BRank_summB4 joined back to WU_BRank")

## Select records with 4 or more elements and assign value to BConc
strWHERE = """"WU_BRank_summB4.COUNT_MIN_WUKey > 3""""
arcpy.SelectLayerByAttribute_management("fcBRank", "NEW_SELECTION", strWHERE)
arcpy.CalculateField_management("fcBRank", "BConc", "B4", "PYTHON")
logger.info("records with 4 or more elements selected and value assigned to BConc")

## Remove Join
arcpy.RemoveJoin_management("fcBRank")
logger.info("join removed")

## Rank B3 selection
## Select C-ranked occurrences of G3 elements and A- or B-ranked occurrences of S1
elements
strWHERE = """"("First_Grank" = 'G3' AND "Max_OQrankInt" = 2) OR ("First_Srank" =
'S1' AND "Max_OQrankInt" IN (3,4))""""
arcpy.SelectLayerByAttribute_management("tvBRankSumm", "NEW_SELECTION",
strWHERE)
arcpy.Statistics_analysis("tvBRankSumm", "WU_BRank_summB3", [{"MIN_WUKey",
"COUNT"}], [{"MIN_WUKey"}])
arcpy.MakeTableView_management(r"WU_BRank_summB3", "tvBRankSummB3")
logger.info("C-ranked occurrences of G3 elements and A- or B-ranked occurrences of S1
elements selected")

## Join table back to WU_BRank
arcpy.AddJoin_management( "fcBRank", "WUKey", "tvBRankSummB3", "MIN_WUKey")

```

```

logger.info("table WU_BRank_summB3 joined back to WU_BRank")

## Select records with 4 or more elements and assign value to BConc
strWHERE = """"WU_BRank_summB3.COUNT_MIN_WUKey > 3""""
arcpy.SelectLayerByAttribute_management("fcBRank", "NEW_SELECTION", strWHERE)
arcpy.CalculateField_management("fcBRank", "BConc", ""B3"", "PYTHON")
logger.info("records with 4 or more elements selected and value assigned to BConc")

## Remove Join
arcpy.RemoveJoin_management("fcBRank")
logger.info("join removed")

## Rank B2 selection
## Select C-ranked occurrences of G2 elements and A- or B-ranked occurrences of G3
elements
strWHERE = """"("First_Grank" = 'G2' AND "Max_OQrankInt" = 2) OR ("First_Grank" =
'G3' AND "Max_OQrankInt" IN (3,4))""""
arcpy.SelectLayerByAttribute_management("tvBRankSumm", "NEW_SELECTION",
strWHERE)
arcpy.Statistics_analysis("tvBRankSumm", "WU_BRank_summB2", [{"MIN_WUKey",
"COUNT"}], [{"MIN_WUKey"}])
arcpy.MakeTableView_management(r"WU_BRank_summB2", "tvBRankSummB2")
logger.info("C-ranked occurrences of G2 elements and A- or B-ranked occurrences of G3
elements selected")

## Join table back to WU_BRank
arcpy.AddJoin_management( "fcBRank", "WUKey", "tvBRankSummB2", "MIN_WUKey")
logger.info("table WU_BRank_summB2 joined back to WU_BRank")

## Select records with 4 or more elements and assign value to BConc
strWHERE = """"WU_BRank_summB2.COUNT_MIN_WUKey > 3""""
arcpy.SelectLayerByAttribute_management("fcBRank", "NEW_SELECTION", strWHERE)
arcpy.CalculateField_management("fcBRank", "BConc", ""B2"", "PYTHON")
logger.info("records with 4 or more elements selected and value assigned to BConc")

## Remove Join
arcpy.RemoveJoin_management("fcBRank")
logger.info("join removed")

## Rank B1 selection
## Select B-ranked occurrences of G1 elements and A- or B-ranked occurrences of G2
elements
strWHERE = """"("First_Grank" = 'G1' AND "Max_OQrankInt" = 3) OR ("First_Grank" =
'G2' AND "Max_OQrankInt" IN (3,4))""""
arcpy.SelectLayerByAttribute_management("tvBRankSumm", "NEW_SELECTION",
strWHERE)

```

```

arcpy.Statistics_analysis("tvBRankSumm", "WU_BRank_summB1", [{"MIN_WUKey",
"COUNT"}], [{"MIN_WUKey"}]
arcpy.MakeTableView_management(r"WU_BRank_summB1", "tvBRankSummB1")
logger.info("B-ranked occurrences of G1 elements and A- or B-ranked occurrences of G2
elements selected")

## Join table back to WU_BRank
arcpy.AddJoin_management("fcBRank", "WUKey", "tvBRankSummB1", "MIN_WUKey")
logger.info("table WU_BRank_summB1 joined back to WU_BRank")

## Select records with 4 or more elements and assign value to BConc
strWHERE = """"WU_BRank_summB1.COUNT_MIN_WUKey > 3""""
arcpy.SelectLayerByAttribute_management("fcBRank", "NEW_SELECTION", strWHERE)
arcpy.CalculateField_management("fcBRank", "BConc", ""B1"", "PYTHON")
logger.info("records with 4 or more elements selected and value assigned to BConc")

## Remove Join
arcpy.RemoveJoin_management("fcBRank")
logger.info("join removed")
arcpy.SelectLayerByAttribute_management("tvBRankSumm", "CLEAR_SELECTION")

## STEP 6: Calculate final Site Biodiversity Rank
strWHERE = """"BSing" = 'B6'""""
arcpy.SelectLayerByAttribute_management("fcBRank", "NEW_SELECTION", strWHERE)
arcpy.CalculateField_management("fcBRank", "BRank", ""B6"", "PYTHON")

strWHERE = """"BSing" = 'B5' OR "BConc" = 'B5'""""
arcpy.SelectLayerByAttribute_management("fcBRank", "NEW_SELECTION", strWHERE)
arcpy.CalculateField_management("fcBRank", "BRank", ""B5"", "PYTHON")

strWHERE = """"BSing" = 'B4' OR "BConc" = 'B4'""""
arcpy.SelectLayerByAttribute_management("fcBRank", "NEW_SELECTION", strWHERE)
arcpy.CalculateField_management("fcBRank", "BRank", ""B4"", "PYTHON")

strWHERE = """"BSing" = 'B3' OR "BConc" = 'B3'""""
arcpy.SelectLayerByAttribute_management("fcBRank", "NEW_SELECTION", strWHERE)
arcpy.CalculateField_management("fcBRank", "BRank", ""B3"", "PYTHON")

strWHERE = """"BSing" = 'B2' OR "BConc" = 'B2'""""
arcpy.SelectLayerByAttribute_management("fcBRank", "NEW_SELECTION", strWHERE)
arcpy.CalculateField_management("fcBRank", "BRank", ""B2"", "PYTHON")

strWHERE = """"BSing" = 'B1' OR "BConc" = 'B1'""""
arcpy.SelectLayerByAttribute_management("fcBRank", "NEW_SELECTION", strWHERE)
arcpy.CalculateField_management("fcBRank", "BRank", ""B1"", "PYTHON")
logger.info("final Site Biodiversity Ranks calculated")

```

```

## Populate the "Null" BRank records with "none"
strWHERE = """"BRank" IS NULL""""
arcpy.SelectLayerByAttribute_management("fcBRank", "NEW_SELECTION", strWHERE)
arcpy.CalculateField_management("fcBRank", "BRank", "none", "PYTHON")
logger.info("the 'Null' BRank records populated with 'none'")

arcpy.SelectLayerByAttribute_management("fcBRank", "CLEAR_SELECTION")

## Note that it is preferable to have WVNHP staff check B1 sites manually to ensure they are
correct
## Several Wetland Units should have the BRank changed to "NULL" because the qualifying
element
## occurrences are not wetland species nor wetland communities.

## Add fields to store expert review input from the WV Natural Heritage Program
arcpy.AddField_management("fcBRank", "WVNHP_BRank", "TEXT", field_length = 10)
arcpy.AddField_management("fcBRank", "WVNHP_note", "TEXT", field_length = 254)
logger.info("fields added to store expert review input from the WV Natural Heritage
Program")

'''
## Solicit review from WVNHP experts or their designees regarding B1 and B2 sites (and
any other sites of interest).

## Check the "WVNHP_BRank" field and if it is populated, change the rank to the
WVNHP_BRank.
strWHERE = """"WVNHP_BRank" <>""""
arcpy.SelectLayerByAttribute_management("fcBRank", "NEW_SELECTION", strWHERE)
arcpy.CalculateField_management("fcBRank", "BRank", "[WVNHP_BRank]", "VB")
logger.info("the 'Null' BRank records populated with 'none'")
'''

# Clean up
if arcpy.Exists("WU_BRank_join"):
    arcpy.Delete_management("WU_BRank_join")
if arcpy.Exists("WU_BRank_summ"):
    arcpy.Delete_management("WU_BRank_summ")
if arcpy.Exists(r"WU_BRank_summB5"):
    arcpy.Delete_management(r"WU_BRank_summB5")
if arcpy.Exists(r"WU_BRank_summB4"):
    arcpy.Delete_management(r"WU_BRank_summB4")
if arcpy.Exists(r"WU_BRank_summB3"):
    arcpy.Delete_management(r"WU_BRank_summB3")
if arcpy.Exists(r"WU_BRank_summB2"):
    arcpy.Delete_management(r"WU_BRank_summB2")
if arcpy.Exists(r"WU_BRank_summB1"):

```

```
arcpy.Delete_management(r"WU_BRank_summB1")
```

### 5.7.25 HFuncNoBR: Habitat and Ecological Integrity Function

```
#####  
#  
# File Name: HFuncNoBR.py  
# Developer: Yibing Han  
# Date: 10/19/2017  
# Purpose:  
#   Input to Habitat and Ecological Integrity Function  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import arcpy  
from utilities import actions  
import logging  
  
def CalcHFuncNoBR():  
    logger = logging.getLogger("WFA.HabEco.HFuncNoBR")  
  
    # Setting python variables  
    arcpy.MakeFeatureLayer_management(r"WU_HPpotential", "fcHPotential")  
    arcpy.MakeFeatureLayer_management(r"WU_HSociety", "fcHSociety")  
    arcpy.MakeFeatureLayer_management(r"WU_HOpportun", "fcHOportun")  
    logger.info("feature layers ready")  
  
    # Clean up if needed  
    if arcpy.Exists('WU_HFuncNoBR1'):  
        arcpy.Delete_management('WU_HFuncNoBR1')  
    if arcpy.Exists('WU_HFuncNoBR'):  
        arcpy.Delete_management('WU_HFuncNoBR')  
  
    ## Spatial Join to merge metrics and create feature class to store HFuncNoBR  
    fmSJFLIN = arcpy.FieldMappings()  
    fmSJFLIN.addTable("fcHPotential")  
    fmSJFLIN.addTable("fcHOportun")  
    keepers = []  
    keepers = ['WUKey', 'Shape_Length', 'Shape_Area', 'HPotential', 'HOportun']  
    for field in fmSJFLIN.fields:  
        if field.name not in keepers:  
            fmSJFLIN.removeFieldMap(fmSJFLIN.findFieldMapIndex(field.name))  
  
    arcpy.SpatialJoin_analysis("fcHPotential", "fcHOportun", 'WU_HFuncNoBR1',  
    'JOIN_ONE_TO_ONE', 'KEEP_ALL', fmSJFLIN, 'CONTAINS')  
    arcpy.MakeFeatureLayer_management(r"WU_HFuncNoBR1", "fcHFuncNoBR1")
```



```

logger.info("spatial join HPotential and HSociety completed")

fmSJFLIN = arcpy.FieldMappings()
fmSJFLIN.addTable("fcHFuncNoBR1")
fmSJFLIN.addTable("fcHSociety")
keepers = []
keepers = ['WUKey','Shape_Length','Shape_Area','HPotential','HOpportun','HSociety']
for field in fmSJFLIN.fields:
    if field.name not in keepers:
        fmSJFLIN.removeFieldMap(fmSJFLIN.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis("fcHFuncNoBR1", "fcHSociety", 'WU_HFuncNoBR',
'JOIN_ONE_TO_ONE', 'KEEP_ALL', fmSJFLIN, 'CONTAINS')
fcHFuncNoBR = arcpy.mapping.Layer(r"WU_HFuncNoBR")
logger.info("spatial join HFuncNoBR1 and HSociety completed")

## Add HFuncNoBR field to Wetland Units and set initial point value to zero.
actions.DeleteField(fcHFuncNoBR, 'HFuncNoBR')
arcpy.AddField_management(fcHFuncNoBR, 'HFuncNoBR', 'SHORT')
arcpy.CalculateField_management(fcHFuncNoBR, 'HFuncNoBR', '0', 'VB', '#')
logger.info("field HFuncNoBR added and initial value set to 0")

## Sum the points for HInvest and HUse
arcpy.CalculateField_management(fcHFuncNoBR, 'HFuncNoBR', '[HPotential] +
[HOpportun] + [HSociety]', 'VB', '#')
logger.info("field HFuncNoBR calculated")

# Clean up
if arcpy.Exists('WU_HFuncNoBR1'):
    arcpy.Delete_management('WU_HFuncNoBR1')

```

### 5.7.26 HFunction: Habitat and Ecological Integrity Function

```
#####  
#  
# File Name: HFunction.py  
# Developer: Yibing Han  
# Date: 10/19/2017  
# Purpose:  
# Habitat & Ecological Integrity function  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import arcpy  
from utilities import actions  
import logging  
  
def CalcHFunction():  
    logger = logging.getLogger("WFA.HabEco.HFunction")  
  
    # Setting python variables  
    arcpy.MakeFeatureLayer_management(r"WU_BRank","fcBRank")  
    arcpy.MakeFeatureLayer_management(r"WU_HFuncNoBR","fcHFuncNoBR")  
    logger.info("feature layers ready")  
  
    # Clean up if needed  
    if arcpy.Exists('WU_HFunction'):  
        arcpy.Delete_management('WU_HFunction')
```

```

## Spatial Join to merge metrics and create feature class to store Function
fmSJ = arcpy.FieldMappings()
fmSJ.addTable("fcBRank")
fmSJ.addTable("fcHFuncNoBR")
keepers = []
keepers =
['WUKey','Shape_Length','Shape_Area','HPotential','HOpportun','HSociety','HFuncNoBR','BRa
nk']
for field in fmSJ.fields:
    if field.name not in keepers:
        fmSJ.removeFieldMap(fmSJ.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis("fcBRank", "fcHFuncNoBR", 'WU_HFunction',
'JOIN_ONE_TO_ONE', 'KEEP_ALL', fmSJ, 'CONTAINS')
fcHFunction = arcpy.mapping.Layer(r"WU_HFunction")
logger.info("spatial join BRank and HFuncNoBR completed")

## Add Function field to Wetland Units and set initial point value to zero.
actions.DeleteField(fcHFunction, 'HPotB6')
arcpy.AddField_management(fcHFunction, 'HPotB6', 'SHORT')
actions.DeleteField(fcHFunction, 'HFunction')
arcpy.AddField_management(fcHFunction, 'HFunction', 'SHORT')
arcpy.CalculateField_management(fcHFunction, 'HFunction', '[HFuncNoBR]', 'VB', '#')
logger.info("fields added to store intermediate value for B6 sites and results and initial values
set")

## Select B6 wetlands
strWHERE = """"BRank" = 'B6'""""
arcpy.SelectLayerByAttribute_management(fcHFunction, "NEW_SELECTION",
strWHERE)

```

```

logger.info("B6 wetlands selected")

## Add 5 points to HPotential for B6 wetlands, up to a maximum of 30 points
arcpy.CalculateField_management(fcHFunction, "HPotB6", "[HPotential] + 5", "VB", "#")
strWHERE = """"HPotB6" > 30""""
arcpy.SelectLayerByAttribute_management(fcHFunction, "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management(fcHFunction, "HPotB6", "30", "VB", "#")
logger.info("5 points added to HPotential for B6 wetlands, up to a maximum of 30 points")

## Select B6 wetlands and calculate HFunction
strWHERE = """"BRank" = 'B6'""""
arcpy.SelectLayerByAttribute_management(fcHFunction, "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management(fcHFunction, "HFunction", "[HPotB6] + [HOportun]+
[HSociety]", "VB", "#")

## Select B5 wetlands and calculate HFunction
strWHERE = """"BRank" = 'B5'""""
arcpy.SelectLayerByAttribute_management(fcHFunction, "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management(fcHFunction, "HFunction", "[HOportun]+ [HSociety] +
30", "VB", "#")

## Select B4 wetlands and calculate HFunction
strWHERE = """"BRank" = 'B4'""""
arcpy.SelectLayerByAttribute_management(fcHFunction, "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management(fcHFunction, "HFunction", "50", "VB", "#")

## Select B3 wetlands and calculate HFunction

```

```

strWHERE = """"BRank" = 'B3'""""
arcpy.SelectLayerByAttribute_management(fcHFunction, "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management(fcHFunction, "HFunction", "75", "VB", "#")

## Select B2 wetlands and calculate HFunction
strWHERE = """"BRank" = 'B2'""""
arcpy.SelectLayerByAttribute_management(fcHFunction, "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management(fcHFunction, "HFunction", "100", "VB", "#")

## Select B1 wetlands and calculate HFunction
strWHERE = """"BRank" = 'B1'""""
arcpy.SelectLayerByAttribute_management(fcHFunction, "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management(fcHFunction, "HFunction", "150", "VB", "#")

# Clear all selections
arcpy.SelectLayerByAttribute_management(fcHFunction, "CLEAR_SELECTION")

# Clean up

```

### 5.7.27 HOpportun: Habitat and Ecological Integrity

```
#####  
#  
# File Name: HOpportun.py  
# Developer: Yibing Han  
# Date: 12/12/2017  
# Purpose:  
# This script handles the execution of all the Habitat and Ecological Integrity Value to Society  
metrics.  
#  
#####  
import datetime  
import logging  
import traceback  
import arcpy  
  
from Variables import AquaAbund, BRankHUC, BufferContig, BufferPerim, ConsFocus,  
LandInteg, WetldBird, Karst, WshdPos, WshdUniq  
from Factors import BufferLand, LandHydro, LandEco  
from Aspects import HOpportun  
  
def procHOpportun(WetlandPoly):  
    logger = logging.getLogger("WFA.HabEco.HOpportun")  
  
    #####  
    ## 1. Run Variables  
    #####  
    AquaAbund.CalcAquaAbund(WetlandPoly)  
    BRankHUC.CalcBRankHUC(WetlandPoly)  
    BufferContig.CalcBufferContig(WetlandPoly)  
    BufferPerim.CalcBufferPerim(WetlandPoly)  
    ConsFocus.CalcConsFocus(WetlandPoly)  
    LandInteg.CalcLandInteg(WetlandPoly)  
    WetldBird.CalcWetldBird(WetlandPoly)  
    Karst.CalcKarst(WetlandPoly)  
    WshdPos.CalcWshdPos()  
    WshdUniq.CalcWshdUniq()  
  
    #####  
    ## 2. Run Factors  
    #####  
    BufferLand.CalcBufferLand()  
    LandHydro.CalcLandHydro()  
    LandEco.CalcLandEco()  
  
    #####
```

## 3. Run Aspect

#####

HOportun.CalcHOportun()

### 5.7.28 HOpportun: Habitat and Ecological Integrity Aspects

```
#####  
#  
# File Name: HOpportun.py  
# Developer: Yibing Han  
# Date: 10/10/2017  
# Purpose:  
#  Habitat Function  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import arcpy  
from utilities import actions  
import logging  
  
def CalcHOpportun():  
    logger = logging.getLogger("WFA.HabEco.HOpportun.HOpportun")  
  
    # Setting python variables  
    arcpy.MakeFeatureLayer_management(r"WU_BufferLand", "fcBufferLand")  
    arcpy.MakeFeatureLayer_management(r"WU_LandHydro", "fcLandHydro")  
    arcpy.MakeFeatureLayer_management(r"WU_LandEco", "fcLandEco")  
  
    # Clean up if needed  
    if arcpy.Exists("WU_HOpportun"):  
        arcpy.Delete_management("WU_HOpportun")  
    if arcpy.Exists("WU_HOpportun1"):  
        arcpy.Delete_management("WU_HOpportun1")  
  
    ## Spatial joins to bring together factor values  
    fmSJFLIN = arcpy.FieldMappings()  
    fmSJFLIN.addTable("fcBufferLand")  
    fmSJFLIN.addTable("fcLandHydro")  
    keepers = []  
    keepers = ['WUKey', 'Shape_Length', 'Shape_Area', 'BufferLand', 'LandHydro']  
    for field in fmSJFLIN.fields:  
        if field.name not in keepers:  
            fmSJFLIN.removeFieldMap(fmSJFLIN.findFieldMapIndex(field.name))  
  
    arcpy.SpatialJoin_analysis('fcBufferLand', 'fcLandHydro', 'WU_HOpportun1',  
'JOIN_ONE_TO_ONE', 'KEEP_ALL', fmSJFLIN, 'CONTAINS')  
    arcpy.MakeFeatureLayer_management(r"WU_HOpportun1", "fcHOpportun1")  
    logger.info("Spatial Join BufferLand and LandHydro completed")
```



```

fmSJFLIN = arcpy.FieldMappings()
fmSJFLIN.addTable("fcHOoportun1")
fmSJFLIN.addTable("fcLandEco")
keepers = []
keepers = ['WUKey','Shape_Length','Shape_Area','BufferLand','LandHydro','LandEco']
for field in fmSJFLIN.fields:
    if field.name not in keepers:
        fmSJFLIN.removeFieldMap(fmSJFLIN.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis('fcHOoportun1', 'fcLandEco', 'WU_HOoportun',
'JOIN_ONE_TO_ONE', 'KEEP_ALL', fmSJFLIN, 'CONTAINS')
fcHOoportun = arcpy.mapping.Layer(r"WU_HOoportun")
logger.info("Spatial Join HOoportun1 and LandEco completed")

## Add HOoportun field and set initial point value to zero
actions.DeleteField(fcHOoportun, "HOoportun")
arcpy.AddField_management(fcHOoportun, "HOoportun", "SHORT")
arcpy.CalculateField_management(fcHOoportun,"HOoportun","0","VB","#")
logger.info("field HOoportun added and initial value set to 0")

## Sum the factor points
arcpy.CalculateField_management(fcHOoportun,"HOoportun","[BufferLand]+
[LandHydro]+ [LandEco]","VB","#")
logger.info("Points calculated to wetland units")

# Clean up
if arcpy.Exists("WU_HOoportun1"):
    arcpy.Delete_management("WU_HOoportun1")

```

### 5.7.29 BufferLand: Habitat and Ecological Integrity Opportunity

```
#####  
#  
# File Name: BufferLand.py  
# Developer: Yibing Han  
# Date: 10/03/2017  
# Purpose:  
#   Input to Habitat & Ecological Integrity / Landscape Opportunity  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcBufferLand():  
    logger = logging.getLogger("WFA.HabEco.HOpportun.BufferLand")  
  
    # Setting python variables  
    arcpy.MakeFeatureLayer_management(r"WU_BufferPerim", 'fcBufferPerim')  
    arcpy.MakeFeatureLayer_management(r"WU_BufferContig", 'fcBufferContig')  
    arcpy.MakeFeatureLayer_management(r"WU_LandInteg", 'fcLandInteg')  
  
# Clean up if needed  
if arcpy.Exists('WU_BufferLand1'):
```

```

    arcpy.Delete_management('WU_BufferLand1')
if arcpy.Exists('WU_BufferLand'):
    arcpy.Delete_management('WU_BufferLand')
logger.info("feature layers ready")

## Spatial join to merge BufferPerim and BufferContig into one attribute table
fmSJ = arcpy.FieldMappings()
fmSJ.addTable('fcBufferPerim')
fmSJ.addTable('fcBufferContig')
keepers = []
keepers = ['WUKey','Shape_Length','Shape_Area','BufferPerim','BufferContig']
for field in fmSJ.fields:
    if field.name not in keepers:
        fmSJ.removeFieldMap(fmSJ.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis('fcBufferPerim', 'fcBufferContig', 'WU_BufferLand1',
'JOIN_ONE_TO_ONE', 'KEEP_ALL', fmSJ, 'CONTAINS')
arcpy.MakeFeatureLayer_management('WU_BufferLand1', 'fcBufferLand1')
logger.info("spatial join BufferPerim and BufferContig completed")

## Spatial join to merge LandInteg
fmSJ = arcpy.FieldMappings()
fmSJ.addTable('fcBufferLand1')
fmSJ.addTable('fcLandInteg')
keepers = []
keepers = ['WUKey','Shape_Length','Shape_Area','BufferPerim','BufferContig','LandInteg']
for field in fmSJ.fields:
    if field.name not in keepers:
        fmSJ.removeFieldMap(fmSJ.findFieldMapIndex(field.name))

```

```

    arcpy.SpatialJoin_analysis('fcBufferLand1', 'fcLandInteg', 'WU_BufferLand',
'JOIN_ONE_TO_ONE', 'KEEP_ALL', fmSJ, 'CONTAINS')
    fcBufferLand = arcpy.mapping.Layer(r"WU_BufferLand")
    logger.info("spatial join BufferLand1 and LandInteg completed")

## Add BufferLand field to Wetland Units and set initial point value to zero.
actions.DeleteField(fcBufferLand, 'BufferLand')
arcpy.AddField_management(fcBufferLand, 'BufferLand', 'SHORT')
arcpy.CalculateField_management(fcBufferLand, 'BufferLand', '0', 'VB', '#')
logger.info("field BufferLand added")

## Sum the points for VegVerStr, VegHorInt, VegFQ
arcpy.CalculateField_management(fcBufferLand, 'BufferLand', '[BufferPerim] +
[BufferContig] + [LandInteg]', 'VB', '#')
logger.info("field BufferLand calculated")

# Clean up
if arcpy.Exists('WU_BufferLand1'):
    arcpy.Delete_management('WU_BufferLand1')

```

### 5.7.30 LandEco: Habitat and Ecological Integrity Opportunity

```
#####  
#  
# File Name: LandEco.py  
# Developer: Yibing Han  
# Date: 10/10/2017  
# Purpose:  
#   Input to Habitat / Landscape Opportunity  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcLandEco():  
    logger = logging.getLogger("WFA.HabEco.HOpportun.HOpportun")  
  
    # Setting python variables  
    arcpy.MakeFeatureLayer_management(r"WU_BRankHUC","fcBRankHUC")  
    arcpy.MakeFeatureLayer_management(r"WU_WshdUniq","fcWshdUniq")  
    arcpy.MakeFeatureLayer_management(r"WU_ConsFocus","fcConsFocus")  
    arcpy.MakeFeatureLayer_management(r"WU_WetlandBird","fcWetlandBird")  
  
    # Clean up if needed
```

```

if arcpy.Exists("WU_LandEco"):
    arcpy.Delete_management("WU_LandEco")
if arcpy.Exists("WU_LandEco1"):
    arcpy.Delete_management("WU_LandEco1")
if arcpy.Exists("WU_LandEco2"):
    arcpy.Delete_management("WU_LandEco2")

## Spatial Join to merge attributes into one table
fmSJFLIN = arcpy.FieldMappings()
fmSJFLIN.addTable("fcBRankHUC")
fmSJFLIN.addTable("fcWshdUniq")
keepers = []
keepers = ['WUKey','Shape_Length','Shape_Area','BRankHUC','WshdUniq']
for field in fmSJFLIN.fields:
    if field.name not in keepers:
        fmSJFLIN.removeFieldMap(fmSJFLIN.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis('fcBRankHUC', 'fcWshdUniq', 'WU_LandEco1',
'JOIN_ONE_TO_ONE', 'KEEP_ALL', fmSJFLIN, 'CONTAINS')
arcpy.MakeFeatureLayer_management(r"WU_LandEco1", "fcLandEco1")
logger.info("Spatial Join BRankHUC and WshdUniq completed")

fmSJFLIN = arcpy.FieldMappings()
fmSJFLIN.addTable("fcLandEco1")
fmSJFLIN.addTable("fcConsFocus")
keepers = []
keepers = ['WUKey','Shape_Length','Shape_Area','BRankHUC','WshdUniq','ConsFocus']
for field in fmSJFLIN.fields:
    if field.name not in keepers:
        fmSJFLIN.removeFieldMap(fmSJFLIN.findFieldMapIndex(field.name))

```

```

arcpy.SpatialJoin_analysis('fcLandEco1', 'fcConsFocus', 'WU_LandEco2',
'JOIN_ONE_TO_ONE', 'KEEP_ALL', fmSJFLIN, 'CONTAINS')
arcpy.MakeFeatureLayer_management(r"WU_LandEco2", "fcLandEco2")
logger.info("Spatial Join LandEco1 and ConsFocus completed")

fmSJFLIN = arcpy.FieldMappings()
fmSJFLIN.addTable("fcLandEco2")
fmSJFLIN.addTable("fcWetlandBird")
keepers = []
keepers =
['WUKey','Shape_Length','Shape_Area','BRankHUC','WshdUniq','ConsFocus','WetldBird']
for field in fmSJFLIN.fields:
    if field.name not in keepers:
        fmSJFLIN.removeFieldMap(fmSJFLIN.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis('fcLandEco2', 'fcWetlandBird', 'WU_LandEco',
'JOIN_ONE_TO_ONE', 'KEEP_ALL', fmSJFLIN, 'CONTAINS')
fcLandEco = arcpy.mapping.Layer(r"WU_LandEco")
logger.info("Spatial Join LandEco1 and ConsFocus completed")

## Create feature class to store results for LandEco and set initial value to zero
actions.DeleteField(fcLandEco, "LandEco")
arcpy.AddField_management(fcLandEco, "LandEco", "SHORT")
arcpy.CalculateField_management(fcLandEco,"LandEco","0","VB","#")
logger.info("field LandEco added and initial value set to 0")

## Sum the metrics and assign points:
strWHERE = """"("ConsFocus" + "WetldBird" + "BRankHUC" + "WshdUniq") > 1""""
arcpy.SelectLayerByAttribute_management(fcLandEco, "NEW_SELECTION", strWHERE)

```

```
arcpy.CalculateField_management(fcLandEco,"LandEco","1","VB","#")
logger.info("1 point assigned to qualifying wetland units")
```

```
strWHERE = """"("ConsFocus" + "WetldBird" + "BRankHUC" + "WshdUniq") > 4""""
arcpy.SelectLayerByAttribute_management(fcLandEco, "NEW_SELECTION", strWHERE)
arcpy.CalculateField_management(fcLandEco,"LandEco","2","VB","#")
logger.info("2 points assigned to qualifying wetland units")
```

```
strWHERE = """"("ConsFocus" + "WetldBird" + "BRankHUC" + "WshdUniq") > 7""""
arcpy.SelectLayerByAttribute_management(fcLandEco, "NEW_SELECTION", strWHERE)
arcpy.CalculateField_management(fcLandEco,"LandEco","3","VB","#")
logger.info("2 points assigned to qualifying wetland units")
```

```
arcpy.SelectLayerByAttribute_management(fcLandEco, "CLEAR_SELECTION")
```

```
# Clean up
```

```
if arcpy.Exists("WU_LandEco1"):
    arcpy.Delete_management("WU_LandEco1")
if arcpy.Exists("WU_LandEco2"):
    arcpy.Delete_management("WU_LandEco2")
```



### 5.7.31 LandHydro: Habitat and Ecological Integrity Opportunity

```
#####  
#  
# File Name: LandHydro.py  
# Developer: Yibing Han  
# Date: 10/03/2017  
# Purpose:  
#   Input to Habitat & Ecological Integrity / Landscape Opportunity  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcLandHydro():  
    logger = logging.getLogger("WFA.HabEco.HOpportun.LandHydro")  
  
    # Setting python variables  
    fcWshdPos = arcpy.mapping.Layer(r"WU_WshdPos")  
    fcAquaAbund = arcpy.mapping.Layer(r"WU_AquaAbund")  
    logger.info("feature layers ready")  
  
    # Clean up if needed  
    if arcpy.Exists('WU_LandHydro'):
```

```

arcpy.Delete_management('WU_LandHydro')

## Spatial join to merge WshdPos and AquaAbund into one attribute table
fmSJFLIN = arcpy.FieldMappings()
fmSJFLIN.addTable(fcWshdPos)
fmSJFLIN.addTable(fcAquaAbund)
keepers = []
keepers = ['WUKey','Shape_Length','Shape_Area','WshdPos','AquaAbund']
for field in fmSJFLIN.fields:
    if field.name not in keepers:
        fmSJFLIN.removeFieldMap(fmSJFLIN.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis(fcWshdPos, fcAquaAbund, 'WU_LandHydro',
'JOIN_ONE_TO_ONE', 'KEEP_ALL', fmSJFLIN, 'CONTAINS')
fcLandHydro = arcpy.mapping.Layer(r"WU_LandHydro")
logger.info("spatial join WshdPos and AquaAbund completed")

## Add LandHydro field to Wetland Units and set initial point value to zero.
actions.DeleteField(fcLandHydro, 'LandHydro')
arcpy.AddField_management(fcLandHydro, 'LandHydro', 'SHORT')
arcpy.CalculateField_management(fcLandHydro, 'LandHydro', '0', 'VB', '#')
logger.info("field LandHydro added and initial value set to 0")

## Sum the points for WshdPos and AquaAbund
arcpy.CalculateField_management(fcLandHydro, 'LandHydro', '[WshdPos] + [AquaAbund]',
'VB', '#')
logger.info("field LandHydro calculated")

# Clean up

```

### 5.7.32 AquaAbund: Habitat and Ecological Integrity Opportunity

```
#####  
#  
# File Name: AquaAbund.py  
# Developer: Yibing Han  
# Date: 10/03/2017  
# Purpose:  
# Input to Habitat / Landscape Opportunity (LandHydro: Landscape Hydrologic Connectivity)  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcAquaAbund(WetlandPoly):  
    logger = logging.getLogger("WFA.HabEco.HOpportun.AquaAbund")  
  
    # Setting python variables  
    fcBuffer1km = arcpy.mapping.Layer(globalvars.srcBuffer1km)  
    fcWWetland = arcpy.mapping.Layer(globalvars.srcEnhWetland)  
    fcStreams = arcpy.mapping.Layer(globalvars.srcStreams)  
    logger.info("feature layers ready")  
  
    # Clean up if needed
```

```

if arcpy.Exists('Buffer1kAqua'):
    arcpy.Delete_management('Buffer1kAqua')
if arcpy.Exists('Buffer1kAqua_diss'):
    arcpy.Delete_management('Buffer1kAqua_diss')
if arcpy.Exists('Buffer1kStrm'):
    arcpy.Delete_management('Buffer1kStrm')
if arcpy.Exists('Buffer1kStrm_diss'):
    arcpy.Delete_management('Buffer1kStrm_diss')
if arcpy.Exists('WU_AquaAbund1'):
    arcpy.Delete_management('WU_AquaAbund1')
if arcpy.Exists('WU_AquaAbund2'):
    arcpy.Delete_management('WU_AquaAbund2')
if arcpy.Exists('WU_AquaAbund'):
    arcpy.Delete_management('WU_AquaAbund')

## STEP 1 Calculate percent of 1 km buffer that contains aquatic features from NWI
## Create feature class to store intermediate results for AquaAbund
arcpy.CopyFeatures_management(WetlandPoly,"WU_AquaAbund1", "#", "0", "0", "0")
arcpy.MakeFeatureLayer_management(r"WU_AquaAbund1", "fcWUAquaAbund1")
logger.info("feature class WU_AquaAbund1 created")

## Intersect the 1 km buffers and the Enhanced National Wetlands Inventory.
arInputData = [fcBuffer1km,fcWVWetland]
arcpy.Intersect_analysis(arInputData,"Buffer1kAqua","ALL",output_type="INPUT")
fcBuffer1kAqua = arcpy.mapping.Layer(r"Buffer1kAqua")
logger.info("intersect completed")

## Dissolve aquatic portion of wetland buffer by WUKey
arcpy.Dissolve_management(fcBuffer1kAqua,"Buffer1kAqua_diss","WUKey","Buf1kArea
FIRST")

```

```

arcpy.MakeFeatureLayer_management("Buffer1kAqua_diss", "fcBuffer1kAqua_diss")
logger.info("aquatic portion of wetland buffer dissolved")

## Add field and calculate ratio of aquatic area to total buffer area.
actions.DeleteField("fcBuffer1kAqua_diss","Aqua1kRat")
arcpy.AddField_management("fcBuffer1kAqua_diss", "Aqua1kRat", "FLOAT")

arcpy.CalculateField_management("fcBuffer1kAqua_diss","Aqua1kRat","[Shape_Area]/[FIRST_Buf1kArea]","VB","#")
logger.info("added and calculated field of Aqua1kRat")

## Join ratio of disturbed land to Wetland Units

arcpy.AddJoin_management("fcWUAquaAbund1","WUKey","fcBuffer1kAqua_diss","WUKey",
"KEEP_ALL")
logger.info("added join to WU_AquaAbund1")

## Export joined data

#arcpy.CopyFeatures_management("fcWUAquaAbund1","WU_AquaAbund2","#","0","0","0")
arcpy.FeatureClassToFeatureClass_conversion("fcWUAquaAbund1", arcpy.env.workspace,
"WU_AquaAbund2")
arcpy.MakeFeatureLayer_management("WU_AquaAbund2", "fcWUAquaAbund2")
logger.info("Joined data exported as WU_AquaAbund2")

## Remove Join
arcpy.RemoveJoin_management("fcWUAquaAbund1")
logger.info("Join removed")

# Set value of Aqua1kRat to zero for null intersections
strWHERE = """"Buffer1kAqua_diss_Aqua1kRat" IS NULL""""

```

```
arcpy.SelectLayerByAttribute_management("fcWUAquaAbund2","NEW_SELECTION",strW
HERE)
```

```
arcpy.CalculateField_management("fcWUAquaAbund2","Buffer1kAqua_diss_Aqua1kRat","0"
,"VB","#")
```

```
logger.info("field Aqua1kRat value added for null intersections")
```

```
arcpy.SelectLayerByAttribute_management("fcWUAquaAbund2","CLEAR_SELECTION")
```

```
## STEP 2 Calculate total length of NHD streams in 1 km buffer
```

```
## Intersect the 1 km buffers and the NHD stream reaches
```

```
arInputData = [fcBuffer1km,fcStreams]
```

```
arcpy.Intersect_analysis(arInputData,"Buffer1kStrm","ALL",output_type="INPUT")
```

```
fcBuffer1kStrm = arcpy.mapping.Layer(r"Buffer1kStrm")
```

```
logger.info("intersect completed")
```

```
## Add field to store Stream Reach Length
```

```
actions.DeleteField(fcBuffer1kStrm,"StrmLength")
```

```
arcpy.AddField_management(fcBuffer1kStrm, "StrmLength", "FLOAT")
```

```
arcpy.CalculateField_management(fcBuffer1kStrm,"StrmLength","[Shape_Length]","VB","#")
```

```
logger.info("added and calculated field of StrmLength")
```

```
## Delete unnecessary fields in this large table to reduce processing time in the Dissolve
below
```

```
fields = arcpy.ListFields(fcBuffer1kStrm)
```

```
keepList = ['WUKey','StrmLength']
```

```
fieldsDel = [f.name for f in arcpy.ListFields(fcBuffer1kStrm) if not(f.type in
["OID","Geometry"] or f.name in ["Shape_Length","Shape_Area"] or f.name in keepList)]
```

```
arcpy.DeleteField_management(fcBuffer1kStrm,fieldsDel)
```

```

logger.info("unnecessary fields in table deleted to reduce processing time below")

## Dissolve stream reach lengths in the wetland buffer by WUKey
arcpy.Dissolve_management(fcBuffer1kStrm,"Buffer1kStrm_diss","WUKey","StrmLength
SUM")
arcpy.MakeFeatureLayer_management("Buffer1kStrm_diss", "flBuffer1kStrm_diss")
logger.info("stream reach lengths in the wetland buffer dissolved")

## Join sum of stream lengths to Wetland Units

arcpy.AddJoin_management("fcWUAquaAbund2","WU_AquaAbund1_WUKey","flBuffer1kS
trm_diss","WUKey","KEEP_ALL")
logger.info("added join to WU_AquaAbund2")

## Export joined data

#arcpy.CopyFeatures_management("fcWUAquaAbund2","WU_AquaAbund","#","0","0","0")
arcpy.FeatureClassToFeatureClass_conversion("fcWUAquaAbund2", arcpy.env.workspace,
"WU_AquaAbund")
fcWUAquaAbund = arcpy.mapping.Layer(r"WU_AquaAbund")
logger.info("Joined data exported as WU_AquaAbund")

## Remove Join
arcpy.RemoveJoin_management("fcWUAquaAbund2")
logger.info("Join removed")

## Set value of FINALCODE to zero for null intersections
strWHERE = """"Buffer1kStrm_diss_SUM_StrmLength" IS NULL""""

arcpy.SelectLayerByAttribute_management(fcWUAquaAbund,"NEW_SELECTION",strWHE
RE)

```

```

arcpy.CalculateField_management(fcWUAquaAbund,"Buffer1kStrm_diss_SUM_StrmLength",
"0","VB","#")

logger.info("field SUM_StrmLength value added for null intersections")

## STEP 3: Assign points
## Add field AquaAbund, set initial value to zero
arcpy.SelectLayerByAttribute_management(fcWUAquaAbund, "CLEAR_SELECTION")
actions.DeleteField(fcWUAquaAbund, "AquaAbund")
arcpy.AddField_management(fcWUAquaAbund, "AquaAbund", "SHORT")
arcpy.CalculateField_management(fcWUAquaAbund,"AquaAbund","0","VB","#")
logger.info("field AquaAbund added")

## Assign points
## StrmLength one SD below mean = 0, within 1 SD of mean = 1, >1 SD above mean = 2
points
strWHERE = """"WU_AquaAbund2_Buffer1kAqua_diss_Aqua1kRat" > 0.01 OR
"Buffer1kStrm_diss_SUM_StrmLength" > 6000""""

arcpy.SelectLayerByAttribute_management(fcWUAquaAbund,"NEW_SELECTION",strWHE
RE)

arcpy.CalculateField_management(fcWUAquaAbund,"AquaAbund","1","VB","#")

strWHERE = """"WU_AquaAbund2_Buffer1kAqua_diss_Aqua1kRat" > 0.05 OR
"Buffer1kStrm_diss_SUM_StrmLength" > 8000""""

arcpy.SelectLayerByAttribute_management(fcWUAquaAbund,"NEW_SELECTION",strWHE
RE)

arcpy.CalculateField_management(fcWUAquaAbund,"AquaAbund","2","VB","#")
logger.info("AquaAbund points assigned")
arcpy.SelectLayerByAttribute_management(fcWUAquaAbund,"CLEAR_SELECTION")

```



```
# Clean up
if arcpy.Exists('Buffer1kAqua'):
    arcpy.Delete_management('Buffer1kAqua')
if arcpy.Exists('Buffer1kAqua_diss'):
    arcpy.Delete_management('Buffer1kAqua_diss')
if arcpy.Exists('Buffer1kStrm'):
    arcpy.Delete_management('Buffer1kStrm')
if arcpy.Exists('Buffer1kStrm_diss'):
    arcpy.Delete_management('Buffer1kStrm_diss')
if arcpy.Exists('WU_AquaAbund1'):
    arcpy.Delete_management('WU_AquaAbund1')
if arcpy.Exists('WU_AquaAbund2'):
    arcpy.Delete_management('WU_AquaAbund2')
```

### 5.7.33 BRankHUC: Habitat and Ecological Integrity Opportunity

```
#####  
#  
# File Name: BRankHUC.py  
# Developer: Yibing Han  
# Date: 10/09/2017  
# Purpose:  
# Input to Habitat / Landscape Opportunity (LandEco: Landscape Ecological Connectivity)  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcBRankHUC(WetlandPoly):  
    logger = logging.getLogger("WFA.HabEco.HOpportun.BRankHUC")  
  
    # Setting python variables  
    fcBRHUC = arcpy.mapping.Layer(globalvars.srcBRHUC)  
  
    # Clean up if needed  
    if arcpy.Exists("WU_BRankHUC"):  
        arcpy.Delete_management("WU_BRankHUC")
```

```

## Create feature class to store results for BRankHUC and set initial value to zero
arcpy.CopyFeatures_management(WetlandPoly,"WU_BRankHUC","#","0","0","0")
fcBRankHUC = arcpy.mapping.Layer(r"WU_BRankHUC")
logger.info("feature class WU_BRankHUC created")

actions.DeleteField(fcBRankHUC, "BRankHUC")
arcpy.AddField_management(fcBRankHUC, "BRankHUC", "SHORT")
arcpy.CalculateField_management(fcBRankHUC,"BRankHUC","0","VB","#")
logger.info("field BRankHUC added and initial value set to 0")

## Select B4- or B5 ranked watersheds
strWHERE = """"Brank" = 'B4' OR "Brank" = 'B5'"""
arcpy.SelectLayerByAttribute_management(fcBRHUC, "NEW_SELECTION", strWHERE)
logger.info("B4- or B5 ranked watersheds selected")

## Select Wetland Units that intersect B4- or B5-ranked watershed
arcpy.SelectLayerByLocation_management(fcBRankHUC, "INTERSECT", fcBRHUC)
logger.info("Wetland Units that intersect B4- or B5-ranked watershed selected")

## Assign 1 point
arcpy.CalculateField_management(fcBRankHUC,"BRankHUC","1","VB","#")
logger.info("1 point assigned to qualifying wetland units")

## Select B3-ranked watersheds
strWHERE = """"Brank" = 'B3'"""
arcpy.SelectLayerByAttribute_management(fcBRHUC, "NEW_SELECTION", strWHERE)
logger.info("B3-ranked watersheds selected")

## Select Wetland Units that intersect B3-ranked watershed

```

```
arcpy.SelectLayerByLocation_management(fcBRankHUC, "INTERSECT", fcBRHUC)
logger.info("Wetland Units that intersect B2-ranked watershed selected")
```

```
## Assign 2 points
```

```
arcpy.CalculateField_management(fcBRankHUC,"BRankHUC","2","VB","#")
logger.info("2 points assigned to qualifying wetland units")
```

```
## Select B2-ranked watersheds
```

```
strWHERE = """"BRank" = 'B2'""""
```

```
arcpy.SelectLayerByAttribute_management(fcBRHUC, "NEW_SELECTION", strWHERE)
logger.info("B2-ranked watersheds selected")
```

```
## Select Wetland Units that intersect B2-ranked watershed
```

```
arcpy.SelectLayerByLocation_management(fcBRankHUC, "INTERSECT", fcBRHUC)
logger.info("Wetland Units that intersect B2-ranked watershed selected")
```

```
## Assign 3 points and clear selections
```

```
arcpy.CalculateField_management(fcBRankHUC,"BRankHUC","3","VB","#")
logger.info("3 points assigned to qualifying wetland units")
```

```
## Select B2-ranked watersheds
```

```
strWHERE = """"BRank" = 'B1'""""
```

```
arcpy.SelectLayerByAttribute_management(fcBRHUC, "NEW_SELECTION", strWHERE)
logger.info("B2-ranked watersheds selected")
```

```
## Select Wetland Units that intersect B1-ranked watershed
```

```
arcpy.SelectLayerByLocation_management(fcBRankHUC, "INTERSECT", fcBRHUC)
logger.info("Wetland Units that intersect B1-ranked watershed selected")
```

```
## Assign 4 points and clear selections
arcpy.CalculateField_management(fcBRankHUC,"BRankHUC","4","VB","#")
logger.info("4 points assigned to qualifying wetland units")

arcpy.SelectLayerByAttribute_management(fcBRHUC, "CLEAR_SELECTION")
arcpy.SelectLayerByAttribute_management(fcBRankHUC, "CLEAR_SELECTION")

# Clean up
```

### 5.7.34 BufferContig: Habitat and Ecological Integrity Opportunity

```
#####  
#  
# File Name: BufferContig.py  
# Developer: Yibing Han  
# Date: 10/02/2017  
# Purpose:  
#   Input to Habitat / Opportunity / BufferLand (Buffer and Landscape Integrity)  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcBufferContig(WetlandPoly):  
    logger = logging.getLogger("WFA.HabEco.HOpportun.BufferContig")  
  
    # Setting python variables  
    arcpy.MakeFeatureLayer_management(WetlandPoly, "fcWU")  
    fcBuffer300m = arcpy.mapping.Layer(globalvars.srcBuffer300m)  
    fcDisturbedLand = arcpy.mapping.Layer(globalvars.srcDisturbedLand)  
  
    # Clean up if needed  
    if arcpy.Exists("Buffer300mUndist"):
```

```

    arcpy.Delete_management("Buffer300mUndist")
if arcpy.Exists("Buffer300mUndist_sing"):
    arcpy.Delete_management("Buffer300mUndist_sing")
if arcpy.Exists("Buffer300mUndist_diss"):
    arcpy.Delete_management("Buffer300mUndist_diss")
if arcpy.Exists("WU_BufferContig1"):
    arcpy.Delete_management("WU_BufferContig1")
if arcpy.Exists("WU_BufferContig"):
    arcpy.Delete_management("WU_BufferContig")

## Erase the portions of the 300m buffer that overlap DisturbedLand
arcpy.Erase_analysis(fcBuffer300m, fcDisturbedLand, "Buffer300mUndist")
fcBuffer300mUndist = arcpy.mapping.Layer(r"Buffer300mUndist")
logger.info("Feature Layers ready")

## The Erase tool produces multipart polygons. Change these to singlepart polygons.
arcpy.MultipartToSinglepart_management(fcBuffer300mUndist, "Buffer300mUndist_sing")
fcBuffer300mUndist_sing = arcpy.mapping.Layer("Buffer300mUndist_sing")
actions.DeleteField(fcBuffer300mUndist_sing,"ContigSingArea")
arcpy.AddField_management(fcBuffer300mUndist_sing, "ContigSingArea", "FLOAT")
logger.info("Field ContigSingArea added")

## Select undisturbed buffer polygons that share a line segment with Wetland Units.
arcpy.SelectLayerByLocation_management(fcBuffer300mUndist_sing,
"SHARE_A_LINE_SEGMENT_WITH", "fcWU")
logger.info("undisturbed buffer polygons selected by location")

## Calculate area of contiguous singlepart polygons

```

```

arcpy.CalculateField_management(fcBuffer300mUndist_sing,"ContigSingArea","[Shape_Area]
","VB","#")

    arcpy.SelectLayerByAttribute_management(fcBuffer300mUndist_sing,
"CLEAR_SELECTION")

    strWHERE = """"ContigSingArea" IS NULL""

    arcpy.SelectLayerByAttribute_management(fcBuffer300mUndist_sing,
"NEW_SELECTION", strWHERE)

arcpy.CalculateField_management(fcBuffer300mUndist_sing,"ContigSingArea","0","VB","#")

    arcpy.SelectLayerByAttribute_management(fcBuffer300mUndist_sing,
"CLEAR_SELECTION")

    logger.info("area of contiguous singlepart polygons calculated")

    ## Dissolve undisturbed portion of wetland buffer by WUKey
    arcpy.Dissolve_management(fcBuffer300mUndist_sing, "Buffer300mUndist_diss",
"WUKey", "Buf300Area FIRST;ContigSingArea SUM")

    arcpy.MakeFeatureLayer_management("Buffer300mUndist_diss",
"fcBuffer300mUndist_diss")

    logger.info("undisturbed portion of wetland buffer dissolved")

    ## Add field and calculate ratio of contiguous undisturbed area to total buffer area.
    actions.DeleteField("fcBuffer300mUndist_diss","ContigUndRat")

    arcpy.AddField_management("fcBuffer300mUndist_diss", "ContigUndRat", "FLOAT")

arcpy.CalculateField_management("fcBuffer300mUndist_diss","ContigUndRat","[SUM_Conti
gSingArea]/[FIRST_Buf300Area]","VB","#")

    logger.info("field ContigUndRat added and calculated")

    ## Create feature class to store intermediate results for BufferContig
    arcpy.CopyFeatures_management("fcWU","WU_BufferContig1","#","0","0","0")

    logger.info("feature class WU_BufferContig1 created")

```



```

## Join ratio of contiguous undisturbed buffer to Wetland Units
arcpy.MakeFeatureLayer_management("WU_BufferContig1", "fcWUBufferContig1")

arcpy.AddJoin_management("fcWUBufferContig1","WUKey","fcBuffer300mUndist_diss","WUKey","KEEP_ALL")
logger.info("join added to Wetland Units")

## Export joined data

#arcpy.CopyFeatures_management("fcWUBufferContig1","WU_BufferContig","#","0","0","0")
)
arcpy.FeatureClassToFeatureClass_conversion("fcWUBufferContig1", arcpy.env.workspace, "WU_BufferContig")
fcBufferContig = arcpy.mapping.Layer("WU_BufferContig")
logger.info("joined data exported")

## Remove Join
arcpy.RemoveJoin_management("fcWUBufferContig1")
logger.info("joined removed")

## Set value of ContigUndRat to zero for null intersections
strWHERE = """"Buffer300mUndist_diss_ContigUndRat" IS NULL""
arcpy.SelectLayerByAttribute_management(fcBufferContig, "NEW_SELECTION", strWHERE)

arcpy.CalculateField_management(fcBufferContig,"Buffer300mUndist_diss_ContigUndRat","0","VB","#")
arcpy.SelectLayerByAttribute_management(fcBufferContig, "CLEAR_SELECTION")
logger.info("field ContigUndRat value set to 0 for null intersections")

## Add field BufferContig, set initial value to zero

```

```

actions.DeleteField(fcBufferContig,"BufferContig")
arcpy.AddField_management(fcBufferContig, "BufferContig", "SHORT")
arcpy.CalculateField_management(fcBufferContig,"BufferContig","0","VB","#")
logger.info("field BufferContig added")

## Assign points to Wetland Units
strWHERE = """"Buffer300mUndist_diss_ContigUndRat" > 0.6""""
arcpy.SelectLayerByAttribute_management(fcBufferContig, "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management(fcBufferContig,"BufferContig","1","VB","#")

strWHERE = """"Buffer300mUndist_diss_ContigUndRat" > 0.9""""
arcpy.SelectLayerByAttribute_management(fcBufferContig, "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management(fcBufferContig,"BufferContig","2","VB","#")
logger.info("field BufferContig values calculated")
arcpy.SelectLayerByAttribute_management(fcBufferContig, "CLEAR_SELECTION")

arcpy.AddField_management(fcBufferContig, "WUKey", "LONG")

arcpy.CalculateField_management(fcBufferContig,"WUKey","[WU_BufferContig1_WUKey]",
"VB","#")
arcpy.DeleteField_management(fcBufferContig,"WU_BufferContig1_WUKey")

# Clean up
if arcpy.Exists("Buffer300mUndist"):
    arcpy.Delete_management("Buffer300mUndist")
if arcpy.Exists("Buffer300mUndist_sing"):
    arcpy.Delete_management("Buffer300mUndist_sing")
if arcpy.Exists("Buffer300mUndist_diss"):
    arcpy.Delete_management("Buffer300mUndist_diss")

```

```
if arcpy.Exists("WU_BufferContig1"):
    arcpy.Delete_management("WU_BufferContig1")
```

### 5.7.35 BufferPerim: Habitat and Ecological Integrity Opportunity

```
#####  
#  
# File Name: BufferPerim.py  
# Developer: Yibing Han  
# Date: 10/03/2017  
# Purpose:  
# Input to Habitat / Opportunity / BufferLand (Buffer and Landscape Integrity)  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcBufferPerim(WetlandPoly):  
    logger = logging.getLogger("WFA.HabEco.HOpportun.BufferPerim")  
  
    # Setting python variables  
    fcBuffer10m = arcpy.mapping.Layer(globalvars.srcBuffer10m)  
    fcDisturbedLand = arcpy.mapping.Layer(globalvars.srcDisturbedLand)  
    fcInterstates = arcpy.mapping.Layer(globalvars.srcInterstates)  
    fcPrimaryRoads = arcpy.mapping.Layer(globalvars.srcPrimaryRoads)  
    fcLocalRoads = arcpy.mapping.Layer(globalvars.srcLocalRoads)  
    fcOthers = arcpy.mapping.Layer(globalvars.srcOtherRoads)
```

```

fcRailway = arcpy.mapping.Layer(globalvars.srcRailway)
fcTrails = arcpy.mapping.Layer(globalvars.srcTrails)
logger.info("Feature Layers ready")

# Clean up if needed
if arcpy.Exists("WU_BufferPerim1"):
    arcpy.Delete_management("WU_BufferPerim1")
if arcpy.Exists("WU_BufferPerim"):
    arcpy.Delete_management("WU_BufferPerim")
if arcpy.Exists("Buffer10mDist"):
    arcpy.Delete_management("Buffer10mDist")

## STEP 1 Roads and Railways
## Create feature class to store intermediate results for BufferPerim
arcpy.CopyFeatures_management(WetlandPoly,"WU_BufferPerim1","#","0","0","0")
fcBufferPerim1 = arcpy.mapping.Layer(r"WU_BufferPerim1")

## Add field to store road and rail type
actions.DeleteField(fcBufferPerim1,"RoadRailType")
arcpy.AddField_management(fcBufferPerim1, "RoadRailType", "TEXT","","","10")
logger.info("field RoadRailType added to WU_BufferPerim1")

## Select Wetland Units that intersect or are within 10 meters of mapped trails
arcpy.SelectLayerByLocation_management(fcBufferPerim1, "INTERSECT", fcTrails, "10
Meters")
arcpy.CalculateField_management(fcBufferPerim1,"RoadRailType","Trail","VB","#")
logger.info("field RoadRailType calculated with type 'Trail'")

## Select Wetland Units that intersect or are within 10 meters of other roads & trails

```

```
arcpy.SelectLayerByLocation_management(fcBufferPerim1, "INTERSECT", fcOthers, "10 Meters")
```

```
arcpy.CalculateField_management(fcBufferPerim1,"RoadRailType","Other","VB","#")  
logger.info("field RoadRailType calculated with type 'Other'")
```

```
## Select Wetland Units that intersect or are within 10 meters of local roads
```

```
arcpy.SelectLayerByLocation_management(fcBufferPerim1, "INTERSECT", fcLocalRoads, "10 Meters")
```

```
arcpy.CalculateField_management(fcBufferPerim1,"RoadRailType","Local","VB","#")  
logger.info("field RoadRailType calculated with type 'Local'")
```

```
## Select Wetland Units that intersect or are within 10 meters of railways
```

```
arcpy.SelectLayerByLocation_management(fcBufferPerim1, "INTERSECT", fcRailway, "10 Meters")
```

```
arcpy.CalculateField_management(fcBufferPerim1,"RoadRailType","Rail","VB","#")  
logger.info("field RoadRailType calculated with type 'Rail'")
```

```
## Select Wetland Units that intersect or are within 10 meters of primary roads
```

```
arcpy.SelectLayerByLocation_management(fcBufferPerim1, "INTERSECT", fcPrimaryRoads, "10 Meters")
```

```
arcpy.CalculateField_management(fcBufferPerim1,"RoadRailType","Primary","VB","#")  
logger.info("field RoadRailType calculated with type 'Primary'")
```

```
## Select Wetland Units that intersect or are within 10 meters of interstate highways
```

```
arcpy.SelectLayerByLocation_management(fcBufferPerim1, "INTERSECT", fcInterstates, "10 Meters")
```

```
arcpy.CalculateField_management(fcBufferPerim1,"RoadRailType","Interstate","VB","#")  
logger.info("field RoadRailType calculated with type 'Interstate'")
```

```
arcpy.SelectLayerByAttribute_management(fcBufferPerim1, "CLEAR_SELECTION")
```

```
## STEP 2 DisturbedLand
```

```

## Note that much of this step is the same as the method for Disturb50m

# Intersect the 10m buffers and the disturbed land uses
arInputData = [fcBuffer10m,fcDisturbedLand]
arcpy.Intersect_analysis(arInputData,"Buffer10mDist","ALL",output_type="INPUT")
fcBuffer10mDist = arcpy.mapping.Layer(r"Buffer10mDist")
logger.info("intersect completed")

# Dissolve disturbed portion of wetland buffer by WUKey
arcpy.Dissolve_management(fcBuffer10mDist,"Buffer10mDist_diss","WUKey","Buf10Area
FIRST")
fcBuffer10mDist_diss = arcpy.mapping.Layer(r"Buffer10mDist_diss")
logger.info("disturbed portion of wetland buffer dissolved")

## Add field and calculate ratio of disturbed area to total buffer area.
actions.DeleteField(fcBuffer10mDist_diss,"Dist10mRat")
arcpy.AddField_management(fcBuffer10mDist_diss, "Dist10mRat", "FLOAT")

arcpy.CalculateField_management(fcBuffer10mDist_diss,"Dist10mRat","[Shape_Area]/[FIRST
_Buf10Area]","VB","#")
logger.info("added and calculated field of Dist10mRat")

# Join ratio of distrubed land to Wetland Units
arcpy.MakeFeatureLayer_management("WU_BufferPerim1", "flWUBufferPerim1")
arcpy.MakeFeatureLayer_management("Buffer10mDist_diss", "flBuffer10mDist_diss")

arcpy.AddJoin_management("flWUBufferPerim1","WUKey","flBuffer10mDist_diss","WUKey
","KEEP_ALL")
logger.info("added join to WU_BufferPerim1")

# Export joined data

```

```

#arcpy.CopyFeatures_management("flWUBufferPerim1","WU_BufferPerim","#","0","0","0")
    arcpy.FeatureClassToFeatureClass_conversion("flWUBufferPerim1", arcpy.env.workspace,
"WU_BufferPerim")
    fcBufferPerim = arcpy.mapping.Layer(r"WU_BufferPerim")
    logger.info("Joined data exported as WU_BufferPerim")

# Remove Join
arcpy.RemoveJoin_management("flWUBufferPerim1")
logger.info("Join removed")

# Set value of Dist10mRat to zero for null intersections
strWHERE = """"Buffer10mDist_diss_Dist10mRat" IS NULL""""

arcpy.SelectLayerByAttribute_management(fcBufferPerim,"NEW_SELECTION",strWHERE)

arcpy.CalculateField_management(fcBufferPerim,"Buffer10mDist_diss_Dist10mRat","0","VB"
,"#")
    logger.info("field Dist10mRat value added for null intersections")

## STEP 3
## Assign points

# Add field BufferPerim, set initial value to zero
arcpy.SelectLayerByAttribute_management(fcBufferPerim, "CLEAR_SELECTION")
actions.DeleteField(fcBufferPerim, "BufferPerim")
arcpy.AddField_management(fcBufferPerim, "BufferPerim", "FLOAT")
arcpy.CalculateField_management(fcBufferPerim,"BufferPerim","0","VB","#")
logger.info("field BufferPerim added")

# Assign points

```



```

    strWHERE = """"Buffer10mDist_diss_Dist10mRat" = 0 AND
"WU_BufferPerim1_RoadRailType" IS NULL""

    arcpy.SelectLayerByAttribute_management(fcBufferPerim, "NEW_SELECTION",
strWHERE)

    arcpy.CalculateField_management(fcBufferPerim,"BufferPerim","2","VB","#")

    strWHERE = """"Buffer10mDist_diss_Dist10mRat" > 0 OR
"WU_BufferPerim1_RoadRailType" IN ('Trail', 'Local', 'Other')""

    arcpy.SelectLayerByAttribute_management(fcBufferPerim, "NEW_SELECTION",
strWHERE)

    arcpy.CalculateField_management(fcBufferPerim,"BufferPerim","1","VB","#")

    strWHERE = """"Buffer10mDist_diss_Dist10mRat" > 0.25 OR
"WU_BufferPerim1_RoadRailType" IN ('Rail', 'Primary', 'Interstate')""

    arcpy.SelectLayerByAttribute_management(fcBufferPerim, "NEW_SELECTION",
strWHERE)

    arcpy.CalculateField_management(fcBufferPerim,"BufferPerim","0","VB","#")

    logger.info("calculation completed for field BufferPerim")

    arcpy.SelectLayerByAttribute_management(fcBufferPerim, "CLEAR_SELECTION")

    arcpy.AddField_management(fcBufferPerim, "WUKey", "LONG")

arcpy.CalculateField_management(fcBufferPerim,"WUKey","[WU_BufferPerim1_WUKey]","
VB","#")

    arcpy.DeleteField_management(fcBufferPerim,"WU_BufferPerim1_WUKey")

# Clean up
if arcpy.Exists("WU_BufferPerim1"):
    arcpy.Delete_management("WU_BufferPerim1")
if arcpy.Exists("Buffer10mDist"):
    arcpy.Delete_management("Buffer10mDist")

```

### 5.7.36 ConsFocus: Habitat and Ecological Integrity Opportunity

```
#####  
#  
# File Name: ConsFocus.py  
# Developer: Yibing Han  
# Date: 10/09/2017 (updated 12/27/2018)  
# Purpose:  
# Input to Habitat / Landscape Opportunity (LandEco: Landscape Ecological Connectivity)  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcConsFocus(WetlandPoly):  
    logger = logging.getLogger("WFA.HabEco.HOpportun.ConsFocus")  
  
    # Setting python variables  
    fcCFA = arcpy.mapping.Layer(globalvars.srcCFAArea)  
  
    # Clean up if needed  
    if arcpy.Exists("WU_ConsFocus"):  
        arcpy.Delete_management("WU_ConsFocus")
```

```

## Create feature class to store results for ConsFocus and set initial value to zero
arcpy.CopyFeatures_management(WetlandPoly,"WU_ConsFocus", "#", "0", "0", "0")
fcConstFocus = arcpy.mapping.Layer(r"WU_ConsFocus")
logger.info("feature class WU_ConsFocus created")

actions.DeleteField(fcConstFocus, "ConsFocus")
arcpy.AddField_management(fcConstFocus, "ConsFocus", "SHORT")
arcpy.CalculateField_management(fcConstFocus,"ConsFocus","0","PYTHON","#")
logger.info("field ConsFocus added and initial value set to 0")

"## Select all CFAs except the general CFA
strWHERE = """"CFA_Name" <> 'General Conservation Area""""
arcpy.SelectLayerByAttribute_management(fcCFA, "NEW_SELECTION", strWHERE)
logger.info("all CFAs except the general CFA selected")"

## Select Wetland Units that intersect the selected CFAs
arcpy.SelectLayerByLocation_management(fcConstFocus, "INTERSECT", fcCFA)
logger.info("Wetland Units that intersect the selected CFAs selected")

## Assign 1 point
arcpy.CalculateField_management(fcConstFocus,"ConsFocus","1","PYTHON","#")
logger.info("1 point assigned to qualifying wetland units")

## Select CFAs with wetland focus
strWHERE = """"WetlFocus" = 'yes""""
arcpy.SelectLayerByAttribute_management(fcCFA, "NEW_SELECTION", strWHERE)
logger.info("CFAs with wetland focus selected")

## Select Wetland Units that intersect CFAs with wetland focus

```

```
arcpy.SelectLayerByLocation_management(fcConstFocus, "INTERSECT", fcCFA)
logger.info("Wetland Units that intersect CFAs with wetland focus selected")

## Assign 2 points
arcpy.CalculateField_management(fcConstFocus,"ConsFocus","2","PYTHON","#")
logger.info("2 points assigned to qualifying wetland units")

arcpy.SelectLayerByAttribute_management(fcCFA, "CLEAR_SELECTION")
arcpy.SelectLayerByAttribute_management(fcConstFocus, "CLEAR_SELECTION")

# Clean up
```

### 5.7.37 Karst: Habitat and Ecological Integrity Opportunity

#####

#

# File Name: Karst.py

# Developer: Yibing Han

# Date 9/20/2017

# Purpose:

# Input to Habitat / Potential / Vegetation / Floristic Quality

#

#####

#!/usr/bin/python

import sys

sys.path.append("../..")

import logging

import arcpy

from globalvars import globalvars

from utilities import actions

def CalcKarst(WetlandPoly):

    logger = logging.getLogger("WFA.HabEco.HPotential.Karst")

    # Setting python variables

    arcpy.MakeFeatureLayer\_management(WetlandPoly, "fcWU")

    arcpy.MakeFeatureLayer\_management(globalvars.srcKarstComp, "fcKarstComposite")

    # Clean up if needed

    if arcpy.Exists("WU\_Karst"):

        arcpy.Delete\_management("WU\_Karst")

```

if arcpy.Exists("WU_Karst1"):
    arcpy.Delete_management("WU_Karst1")
logger.info("feature layers ready")

## Intersect karst and Wetland Units
arcpy.Intersect_analysis(["fcKarstComposite", "fcWU"], "WU_Karst1", "ONLY_FID")
logger.info("Intersect of karst and Wetland Units completed")

## Add field to store karst area.
actions.DeleteField("WU_Karst1","KarstArea")
arcpy.AddField_management("WU_Karst1", "KarstArea", "FLOAT")
arcpy.CalculateField_management("WU_Karst1","KarstArea","[Shape_Area]","VB","#")
arcpy.MakeFeatureLayer_management(r"WU_Karst1","fcWUKarst1")
logger.info("field KarstArea added to store karst area")

## Spatial Join karst selection to Wetland Units and sum karst area.

#####
#####

# SJ: FloodIn

#####
#####

fmSJFLIN = arcpy.FieldMappings()
fmSJFLIN.addTable("fcWU")
fmSJFLIN.addTable("fcWUKarst1")

keepers = []
keepers = ["WUKey","Shape_Length","Shape_Area","KarstArea"]

for field in fmSJFLIN.fields:

```

```

if field.name not in keepers:
    fmSJFLIN.removeFieldMap(fmSJFLIN.findFieldMapIndex(field.name))

fldKeyIndex = fmSJFLIN.findFieldMapIndex("KarstArea")
fieldmap = fmSJFLIN.getFieldMap(fldKeyIndex)
fieldmap.mergeRule = "Sum"
fmSJFLIN.replaceFieldMap(fldKeyIndex, fieldmap)

arcpy.SpatialJoin_analysis("fcWU","fcWUKarst1","WU_Karst","JOIN_ONE_TO_ONE","KEEP_ALL",fmSJFLIN,"CONTAINS")
arcpy.MakeFeatureLayer_management("WU_Karst","fcWUKarst")
logger.info("Spatial Join karst selection to Wetland Units completed")

## Add fields to store KarstRatio and Karst.
actions.DeleteField("fcWUKarst","KarstRatio")
arcpy.AddField_management("fcWUKarst", "KarstRatio", "FLOAT")
arcpy.AddField_management("fcWUKarst", "Karst", "SHORT")
arcpy.CalculateField_management("fcWUKarst","Karst","0","VB","#")

arcpy.CalculateField_management("fcWUKarst","KarstRatio","[KarstArea]/[Shape_Area]","VB","#")
logger.info("field KarstRatio added to store KarstRatio and Karst")

## Assign points to Wetland Units for VegHorInt
strWHERE = """"KarstRatio" > 0.1""""
arcpy.SelectLayerByAttribute_management("fcWUKarst", "NEW_SELECTION", strWHERE)
arcpy.CalculateField_management("fcWUKarst","Karst","1","VB","#")

strWHERE = """"KarstRatio" > 0.33""""

```

```

    arcpy.SelectLayerByAttribute_management("fcWUKarst", "NEW_SELECTION",
strWHERE)
    arcpy.CalculateField_management("fcWUKarst","Karst","2","VB","#")

strWHERE = """"KarstRatio" > 0.67""""
    arcpy.SelectLayerByAttribute_management("fcWUKarst", "NEW_SELECTION",
strWHERE)
    arcpy.CalculateField_management("fcWUKarst","Karst","3","VB","#")
    logger.info("points assigned to Wetland Units for field KarstRatio")

    arcpy.SelectLayerByAttribute_management("fcWUKarst", "CLEAR_SELECTION")

# Clean up
if arcpy.Exists("WU_Karst1"):
    arcpy.Delete_management("WU_Karst1")

```



### 5.7.38 LandInteg: Habitat and Ecological Integrity Opportunity

```
#####
```

```
#
```

```
# File Name: LandInteg.py
```

```
# Developer: Yibing Han
```

```
# Date 9/21/2017 (updated 12/27/2018)
```

```
# Purpose:
```

```
# Input to Habitat / Potential (VegFQ, HydIntact) and Habitat/Opportunity (Buffer and  
Landscape Integrity)
```

```
#
```

```
#####
```

```
#!/usr/bin/python
```

```
import sys
```

```
sys.path.append("../..")
```

```
import logging
```

```
import arcpy
```

```
from globalvars import globalvars
```

```
from utilities import actions
```

```
from arcpy.sa import *
```

```
def CalcLandInteg(WetlandPoly):
```

```
    arcpy.CheckOutExtension("Spatial")
```

```
    logger = logging.getLogger("WFA.HabEco.HOpportun.LandInteg")
```

```
    # Clean up if needed
```

```
    if arcpy.Exists("LandInteg_zonal"):
```

```
        arcpy.Delete_management("LandInteg_zonal")
```

```
    if arcpy.Exists("LandResil_zonal"):
```

```
        arcpy.Delete_management("LandResil_zonal")
```

```

if arcpy.Exists("WU_LandIntegDNR"):
    arcpy.Delete_management("WU_LandIntegDNR")
if arcpy.Exists("WU_IEI1"):
    arcpy.Delete_management("WU_IEI1")
if arcpy.Exists("WU_IEI"):
    arcpy.Delete_management("WU_IEI")
if arcpy.Exists("WUpoint_IEI"):
    arcpy.Delete_management("WUpoint_IEI")
if arcpy.Exists("WU_LandResil1"):
    arcpy.Delete_management("WU_LandResil1")
if arcpy.Exists("WU_LandResil"):
    arcpy.Delete_management("WU_LandResil")
if arcpy.Exists("WUpoint_LandResil"):
    arcpy.Delete_management("WUpoint_LandResil")
if arcpy.Exists("WU_ForestPatch"):
    arcpy.Delete_management("WU_ForestPatch")
if arcpy.Exists("WU_LandInteg"):
    arcpy.Delete_management("WU_LandInteg")
if arcpy.Exists("WU_LandInteg0"):
    arcpy.Delete_management("WU_LandInteg0")
if arcpy.Exists("WU_LandInteg1"):
    arcpy.Delete_management("WU_LandInteg1")
if arcpy.Exists("WUpoint_LandInteg"):
    arcpy.Delete_management("WUpoint_LandInteg")

# Setting python variables
arcpy.CopyFeatures_management(WetlandPoly,"WU_LandInteg0","#","0","0","0")
arcpy.MakeFeatureLayer_management("WU_LandInteg0", "fcWULandInteg0")
arcpy.MakeFeatureLayer_management(globalvars.srcForestPatches, "fcForestPatches")

```

```

arcpy.MakeRasterLayer_management(globalvars.srcIEI, "IEI")
arcpy.MakeRasterLayer_management(globalvars.srcLIIndex, "LIIndex")
arcpy.MakeRasterLayer_management(globalvars.srcResilientConnected, "ResilConnected")
logger.info("feature & raster layers ready")

## Calculate the intermediate metric LandIntegDNR
## Summarize the DNR Landscape Integrity raster values for each Wetland Unit
arcpy.gp.ZonalStatisticsAsTable("fcWULandInteg0", "WUKey", "LIIndex",
"LandInteg_zonal", "DATA", "MEAN")
logger.info("the DNR Landscape Integrity raster values for each Wetland Unit summarized")

## Convert Wetland Unit polygons to points
arcpy.MakeFeatureLayer_management(globalvars.srcWUPoint, "fcWUpoint")
logger.info("Wetland Unit polygons converted to points")

## Extract the DNR Landscape Integrity raster values for each Wetland Unit centroid
ExtractValuesToPoints("fcWUpoint", "LIIndex", "WUpoint_LandInteg")
logger.info("DNR Landscape Integrity raster values for each Wetland Unit centroid
extracted")

## Delete the "Count" field from the LandInteg_zonal table since "Count" is a restricted word
## and may interfere with the join in the next step
arcpy.DeleteField_management ("LandInteg_zonal","Count")
logger.info("field Count deleted")

## Join Wetland Units to the LandInteg_zonal table
arcpy.AddJoin_management("fcWULandInteg0","WUKey","LandInteg_zonal","WUKey")
logger.info("Join Wetland Units to the LandInteg_zonal table completed")

## Export the joined data to a Feature Class

```

```

    arcpy.FeatureClassToFeatureClass_conversion("fcWULandInteg0", arcpy.env.workspace,
"WU_LandInteg1")
    logger.info("joined data exported as WU_LandInteg1")

## Remove Join from Wetland Units
arcpy.RemoveJoin_management("fcWULandInteg0")
logger.info("join removed from Wetland Units")

## Join WU_LandInteg1 to WUpoint_LandInteg
arcpy.MakeFeatureLayer_management("WU_LandInteg1", "fcWULandInteg1")
arcpy.MakeFeatureLayer_management("WUpoint_LandInteg", "fcWUPoint_LandInteg")

arcpy.AddJoin_management("fcWULandInteg1","WU_LandInteg0_WUKey","fcWUPoint_La
ndInteg","WUKey")
    logger.info("joined WU_LandInteg1 to WUpoint_LandInteg")

## Export joined data to feature class
    arcpy.FeatureClassToFeatureClass_conversion("fcWULandInteg1", arcpy.env.workspace,
"WU_LandIntegDNR")
    arcpy.MakeFeatureLayer_management("WU_LandIntegDNR", "fcWULandIntegDNR")
    logger.info("joined data exported as WU_LandIntegDNR")

## Replace NULL values of MEAN with centroid values of Landscape Integrity
strWHERE = """"WU_LandInteg1_LandInteg_zonal_MEAN" IS NULL""""
    arcpy.SelectLayerByAttribute_management("fcWULandIntegDNR", "NEW_SELECTION",
strWHERE)

arcpy.CalculateField_management("fcWULandIntegDNR","WU_LandInteg1_LandInteg_zonal
_MEAN","!WUpoint_LandInteg_RASTERVALU!", "PYTHON", "#")
    arcpy.SelectLayerByAttribute_management("fcWULandIntegDNR",
"CLEAR_SELECTION")
    logger.info("NULL values of MEAN with centroid values of Landscape Integrity replaced")

```

```

## Add field LandIntegDNR, set initial value to zero
actions.DeleteField("fcWULandIntegDNR","LandIntegDNR")
arcpy.AddField_management("fcWULandIntegDNR", "LandIntegDNR", "SHORT")

arcpy.CalculateField_management("fcWULandIntegDNR","LandIntegDNR","0","PYTHON",
#)

logger.info("field LandIntegDNR added and initial value set to zero")

## Assign points
strWHERE = """"WU_LandInteg1_LandInteg_zonal_MEAN" > 600""""
arcpy.SelectLayerByAttribute_management("fcWULandIntegDNR", "NEW_SELECTION",
strWHERE)

arcpy.CalculateField_management("fcWULandIntegDNR","LandIntegDNR","1","PYTHON",
#)

strWHERE = """"WU_LandInteg1_LandInteg_zonal_MEAN" > 700""""
arcpy.SelectLayerByAttribute_management("fcWULandIntegDNR", "NEW_SELECTION",
strWHERE)

arcpy.CalculateField_management("fcWULandIntegDNR","LandIntegDNR","2","PYTHON",
#)

strWHERE = """"WU_LandInteg1_LandInteg_zonal_MEAN" > 800""""
arcpy.SelectLayerByAttribute_management("fcWULandIntegDNR", "NEW_SELECTION",
strWHERE)

arcpy.CalculateField_management("fcWULandIntegDNR","LandIntegDNR","3","PYTHON",
#)

logger.info("points assigned in field LandIntegDNR")
logger.info("Step 1 completed")

```

```

    arcpy.SelectLayerByAttribute_management("fcWULandIntegDNR",
"CLEAR_SELECTION")

## STEP 2

## Note that method is nearly identical to STEP 1 except for field names and final points
## Calculate the intermediate metric IEI
## Summarize the IEI raster values for each Wetland Unit
arcpy.gp.ZonalStatisticsAsTable("fcWULandInteg0", "WUKey", "IEI", "IEI_zonal",
"DATA", "MEAN")
logger.info("the IEI raster values for each Wetland Unit summarized")

## Extract the IEI raster values for each Wetland Unit centroid
ExtractValuesToPoints("fcWUpoint", "IEI", "WUpoint_IEI")
logger.info("IEI raster values for each Wetland Unit centroid extracted")

## Delete the "Count" field from the IEI_zonal table since "Count" is a restricted word
## and may interfere with the join in the next step
arcpy.DeleteField_management ("IEI_zonal","Count")
logger.info("field Count deleted")

## Join Wetland Units to the IEI_zonal table
arcpy.AddJoin_management("fcWULandInteg0","WUKey","IEI_zonal","WUKey")
logger.info("Join Wetland Units to the IEI_zonal table completed")

## Export the joined data to a Feature Class
arcpy.FeatureClassToFeatureClass_conversion("fcWULandInteg0", arcpy.env.workspace,
"WU_IEI1")
logger.info("joined data exported as WU_IEI1")

## Remove Join from Wetland Units

```

```

arcpy.RemoveJoin_management("fcWULandInteg0")
logger.info("join removed from Wetland Units")

## Join WU_IEI1 to WUpoint_IEI
arcpy.MakeFeatureLayer_management("WU_IEI1", "fcWUIEI1")
arcpy.MakeFeatureLayer_management("WUpoint_IEI", "fcWUpoint_IEI")

arcpy.AddJoin_management("fcWUIEI1","WU_LandInteg0_WUKey","fcWUpoint_IEI","WU
Key")
logger.info("joined WU_IEI1 to WUpoint_IEI")

## Export joined data to feature class
arcpy.FeatureClassToFeatureClass_conversion("fcWUIEI1", arcpy.env.workspace,
"WU_IEI")
arcpy.MakeFeatureLayer_management("WU_IEI", "fcWUIEI")
logger.info("joined data exported as WU_IEI")

## Replace NULL values of MEAN with centroid values of IEI
strWHERE = """"WU_IEI1_IEI_zonal_MEAN" IS NULL""
arcpy.SelectLayerByAttribute_management("fcWUIEI", "NEW_SELECTION", strWHERE)

arcpy.CalculateField_management("fcWUIEI","WU_IEI1_IEI_zonal_MEAN","!WUpoint_IEI
_RASTERVALU!", "PYTHON", "#")
arcpy.SelectLayerByAttribute_management("fcWUIEI", "CLEAR_SELECTION")
logger.info("NULL values of MEAN with centroid values of IEI replaced")

## Add field IEI, set initial value to zero
actions.DeleteField("fcWUIEI","IEI")
arcpy.AddField_management("fcWUIEI", "IEI", "SHORT")
arcpy.CalculateField_management("fcWUIEI","IEI","0","PYTHON", "#")
logger.info("field IEI added and initial value set to zero")

```

```

## Assign points
strWHERE = """"WU_IEI1_IEI_zonal_MEAN" > 15""
arcpy.SelectLayerByAttribute_management("fcWUIEI", "NEW_SELECTION", strWHERE)
arcpy.CalculateField_management("fcWUIEI","IEI","1","PYTHON","#")

strWHERE = """"WU_IEI1_IEI_zonal_MEAN" > 45""
arcpy.SelectLayerByAttribute_management("fcWUIEI", "NEW_SELECTION", strWHERE)
arcpy.CalculateField_management("fcWUIEI","IEI","2","PYTHON","#")

strWHERE = """"WU_IEI1_IEI_zonal_MEAN" > 70""
arcpy.SelectLayerByAttribute_management("fcWUIEI", "NEW_SELECTION", strWHERE)
arcpy.CalculateField_management("fcWUIEI","IEI","3","PYTHON","#")
logger.info("points assigned in field IEI")
logger.info("Step 2 completed")
arcpy.SelectLayerByAttribute_management("fcWUIEI", "CLEAR_SELECTION")

## STEP 3
## Note that method in nearly identical to STEP 1 except for field names, MAJORITY, and
final points
## Calculate the intermediate metric LandResil
## Summarize the Resilient_and_Connected raster values for each Wetland Unit
arcpy.gp.ZonalStatisticsAsTable("fcWULandInteg0", "WUKey", "ResilConnected",
"LandResil_zonal", "DATA", "MAJORITY")
logger.info("the Resilient_and_Connected raster values for each Wetland Unit summarized")

## Extract the Resilient_and_Connected raster values for each Wetland Unit centroid
ExtractValuesToPoints("fcWUpoint", "ResilConnected", "WUpoint_LandResil")
logger.info("Resilient_and_Connected raster values for each Wetland Unit centroid
extracted")

```



```

## Delete the "Count" field from the LandResil_zonal table since "Count" is a restricted word
## and may interfere with the join in the next step
arcpy.DeleteField_management ("LandResil_zonal","Count")
logger.info("field Count deleted")

## Join Wetland Units to the LandResil_zonal table
arcpy.AddJoin_management("fcWULandInteg0","WUKey","LandResil_zonal","WUKey")
logger.info("Join Wetland Units to the LandResil_zonal table completed")

## Export the joined data to a Feature Class
arcpy.FeatureClassToFeatureClass_conversion("fcWULandInteg0", arcpy.env.workspace,
"WU_LandResil1")
logger.info("joined data exported as WU_LandResil1")

## Remove Join from Wetland Units
arcpy.RemoveJoin_management("fcWULandInteg0")
logger.info("join removed from Wetland Units")

## Join WU_LandResil1 to WUpoint_LandResil
arcpy.MakeFeatureLayer_management("WU_LandResil1", "fcWULandResil1")
arcpy.MakeFeatureLayer_management("WUpoint_LandResil", "fcWUpoint_LandResil")

arcpy.AddJoin_management("fcWULandResil1","WU_LandInteg0_WUKey","fcWUpoint_Lan
dResil","WUKey")

logger.info("joined WU_LandResil1 to WUpoint_LandResil")

## Export joined data to feature class
arcpy.FeatureClassToFeatureClass_conversion("fcWULandResil1", arcpy.env.workspace,
"WU_LandResil")

arcpy.MakeFeatureLayer_management("WU_LandResil", "fcWULandResil")

```

```

logger.info("joined data exported as WU_LandResil")

## Replace NULL values of MEAN with centroid values of Landscape Integrity
strWHERE = """"WU_LandResil1_LandResil_zonal_MAJORITY" IS NULL""""
arcpy.SelectLayerByAttribute_management("fcWULandResil", "NEW_SELECTION",
strWHERE)

arcpy.CalculateField_management("fcWULandResil","WU_LandResil1_LandResil_zonal_MA
JORITY","!WUpoint_LandResil_RASTERVALU!", "PYTHON", "#")

arcpy.SelectLayerByAttribute_management("fcWULandResil", "CLEAR_SELECTION")
logger.info("NULL values of MEAN with centroid values of Landscape Integrity replaced")

## Add field LandResil, set initial value to zero
actions.DeleteField("fcWULandResil","LandResil")
arcpy.AddField_management("fcWULandResil", "LandResil", "SHORT")
arcpy.CalculateField_management("fcWULandResil","LandResil","0","PYTHON","#")
logger.info("field LandResil added and initial value set to zero")

## Assign points
strWHERE = """"WU_LandResil1_LandResil_zonal_MAJORITY" IN
(2,3,4,11,12,13,14,33,112)""""
arcpy.SelectLayerByAttribute_management("fcWULandResil", "NEW_SELECTION",
strWHERE)

arcpy.CalculateField_management("fcWULandResil","LandResil","1","PYTHON","#")

strWHERE = """"WU_LandResil1_LandResil_zonal_MAJORITY" IN
(2,4,11,12,13,14,33,112)""""
arcpy.SelectLayerByAttribute_management("fcWULandResil", "NEW_SELECTION",
strWHERE)

arcpy.CalculateField_management("fcWULandResil","LandResil","2","PYTHON","#")

```

```

strWHERE = """"WU_LandResil1_LandResil_zonal_MAJORITY" IN (11,12,112)""""
arcpy.SelectLayerByAttribute_management("fcWULandResil", "NEW_SELECTION",
strWHERE)

arcpy.CalculateField_management("fcWULandResil","LandResil","3","PYTHON","#")
logger.info("points assigned in field LandResil")
logger.info("Step 2 completed")
arcpy.SelectLayerByAttribute_management("fcWULandResil", "CLEAR_SELECTION")

## STEP 4
## Calculate the intermediate metric ForestPatch

## Spatial Join Wetland Units and Forest Patches, selecting for the largest forest patch
## that is intersected by the Wetland Unit
fmSJFLIN = arcpy.FieldMappings()
fmSJFLIN.addTable('fcWULandResil')
fmSJFLIN.addTable('fcForestPatches')
keepers = []
keepers =
['WU_LandResil1_WU_LandInteg0_WUKey','Shape_Length','Shape_Area','LandResil','ACRE
AGE']
for field in fmSJFLIN.fields:
    if field.name not in keepers:
        fmSJFLIN.removeFieldMap(fmSJFLIN.findFieldMapIndex(field.name))

fldKeyIndex = fmSJFLIN.findFieldMapIndex("ACREAGE")
fieldmap = fmSJFLIN.getFieldMap(fldKeyIndex)
fieldmap.mergeRule = "Maximum"
fmSJFLIN.replaceFieldMap(fldKeyIndex, fieldmap)

arcpy.SpatialJoin_analysis('WU_LandResil', 'fcForestPatches', 'WU_ForestPatch',
'JOIN_ONE_TO_ONE', 'KEEP_ALL', fmSJFLIN, 'INTERSECT')

```

```

arcpy.MakeFeatureLayer_management('WU_ForestPatch', 'fcForestPatch')
logger.info("Spatial Join Wetland Units and Forest Patches completed")

## Add field ForestPatch, set initial value to zero
actions.DeleteField("fcForestPatch", "ForestPatch")
arcpy.AddField_management("fcForestPatch", "ForestPatch", "SHORT")
arcpy.CalculateField_management("fcForestPatch", "ForestPatch", "0", "PYTHON", "#")
logger.info("field ForestPatch added and initial value set to zero")

## Assign points
strWHERE = """"ACREAGE" >= 50""""
arcpy.SelectLayerByAttribute_management("fcForestPatch", "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management("fcForestPatch", "ForestPatch", "1", "PYTHON", "#")

strWHERE = """"ACREAGE" >= 247""""
arcpy.SelectLayerByAttribute_management("fcForestPatch", "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management("fcForestPatch", "ForestPatch", "2", "PYTHON", "#")

strWHERE = """"ACREAGE" >= 2470""""
arcpy.SelectLayerByAttribute_management("fcForestPatch", "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management("fcForestPatch", "ForestPatch", "3", "PYTHON", "#")
logger.info("points assigned in field ForestPatch")
arcpy.SelectLayerByAttribute_management("fcForestPatch", "CLEAR_SELECTION")

## Spatial Join LandIntegDNR metric to the other two metrics
fmSJFLIN = arcpy.FieldMappings()
fmSJFLIN.addTable('fcForestPatch')

```

```

fmSJFLIN.addTable('fcWULandIntegDNR')

keepers = []

keepers =
['WU_LandResil1_WU_LandInteg0_WUKey','Shape_Length','Shape_Area','LandResil','Forest
Patch','LandIntegDNR']

for field in fmSJFLIN.fields:
    if field.name not in keepers:
        fmSJFLIN.removeFieldMap(fmSJFLIN.findFieldMapIndex(field.name))

    arcpy.SpatialJoin_analysis('fcForestPatch', 'fcWULandIntegDNR', 'WU_LandInteg',
'JOIN_ONE_TO_ONE', 'KEEP_ALL', fmSJFLIN, 'CONTAINS')
    arcpy.MakeFeatureLayer_management('WU_LandInteg', 'fcLandInteg')
    logger.info("Spatial Join LandIntegDNR metric to the other two metrics completed")

## Add field LandInteg, set initial value to zero
actions.DeleteField("fcLandInteg","LandInteg")
arcpy.AddField_management("fcLandInteg", "LandInteg", "SHORT")
arcpy.CalculateField_management("fcLandInteg","LandInteg","0","PYTHON", "#")
logger.info("field LandInteg added and initial value set to zero")

## Assign points
strWHERE = """"(( "LandIntegDNR" * 2) + "LandResil" + "ForestPatch") / 4 >= 0.5""""
arcpy.SelectLayerByAttribute_management("fcLandInteg", "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management("fcLandInteg","LandInteg","1","PYTHON", "#")

strWHERE = """"(( "LandIntegDNR" * 2) + "LandResil" + "ForestPatch") / 4 >= 1.5""""
arcpy.SelectLayerByAttribute_management("fcLandInteg", "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management("fcLandInteg","LandInteg","2","PYTHON", "#")

```

```

strWHERE = """"(( "LandIntegDNR" * 2) + "LandResil" + "ForestPatch") / 4 >= 2.5""""
arcpy.SelectLayerByAttribute_management("fcLandInteg", "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management("fcLandInteg", "LandInteg", "3", "PYTHON", "#")
logger.info("points assigned in field LandInteg")
logger.info("Step 3 completed")
arcpy.SelectLayerByAttribute_management("fcLandInteg", "CLEAR_SELECTION")
arcpy.CheckInExtension("spatial")

# Clean up
if arcpy.Exists("LandInteg_zonal"):
    arcpy.Delete_management("LandInteg_zonal")
if arcpy.Exists("LandResil_zonal"):
    arcpy.Delete_management("LandResil_zonal")
if arcpy.Exists("WU_LandInteg0"):
    arcpy.Delete_management("WU_LandInteg0")
if arcpy.Exists("WU_LandInteg1"):
    arcpy.Delete_management("WU_LandInteg1")
if arcpy.Exists("WU_IEI1"):
    arcpy.Delete_management("WU_IEI1")
if arcpy.Exists("WU_IEI"):
    arcpy.Delete_management("WU_IEI")
if arcpy.Exists("WUpoint_IEI"):
    arcpy.Delete_management("WUpoint_IEI")
if arcpy.Exists("WU_LandResil1"):
    arcpy.Delete_management("WU_LandResil1")
if arcpy.Exists("WU_LandResil"):
    arcpy.Delete_management("WU_LandResil")
if arcpy.Exists("WU_LandIntegDNR"):
    arcpy.Delete_management("WU_LandIntegDNR")

```

```
if arcpy.Exists("WU_ForestPatch"):
    arcpy.Delete_management("WU_ForestPatch")
if arcpy.Exists("WUpoint_LandInteg"):
    arcpy.Delete_management("WUpoint_LandInteg")
if arcpy.Exists("WUpoint_LandResil"):
    arcpy.Delete_management("WUpoint_LandResil")
```

### 5.7.39 WetldBird: Habitat and Ecological Integrity Opportunity

```
#####  
#  
# File Name: WetldBird.py  
# Developer: Yibing Han  
# Date: 10/09/2017  
# Purpose:  
# Input to Habitat / Landscape Opportunity (LandEco: Landscape Ecological Connectivity)  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcWetldBird(WetlandPoly):  
    logger = logging.getLogger("WFA.HabEco.HOpportun.WetldBird")  
  
    # Setting python variables  
    arcpy.MakeFeatureLayer_management(globalvars.srcWetBird, "fcWetBird")  
  
    # Clean up if needed  
    if arcpy.Exists("WU_WetlandBird1"):  
        arcpy.Delete_management("WU_WetlandBird1")  
    if arcpy.Exists("WU_WetlandBird"):
```



```

    arcpy.Delete_management("WU_WetlandBird")
logger.info("feature layers ready")

## Create feature class to store results for WetldBird and set initial value to zero
arcpy.CopyFeatures_management(WetlandPoly,"WU_WetlandBird1","#","0","0","0")
arcpy.MakeFeatureLayer_management("WU_WetlandBird1", "fcWetlandBird1")
logger.info("feature class WU_WetlandBird1 created")

actions.DeleteField("fcWetlandBird1", "WetldBird")
arcpy.AddField_management("fcWetlandBird1", "WetldBird", "SHORT")
arcpy.CalculateField_management("fcWetlandBird1","WetldBird","0","VB","#")
logger.info("field WetldBird added and initial value set to 0")

## Select atlas blocks in the upper 75% of wetland bird occupancy values
strWHERE = """"WetBird" > 0.354""""
arcpy.SelectLayerByAttribute_management("fcWetBird", "NEW_SELECTION",
strWHERE)
logger.info("atlas blocks in the upper 75% of wetland bird occupancy values selected")

## Select Wetland Units that intersect the selected atlas blocks
arcpy.SelectLayerByLocation_management("fcWetlandBird1", "INTERSECT",
"fcWetBird")
logger.info("Wetland Units that intersect the selected atlas blocks selected")

## Assign 1 points
arcpy.CalculateField_management("fcWetlandBird1","WetldBird","1","VB","#")
logger.info("1 point assigned to qualifying wetland units")

## Select atlas blocks in the upper 50% of wetland bird occupancy values
strWHERE = """"WetBird" > 0.408""""

```

```

    arcpy.SelectLayerByAttribute_management("fcWetBird", "NEW_SELECTION",
strWHERE)

    logger.info("atlas blocks in the upper 50% of wetland bird occupancy values selected")

    ## Select Wetland Units that intersect the selected atlas blocks
    arcpy.SelectLayerByLocation_management("fcWetlandBird1", "INTERSECT",
"fcWetBird")
    logger.info("Wetland Units that intersect the selected atlas blocks selected")

    ## Assign 2 points
    arcpy.CalculateField_management("fcWetlandBird1", "WetldBird", "2", "VB", "#")
    logger.info("2 points assigned to qualifying wetland units")

    ## Select atlas blocks in the upper 10% of wetland bird occupancy values
    strWHERE = """"WetBird" > 0.493""""
    arcpy.SelectLayerByAttribute_management("fcWetBird", "NEW_SELECTION",
strWHERE)
    logger.info("atlas blocks in the upper 10% of wetland bird occupancy values selected")

    ## Select Wetland Units that intersect the selected atlas blocks
    arcpy.SelectLayerByLocation_management("fcWetlandBird1", "INTERSECT",
"fcWetBird")
    logger.info("Wetland Units that intersect the selected atlas blocks selected")

    ## Assign 3 points and clear selections
    arcpy.CalculateField_management("fcWetlandBird1", "WetldBird", "3", "VB", "#")
    logger.info("3 points assigned to qualifying wetland units")

    arcpy.SelectLayerByAttribute_management("fcWetBird", "CLEAR_SELECTION")
    arcpy.SelectLayerByAttribute_management("fcWetlandBird1", "CLEAR_SELECTION")

```

```

## Select wetlands that fall outside the atlas block coverage
arcpy.SelectLayerByLocation_management("fcWetlandBird1", "INTERSECT",
"fcWetBird")
arcpy.SelectLayerByAttribute_management("fcWetlandBird1", "SWITCH_SELECTION")
logger.info("wetlands that fall outside the atlas block coverage selected")

## Set temporary value of WetldBird for wetlands outside the atlas block coverage
arcpy.CalculateField_management("fcWetlandBird1", "WetldBird", "99", "VB", "#")
logger.info("temporary value of WetldBird for wetlands outside the atlas block coverage set")
arcpy.SelectLayerByAttribute_management("fcWetlandBird1", "CLEAR_SELECTION")

## Spatial Join to find the closest atlas block to each wetland
fmSJ = arcpy.FieldMappings()
fmSJ.addTable("fcWetlandBird1")
fmSJ.addTable("fcWetBird")
keepers = []
keepers = ['WUKey', 'Shape_Length', 'Shape_Area', 'WetldBird', 'WetBird']
for field in fmSJ.fields:
    if field.name not in keepers:
        fmSJ.removeFieldMap(fmSJ.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis("fcWetlandBird1", "fcWetBird", 'WU_WetlandBird',
'JOIN_ONE_TO_ONE', 'KEEP_ALL', fmSJ, 'CLOSEST')
fcWetlandBird = arcpy.mapping.Layer(r"WU_WetlandBird")
logger.info("Spatial Join to find the closest atlas block to each wetland completed")

## Assign points based on WetBird value to wetlands outside the atlas blocks
strWHERE = """"WetldBird" = 99 AND "WetBird" <= 0.354""""
arcpy.SelectLayerByAttribute_management(fcWetlandBird, "NEW_SELECTION",
strWHERE)

```

```

arcpy.CalculateField_management(fcWetlandBird,"WetldBird","0","VB","#")

strWHERE = """"WetldBird" = 99 AND "WetBird" > 0.354 AND "WetBird" <= 0.408""""
arcpy.SelectLayerByAttribute_management(fcWetlandBird, "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management(fcWetlandBird,"WetldBird","1","VB","#")

strWHERE = """"WetldBird" = 99 AND "WetBird" > 0.408 AND "WetBird" <= 0.493""""
arcpy.SelectLayerByAttribute_management(fcWetlandBird, "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management(fcWetlandBird,"WetldBird","2","VB","#")

strWHERE = """"WetldBird" = 99 AND "WetBird" > 0.493""""
arcpy.SelectLayerByAttribute_management(fcWetlandBird, "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management(fcWetlandBird,"WetldBird","3","VB","#")
logger.info("Points assigned to WetldBird")
arcpy.SelectLayerByAttribute_management(fcWetlandBird, "CLEAR_SELECTION")

# Clean up
if arcpy.Exists("WU_WetlandBird1"):
    arcpy.Delete_management("WU_WetlandBird1")

```

### 5.7.40 WshdPos: Habitat and Ecological Integrity Opportunity

```
#####  
#  
# File Name: WshdPos.py  
# Developer: Yibing Han  
# Date: 10/03/2017  
# Purpose:  
#   Input to Habitat / Landscape Opportunity (LandHydro: Landscape Hydrologic Connectivity)  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcWshdPos():  
    logger = logging.getLogger("WFA.HabEco.HOpportun.WshdPos")  
  
    # Setting python variables  
    arcpy.MakeFeatureLayer_management(r"WU_FloodArea", 'fcFloodArea')  
    arcpy.MakeFeatureLayer_management(r"WU_Headwater", 'fcHeadwater')  
    arcpy.MakeFeatureLayer_management(r"WU_Karst", 'fcKarst')  
    arcpy.MakeFeatureLayer_management(globalvars.srcDrainage, 'fcDrainage')  
    logger.info("feature layers ready")
```

```

# Clean up if needed
if arcpy.Exists('WU_WshdPos1'):
    arcpy.Delete_management('WU_WshdPos1')
if arcpy.Exists('WU_WshdPos2'):
    arcpy.Delete_management('WU_WshdPos2')
if arcpy.Exists('WU_WshdPos'):
    arcpy.Delete_management('WU_WshdPos')

## STEP 1: Wetland Units in the Floodplain of a Major River
## Create feature class to store WshdPos
arcpy.CopyFeatures_management('fcFloodArea','WU_WshdPos1',"#", "0", "0", "0")
arcpy.MakeFeatureLayer_management(r"WU_WshdPos1", 'fcWshdPos1')
logger.info("feature class WU_WshdPos1 created")

## Add field to store major river floodplain (MajorRiverFP) and set initial value to zero
actions.DeleteField('fcWshdPos1', 'MajorRiverFP')
arcpy.AddField_management('fcWshdPos1', 'MajorRiverFP', 'SHORT')
arcpy.CalculateField_management('fcWshdPos1', 'MajorRiverFP', '0', 'VB', '#')
logger.info("field MajorRiverFP added and set to 0")

## Select major rivers with floodplains
strWHERE = """"DA_sq_mi" > 1000 OR "GNIS_Name" IN ('Meadow River', 'Cacapon
River', 'Tygart Valley River') OR ("GNIS_Name" IN ('South Branch Potomac River', 'North
Branch Potomac River') AND "DA_sq_mi" > 1000)""""
arcpy.SelectLayerByAttribute_management('fcDrainage', "NEW_SELECTION",
strWHERE)
logger.info("Major rivers with floodplains selected")

## Select wetlands that are within 500 meters of selected rivers
arcpy.SelectLayerByLocation_management('fcWshdPos1', "WITHIN_A_DISTANCE",
'fcDrainage', "500 Meters")

```

```

logger.info("wetlands that are within 500 meters of selected rivers selected")

## Remove from selection any wetlands not in the floodplain
strWHERE = """"Floodplain" = 'N'""
arcpy.SelectLayerByAttribute_management('fcWshdPos1',
"REMOVE_FROM_SELECTION", strWHERE)
logger.info("wetlands not in the floodplain removed from selection")

## Assign values to MajorRiverFP
arcpy.CalculateField_management('fcWshdPos1', 'MajorRiverFP', '1', 'VB', '#')
arcpy.SelectLayerByAttribute_management('fcWshdPos1', "CLEAR_SELECTION")
arcpy.SelectLayerByAttribute_management('fcDrainage', "CLEAR_SELECTION")
logger.info("values Assigned for MajorRiverFP")

## STEP 2: Join metrics and assign points
## Spatial Join MajorRiversFP to Headwater and Karst

## Spatial join to merge BufferPerim and BufferContig into one attribute table
fmSJ = arcpy.FieldMappings()
fmSJ.addTable('fcWshdPos1')
fmSJ.addTable('fcHeadwater')
keepers = []
keepers = ['WUKey', 'Shape_Length', 'Shape_Area', 'MajorRiverFP', 'Headwater']
for field in fmSJ.fields:
    if field.name not in keepers:
        fmSJ.removeFieldMap(fmSJ.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis('fcWshdPos1', 'fcHeadwater', 'WU_WshdPos2',
'JOIN_ONE_TO_ONE', 'KEEP_ALL', fmSJ, 'CONTAINS')
arcpy.MakeFeatureLayer_management(r"WU_WshdPos2", 'fcWshdPos2')

```

```

logger.info("spatial join WshdPos1 and Headwater completed")

## Spatial join to merge LandInteg
fmSJ = arcpy.FieldMappings()
fmSJ.addTable('fcWshdPos2')
fmSJ.addTable('fcKarst')
keepers = []
keepers = ['WUKey','Shape_Length','Shape_Area','MajorRiverFP','Headwater','Karst']
for field in fmSJ.fields:
    if field.name not in keepers:
        fmSJ.removeFieldMap(fmSJ.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis('fcWshdPos2', 'fcKarst', 'WU_WshdPos', 'JOIN_ONE_TO_ONE',
'KEEP_ALL', fmSJ, 'CONTAINS')
fcWshdPos = arcpy.mapping.Layer(r"WU_WshdPos")
logger.info("spatial join WshdPos2 and Karst completed")

## Add WshdPos field to Wetland Units and set initial point value to zero.
actions.DeleteField(fcWshdPos, 'WshdPos')
arcpy.AddField_management(fcWshdPos, 'WshdPos', 'SHORT')
arcpy.CalculateField_management(fcWshdPos, 'WshdPos', '0', 'VB', '#')
logger.info("field WshdPos added and value set to 0")

## Assign points
strWHERE = """"MajorRiverFP" > 0 OR "Headwater" > 0 OR "Karst" > 0""
arcpy.SelectLayerByAttribute_management(fcWshdPos, "NEW_SELECTION", strWHERE)
arcpy.CalculateField_management(fcWshdPos, 'WshdPos', '1', 'VB', '#')
logger.info("field WshdPos calculated")
arcpy.SelectLayerByAttribute_management(fcWshdPos, "CLEAR_SELECTION")

```



```
# Clean up
if arcpy.Exists('WU_WshdPos1'):
    arcpy.Delete_management('WU_WshdPos1')
if arcpy.Exists('WU_WshdPos2'):
    arcpy.Delete_management('WU_WshdPos2')
```

### 5.7.41 WshdUniq: Habitat and Ecological Integrity Opportunity

```
#####  
#  
# File Name: ConsFocus.py  
# Developer: Yibing Han  
# Date: 10/10/2017  
# Purpose:  
# Input to Habitat / Landscape Opportunity (LandEco: Landscape Ecological Connectivity)  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcWshdUniq():  
    logger = logging.getLogger("WFA.HabEco.HOpportun.WshdUniq")  
  
    # Setting python variables  
  
    arcpy.MakeFeatureLayer_management(globalvars.srcHUCWetSizeUniq,"fcHUCWetSizeUniq"  
    )  
    arcpy.MakeFeatureLayer_management(r"WU_VegAll","fcVegAll")  
  
    # Clean up if needed  
    if arcpy.Exists("WU_WshdUniq"):
```

```

arcpy.Delete_management("WU_WshdUniq")

## Spatial Join of Wetland Units (including VegArea) and HUC characteristics
fmSJFLIN = arcpy.FieldMappings()
fmSJFLIN.addTable("fcVegAll")
fmSJFLIN.addTable("fcHUCWetSizeUniq")
keepers = []
keepers =
['WUKey','VegArea','Shape_Length','Shape_Area','HUC_12','HU_12_NAME','MaxVegArea','D
iverseNWI','DensVegNWI','RatioVeg']

for field in fmSJFLIN.fields:
    if field.name not in keepers:
        fmSJFLIN.removeFieldMap(fmSJFLIN.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis('fcVegAll', 'fcHUCWetSizeUniq', 'WU_WshdUniq',
'JOIN_ONE_TO_ONE', 'KEEP_ALL', fmSJFLIN, 'HAVE_THEIR_CENTER_IN')
fcWshdUniq = arcpy.mapping.Layer(r"WU_WshdUniq")

logger.info("Spatial Join of Wetland Units (including VegArea) and HUC characteristics
completed")

## Create feature class to store results for WshdUniq and set initial value to zero
actions.DeleteField(fcWshdUniq, "WshdUniq")
arcpy.AddField_management(fcWshdUniq, "WshdUniq", "SHORT")
arcpy.CalculateField_management(fcWshdUniq,"WshdUniq","0","VB","#")
logger.info("field WshdUniq added and initial value set to 0")

## Select wetlands in top 10% of HUC watersheds based on
## the number of unique NWI codes, the number of vegetated NWI polygons, or the
proportional area of vegetated wetlands
strWHERE = """"DiverseNWI" > 22 OR "DensVegNWI" > 45 OR "RatioVeg" > 0.005""""

```

```

    arcpy.SelectLayerByAttribute_management(fcWshdUniq, "NEW_SELECTION",
strWHERE)

    logger.info("all CFAs except the general CFA selected")

## Assign 1 point
arcpy.CalculateField_management(fcWshdUniq,"WshdUniq","1","VB","#")
logger.info("1 point assigned to qualifying wetland units")

## Select largest vegetated wetland in each HUC AND wetlands in top 5% of HUC
watersheds based on
## type diversity, density, or proportional area of vegetated wetlands
strWHERE = """"VegArea" >= "MaxVegArea" OR "DiverseNWI" > 28 OR "DensVegNWI"
> 70 OR "RatioVeg" > 0.009""""
arcpy.SelectLayerByAttribute_management(fcWshdUniq, "NEW_SELECTION",
strWHERE)
logger.info("CFAs with wetland focus selected")

## Assign 2 points
arcpy.CalculateField_management(fcWshdUniq,"WshdUniq","2","VB","#")
logger.info("2 points assigned to qualifying wetland units")

arcpy.SelectLayerByAttribute_management(fcWshdUniq, "CLEAR_SELECTION")

# Clean up

```

### 5.7.42 Habitat and Ecological Integrity Potential

```
#####  
#  
# File Name: HPotential.py  
# Developer: Yibing Han  
# Date: 12/12/2017  
# Purpose:  
# This script handles the execution of all the Habitat and Ecological Integrity Potential  
metrics.  
#  
#####  
import datetime  
import logging  
import traceback  
import arcpy  
  
from Variables import Histosol, HydIntact, HydSW, Karst, MarlPEM, SoilIntact, SoilOrgCalc,  
StrucPatch, VegFQ, VegHorInt, VegVerStr  
from Factors import VegH, HydroH, SoilH  
from Aspects import HPotential  
  
def procHPotential(WetlandPoly):  
    logger = logging.getLogger("WFA.HabEco.HPotential")  
  
    #####  
    ## 1. Run Variables  
    #####  
  
    Histosol.CalcHistosol(WetlandPoly)  
    #Karst.CalcKarst(WetlandPoly)  
    MarlPEM.CalcMarlPEM(WetlandPoly)  
    HydIntact.CalcHydIntact()  
    HydSW.CalcHydSW()  
    SoilIntact.CalcSoilIntact()  
    SoilOrgCalc.CalcSoilOrgCalc()  
    VegFQ.CalcVegFQ()  
    VegHorInt.CalcVegHorInt()  
    VegVerStr.CalcVegVerStr()  
    StrucPatch.CalcStrucPatch()  
  
    ## Executed with FloodAttenuation:  
    # ConnectFL  
    # Runoff50m  
    # RunoffWshd  
    # StreamEdge
```

```
## Executed with WaterQuality:  
# Disturb50m  
# VegPerUng1  
# VegWoody2  
# VegWoodyFor  
# WQOpportun
```

```
#####
```

```
## 2. Run Factors
```

```
#####
```

```
VegH.CalcVegH()  
HydroH.CalcHydroH()  
SoilH.CalcSoilH()
```

```
#####
```

```
## 3. Run Aspect
```

```
#####
```

```
HPotential.CalcHPotential()
```

### 5.7.43 HPotential: Habitat and Ecological Integrity Potential Aspects

```
#####  
#  
# File Name: HPotential.py  
# Developer: Yibing Han  
# Date 9/28/2017  
# Purpose:  
#   Habitat Function  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import arcpy  
from utilities import actions  
import logging  
  
def CalcHPotential():  
    logger = logging.getLogger("WFA.HabEco.HPotential.HPotential")  
  
    # Setting python variables  
    arcpy.MakeFeatureLayer_management(r"WU_VegH", 'fcVegH')  
    arcpy.MakeFeatureLayer_management(r"WU_HydroH", 'fcHydroH')  
    arcpy.MakeFeatureLayer_management(r"WU_SoilH", 'fcSoilH')  
  
    # Clean up if needed  
    if arcpy.Exists('WU_HPotential1'):  
        arcpy.Delete_management('WU_HPotential1')
```

```

if arcpy.Exists('WU_HPpotential'):
    arcpy.Delete_management('WU_HPpotential')
logger.info("feature layers ready")

## Spatial joins to bring together factor values
fmSJFLIN = arcpy.FieldMappings()
fmSJFLIN.addTable('fcVegH')
fmSJFLIN.addTable('fcHydroH')
keepers = []
keepers = ['WUKey','Shape_Length','Shape_Area','VegH','HydroH']
for field in fmSJFLIN.fields:
    if field.name not in keepers:
        fmSJFLIN.removeFieldMap(fmSJFLIN.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis('fcVegH', 'fcHydroH', 'WU_HPpotential1', 'JOIN_ONE_TO_ONE',
'KEEP_ALL', fmSJFLIN, 'CONTAINS')
arcpy.MakeFeatureLayer_management('WU_HPpotential1', 'fcHPpotential1')
logger.info("spatial join of VegH and HydroH completed")

fmSJFLIN = arcpy.FieldMappings()
fmSJFLIN.addTable('fcHPpotential1')
fmSJFLIN.addTable('fcSoilH')
keepers = []
keepers = ['WUKey','Shape_Length','Shape_Area','VegH','HydroH','SoilH']
for field in fmSJFLIN.fields:
    if field.name not in keepers:
        fmSJFLIN.removeFieldMap(fmSJFLIN.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis('fcHPpotential1', 'fcSoilH', 'WU_HPpotential',
'JOIN_ONE_TO_ONE', 'KEEP_ALL', fmSJFLIN, 'CONTAINS')

```



```
arcpy.MakeFeatureLayer_management('WU_HPotential', 'fcHPotential')
logger.info("spatial join of HPotential1 and SoilH completed")
```

```
## Add HPotential field and set initial point value to zero.
```

```
actions.DeleteField('fcHPotential', 'HPotential')
arcpy.AddField_management('fcHPotential', 'HPotential', 'SHORT')
arcpy.CalculateField_management('fcHPotential', 'HPotential', '0', 'VB', '#')
logger.info("HPotential field added and initial point value set to zero")
```

```
## Sum the factor points
```

```
arcpy.CalculateField_management("fcHPotential", "HPotential", "[VegH]+ [HydroH]+
[SoilH]", "VB", "#")
logger.info("HPotential field caculated")
```

```
# Clean up
```

```
if arcpy.Exists('WU_HPotential1'):
    arcpy.Delete_management('WU_HPotential1')
```

#### 5.7.44 HydroH: Habitat and Ecological Integrity Potential

```
#####  
#  
# File Name: HydroH.py  
# Developer: Yibing Han  
# Date 9/27/2017  
# Purpose:  
#   Input to Habitat & Ecological Integrity / Potential  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcHydroH():  
    logger = logging.getLogger("WFA.HabEco.HPotential.HydroH")  
  
    # Setting python variables  
    arcpy.MakeFeatureLayer_management(r"WU_Connect", 'fcConnectFL')  
    arcpy.MakeFeatureLayer_management(r"WU_HydroH", 'fcHydroH')  
  
    # Clean up if needed  
    logger.info("feature layers ready")
```

```

## Add field to store ConnectFL
actions.DeleteField('fcHydroH', 'ConnectFL1')
arcpy.AddField_management('fcHydroH', 'ConnectFL1', 'SHORT')
logger.info("field ConnectFL1 added to store ConnectFL")

## Add Join to merge fields into one attribute table
arcpy.AddJoin_management("fcHydroH","WUKey","fcConnectFL","WUKey")
logger.info("Add Join to merge fields into one attribute table completed")

## Calculate field ConnectFL1
arcpy.CalculateField_management('fcHydroH', 'WU_HydroH.ConnectFL1',
'[WU_Connect.ConnectFL]', 'VB', '#')
logger.info("field ConnectFL1 calculated")

## Remove Join
arcpy.RemoveJoin_management("fcHydroH")
logger.info("join removed")

## Add field to store HydroH and set initial value to zero
actions.DeleteField('fcHydroH', 'HydroH')
arcpy.AddField_management('fcHydroH', 'HydroH', 'SHORT')
arcpy.CalculateField_management('fcHydroH', 'HydroH', '0', 'VB', '#')
logger.info("field added to store HydroH and initial value set to zero")

## Assign points to HydroH
arcpy.CalculateField_management('fcHydroH', 'HydroH', '[HydIntact] + [HydSW] +
[ConnectFL1]', 'VB', '#')
logger.info("points assigned to HydroH")

# Clean up if needed

```

### 5.7.45 SoilH: Habitat and Ecological Integrity Potential

```
#####  
#  
# File Name: SoilH.py  
# Developer: Yibing Han  
# Date 9/28/2017  
# Purpose:  
#   Input to Habitat & Ecological Integrity / Potential  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcSoilH():  
    logger = logging.getLogger("WFA.HabEco.HPotential.SoilH")  
  
    # Setting python variables  
    arcpy.MakeFeatureLayer_management(r"WU_Disturb50m", 'fcDisturb50m')  
    arcpy.MakeFeatureLayer_management(r"WU_SoilOrgCalc", 'fcSoilOrgCalc')  
    arcpy.MakeFeatureLayer_management(r"WU_StrucPatch", 'fcStrucPatch')  
  
    # Clean up if needed  
    if arcpy.Exists('WU_SoilH1'):
```

```

    arcpy.Delete_management('WU_SoilH1')
if arcpy.Exists('WU_SoilH'):
    arcpy.Delete_management('WU_SoilH')
logger.info("feature layers ready")

## Spatial Joins to merge fields into one attribute table
fmSJFLIN = arcpy.FieldMappings()
fmSJFLIN.addTable('fcDisturb50m')
fmSJFLIN.addTable('fcSoilOrgCalc')
keepers = []
keepers = ['WUKey','Shape_Length','Shape_Area','SoilIntact','SoilOrgCalc']
for field in fmSJFLIN.fields:
    if field.name not in keepers:
        fmSJFLIN.removeFieldMap(fmSJFLIN.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis('fcDisturb50m', 'fcSoilOrgCalc', 'WU_SoilH1',
'JOIN_ONE_TO_ONE', 'KEEP_ALL', fmSJFLIN, 'CONTAINS')
arcpy.MakeFeatureLayer_management('WU_SoilH1', 'fcSoilH1')

fmSJFLIN = arcpy.FieldMappings()
fmSJFLIN.addTable('fcSoilH1')
fmSJFLIN.addTable('fcStrucPatch')
keepers = []
keepers = ['WUKey','Shape_Length','Shape_Area','SoilIntact','SoilOrgCalc','StrucPatch']
for field in fmSJFLIN.fields:
    if field.name not in keepers:
        fmSJFLIN.removeFieldMap(fmSJFLIN.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis('fcSoilH1', 'fcStrucPatch', 'WU_SoilH', 'JOIN_ONE_TO_ONE',
'KEEP_ALL', fmSJFLIN, 'CONTAINS')

```

```

arcpy.MakeFeatureLayer_management('WU_SoilH', 'fcSoilH')
logger.info("Spatial Joins to merge fields into one attribute table completed")

## Add SoilH field and set initial point value to zero.
actions.DeleteField('fcSoilH', 'SoilH')
arcpy.AddField_management('fcSoilH', 'SoilH', 'SHORT')
arcpy.CalculateField_management('fcSoilH', 'SoilH', '0', 'VB', '#')
logger.info("field SoilH added and initial value set to zero")

## Assign points to fcSoilH
arcpy.CalculateField_management("fcSoilH","SoilH","[SoilIntact] + [SoilOrgCalc] +
[StrucPatch]", "VB", "#")
logger.info("points assigned to SoilH")

# Clean up
if arcpy.Exists('WU_SoilH1'):
    arcpy.Delete_management('WU_SoilH1')

```

### 5.7.46 VegH: Habitat and Ecological Integrity Potential

```
#####  
#  
# File Name: VegH.py  
# Developer: Yibing Han  
# Date 9/25/2017  
# Purpose:  
#   Input to Habitat & Ecological Integrity / Potential  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcVegH():  
    logger = logging.getLogger("WFA.HabEco.HPotential.VegH")  
  
    # Setting python variables  
    arcpy.MakeFeatureLayer_management(r"WU_VegVerStr", 'fcVegVerStr')  
    arcpy.MakeFeatureLayer_management(r"WU_Microtopo", 'fcMicrotopo')  
    arcpy.MakeFeatureLayer_management(r"WU_VegFQ", 'fcVegFQ')  
  
    # Clean up if needed  
    if arcpy.Exists('WU_VegH'):
```

```

    arcpy.Delete_management('WU_VegH')
if arcpy.Exists('WU_VegH1'):
    arcpy.Delete_management('WU_VegH1')
logger.info("feature layers ready")

## Spatial join to merge VegVerStr and VegHorInt into one attribute table
fmSJFLIN = arcpy.FieldMappings()
fmSJFLIN.addTable('fcVegVerStr')
fmSJFLIN.addTable('fcMicrotopo')
keepers = []
keepers = ['WUKey','Shape_Length','Shape_Area','VegVerStr','VegHorInt']
for field in fmSJFLIN.fields:
    if field.name not in keepers:
        fmSJFLIN.removeFieldMap(fmSJFLIN.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis('fcVegVerStr', 'fcMicrotopo', 'WU_VegH1',
'JOIN_ONE_TO_ONE', 'KEEP_ALL', fmSJFLIN, 'CONTAINS')
arcpy.MakeFeatureLayer_management('WU_VegH1', 'fcVegH1')
logger.info("Spatial join to merge VegVerStr and VegHorInt completed")

## Spatial join to merge VegFQ
fmSJFLIN = arcpy.FieldMappings()
fmSJFLIN.addTable('fcVegH1')
fmSJFLIN.addTable('fcVegFQ')
keepers = []
keepers = ['WUKey','Shape_Length','Shape_Area','VegVerStr','VegHorInt','VegFQ']
for field in fmSJFLIN.fields:
    if field.name not in keepers:
        fmSJFLIN.removeFieldMap(fmSJFLIN.findFieldMapIndex(field.name))

```



```

arcpy.SpatialJoin_analysis('fcVegH1', 'fcVegFQ', 'WU_VegH', 'JOIN_ONE_TO_ONE',
'KEEP_ALL', fmSJFLIN, 'CONTAINS')
arcpy.MakeFeatureLayer_management('WU_VegH', 'fcVegH')
logger.info("Spatial join to merge VegFQ completed")

## Add VegH field to Wetland Units and set initial point value to zero.
actions.DeleteField('fcVegH', 'VegH')
arcpy.AddField_management('fcVegH', 'VegH', 'SHORT')
arcpy.CalculateField_management('fcVegH', 'VegH', '0', 'VB', '#')
logger.info("field VegH added and initial value set to 0")

## Sum the points for VegVerStr, VegHorInt, VegFQ
arcpy.CalculateField_management('fcVegH', 'VegH', '[VegVerStr] + [VegHorInt] +
[VegFQ]', 'VB', '#')
logger.info("Points calculated for field VegH")

# Clean up
if arcpy.Exists('WU_VegH1'):
    arcpy.Delete_management('WU_VegH1')

```

### 5.7.47 Histosol: Habitat and Ecological Integrity Potential

```
#####  
#  
# File Name: Histosol.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 2/7/2017 (modified 11/10/2017)  
# Purpose:  
#   Input to Habitat and Ecological Integrity / Intrinsic Potential  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcHistosol(WetlandPoly):  
    logger = logging.getLogger("WFA.HabEco.HPotential.Histosol")  
  
    # Clean up if needed  
    if arcpy.Exists("WU_Histosol"):  
        arcpy.Delete_management("WU_Histosol")  
  
    # Setting python variables  
    arcpy.CopyFeatures_management(WetlandPoly, "WU_Histosol")  
    fcWUHistosol = arcpy.mapping.Layer(r"WU_Histosol")
```

```

fcPeatlands = arcpy.mapping.Layer(globalvars.srcPeatlands)
fcPalustrineplots = arcpy.mapping.Layer(globalvars.srcPalustrineplots)
fcHisticEpipedon = arcpy.mapping.Layer(globalvars.srcHisticEpipedon)
fcHistosol = arcpy.mapping.Layer(globalvars.srcHistosol)
# fcSSURGOWV = arcpy.mapping.Layer(globalvars.srcSSURGOWV)
fcNWI = arcpy.mapping.Layer(globalvars.srcInput)
logger.info("feature layers ready")

```

```

# Add Histosol field to Wetland Units and set initial point value to zero
actions.DeleteField(fcWUHistosol,"Histosol")
arcpy.AddField_management(fcWUHistosol, "Histosol", "SHORT")
arcpy.CalculateField_management(fcWUHistosol,"Histosol","0","VB","#")
logger.info("field Histosol added and initial point value set to 0")

```

```

#####
#####

```

```

## Part 1: Histic Epipedon

```

```

#####
#####

```

```

## Select Palustrine plots that have peat or muck soils (conservative assumption that these are
histic epipedons) or organic oils 20-39 cm thick

```

```

strSelectAttr = """"Soil_Textu" LIKE '%peat%' OR "Soil_Textu" LIKE '%muck%' OR
"Profile__1" LIKE '%peat%' OR "Profile__1" LIKE '%muck%' or( "Depth_of_o" > 19 AND
"Depth_of_o" < 40)""""

```

```

arcpy.SelectLayerByAttribute_management(fcPalustrineplots,"NEW_SELECTION",strSelectA
tr)

```

```

## Select Wetland Units that intersect palustrine plots with histic epipedons.

```

```
arcpy.SelectLayerByLocation_management(fcWUHistosol,"INTERSECT",fcPalustrineplots,"#  
","NEW_SELECTION")
```

```
## Update value for "Histosol" based on palustrine plots.
```

```
arcpy.CalculateField_management(fcWUHistosol,"Histosol","2","VB","#")
```

```
arcpy.SelectLayerByAttribute_management(fcWUHistosol, "CLEAR_SELECTION")
```

```
arcpy.SelectLayerByAttribute_management(fcPalustrineplots, "CLEAR_SELECTION")
```

```
## Select Wetland Units that intersect with the SSURGO histic epipedon selection.
```

```
arcpy.SelectLayerByLocation_management(fcWUHistosol,"INTERSECT",fcHisticEpipedon,"#  
","NEW_SELECTION")
```

```
## Update value for "Histosol" based on ssurgo data
```

```
arcpy.CalculateField_management(fcWUHistosol,"Histosol","2","VB","#")
```

```
arcpy.SelectLayerByAttribute_management(fcWUHistosol, "CLEAR_SELECTION")
```

```
arcpy.SelectLayerByAttribute_management(fcHisticEpipedon, "CLEAR_SELECTION")
```

```
#####  
#####
```

```
## Part 2: Histosol
```

```
#####  
#####
```

```
## Select Palustrine plots that have organic soils at least 40cm thick
```

```
strSelectAttr = """"DepOrgSoil" > 39"""
```

```
arcpy.SelectLayerByAttribute_management(fcPalustrineplots,"NEW_SELECTION",strSelectA  
ttr)
```

## Select Wetland Units that intersect palustrine plots with histic histosols.

```
arcpy.SelectLayerByLocation_management(fcWUHistosol,"INTERSECT",fcPalustrineplots,"#
","NEW_SELECTION")
```

## Update value for "Histosol" based on palustrine plots.

```
arcpy.CalculateField_management(fcWUHistosol,"Histosol","3","VB","#")
arcpy.SelectLayerByAttribute_management(fcWUHistosol,"CLEAR_SELECTION")
arcpy.SelectLayerByAttribute_management(fcPalustrineplots,"CLEAR_SELECTION")
```

## Select Wetland Units that intersect with the SSURGO histosol selection.

```
arcpy.SelectLayerByLocation_management(fcWUHistosol,"INTERSECT",fcHistosol,"#","NE
W_SELECTION")
```

## Update value for "Histosol" based on ssurgo data

```
arcpy.CalculateField_management(fcWUHistosol,"Histosol","3","VB","#")
arcpy.SelectLayerByAttribute_management(fcWUHistosol,"CLEAR_SELECTION")
arcpy.SelectLayerByAttribute_management(fcHistosol,"CLEAR_SELECTION")
```

```
#####
#####
```

## Part 3: Peatlands

```
#####
#####
```

## Select Wetland Units that are peatlands.

```
arcpy.SelectLayerByLocation_management(fcWUHistosol,"INTERSECT",fcPeatlands,"#","NE
W_SELECTION")
```

```
## Update value for "Histosol" based on peatlands
arcpy.CalculateField_management(fcWUHistosol,"Histosol","3","VB","#")
arcpy.SelectLayerByAttribute_management(fcWUHistosol, "CLEAR_SELECTION")
arcpy.SelectLayerByAttribute_management(fcPeatlands, "CLEAR_SELECTION")
```

```
#####
#####
```

```
## Part 4: NWI Organic Modifier
```

```
#####
#####
```

```
## Select polygons that have an organic modifier in the Nation Wetland Inventory
```

```
arcpy.SelectLayerByAttribute_management(fcNWI,"NEW_SELECTION","""ATTRIBUTE"
LIKE '%g'""")
```

```
## Select Wetland Unit that intersect organic NWI polygons.
```

```
arcpy.SelectLayerByLocation_management(fcWUHistosol,"INTERSECT",fcNWI,"#", "NEW_
SELECTION")
```

```
## Update value for "Histosol" based on NWI
arcpy.CalculateField_management(fcWUHistosol,"Histosol","3","VB","#")
arcpy.SelectLayerByAttribute_management(fcWUHistosol, "CLEAR_SELECTION")
arcpy.SelectLayerByAttribute_management(fcNWI, "CLEAR_SELECTION")
```

```
# Clean up
```

### 5.7.48 HydIntact: Habitat and Ecological Integrity Potential

```
#####  
#  
# File Name: HydIntact.py  
# Developer: Yibing Han  
# Date 9/25/2017  
# Purpose:  
#   Input to Habitat & Ecological Integrity / Potential  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcHydIntact():  
    logger = logging.getLogger("WFA.HabEco.HPotential.HydIntact")  
  
    # Setting python variables  
    arcpy.MakeFeatureLayer_management(r"WU_WQOpportun", 'fcWQOpportun')  
    arcpy.MakeFeatureLayer_management(r"WU_LandInteg", 'fcLandInteg')  
  
    # Clean up if needed  
    if arcpy.Exists('WU_HydroH'):  
        arcpy.Delete_management('WU_HydroH')
```

```

logger.info("feature layers ready")

## Spatial join to merge WQOpportun and LandInteg into one attribute table
fmSJFLIN = arcpy.FieldMappings()
fmSJFLIN.addTable('fcWQOpportun')
fmSJFLIN.addTable('fcLandInteg')
keepers = []
keepers = ['WUKey','Shape_Length','Shape_Area','WQOpportun','LandInteg']
for field in fmSJFLIN.fields:
    if field.name not in keepers:
        fmSJFLIN.removeFieldMap(fmSJFLIN.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis('fcWQOpportun', 'fcLandInteg', 'WU_HydroH',
'JOIN_ONE_TO_ONE', 'KEEP_ALL', fmSJFLIN, 'CONTAINS')
arcpy.MakeFeatureLayer_management('WU_HydroH', 'fcHydroH')
logger.info("Spatial join to merge WQOpportun and LandInteg completed")

## Add HydIntact field to Wetland Units and set initial point value to zero.
actions.DeleteField('fcHydroH', 'HydIntact')
arcpy.AddField_management('fcHydroH', 'HydIntact', 'SHORT')
arcpy.CalculateField_management('fcHydroH', 'HydIntact', '0', 'VB', '#')
logger.info("field HydIntact added and initial value set to 0")

## Assign points to HydIntact
strWHERE = """"("WQOpportun" = 5 AND "LandInteg" IN (2,3)) OR ("WQOpportun" = 4
AND "LandInteg" IN (0,1))""""
arcpy.SelectLayerByAttribute_management("fcHydroH", "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management("fcHydroH","HydIntact","1","VB","#")

```



```
strWHERE = """"("WQOpportun" = 4 AND "LandInteg" IN (2,3)) OR ("WQOpportun" = 3  
AND "LandInteg" IN (0,1))""""
```

```
arcpy.SelectLayerByAttribute_management("fcHydroH", "NEW_SELECTION",  
strWHERE)
```

```
arcpy.CalculateField_management("fcHydroH","HydIntact","2","VB","#")
```

```
strWHERE = """"("WQOpportun" = 3 AND "LandInteg" IN (2,3)) OR ("WQOpportun" = 2  
AND "LandInteg" IN (0,1))""""
```

```
arcpy.SelectLayerByAttribute_management("fcHydroH", "NEW_SELECTION",  
strWHERE)
```

```
arcpy.CalculateField_management("fcHydroH","HydIntact","3","VB","#")
```

```
strWHERE = """"("WQOpportun" = 2 AND "LandInteg" IN (2,3)) OR ("WQOpportun" = 1  
AND "LandInteg" IN (0,1))""""
```

```
arcpy.SelectLayerByAttribute_management("fcHydroH", "NEW_SELECTION",  
strWHERE)
```

```
arcpy.CalculateField_management("fcHydroH","HydIntact","4","VB","#")
```

```
strWHERE = """"("WQOpportun" = 1 AND "LandInteg" IN (2,3)) OR ("WQOpportun" = 0  
AND "LandInteg" IN (0,1))""""
```

```
arcpy.SelectLayerByAttribute_management("fcHydroH", "NEW_SELECTION",  
strWHERE)
```

```
arcpy.CalculateField_management("fcHydroH","HydIntact","5","VB","#")
```

```
strWHERE = """""WQOpportun" = 0 AND "LandInteg" IN (2,3)""""
```

```
arcpy.SelectLayerByAttribute_management("fcHydroH", "NEW_SELECTION",  
strWHERE)
```

```
arcpy.CalculateField_management("fcHydroH","HydIntact","6","VB","#")
```

```
logger.info("Points assigned for wetland units to HydIntact")
```

```
arcpy.SelectLayerByAttribute_management("fcHydroH", "CLEAR_SELECTION")
```

```
# Clean up
```

### 5.7.49 HydSW: Habitat and Ecological Integrity Potential

```
#####  
#  
# File Name: HydSW.py  
# Developer: Yibing Han  
# Date 9/25/2017  
# Purpose:  
#   Input to Habitat & Ecological Integrity / Intrinsic Potential / Hydrology  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcHydSW():  
    logger = logging.getLogger("WFA.HabEco.HPotential.HydSW")  
  
    # Setting python variables  
    arcpy.MakeFeatureLayer_management(r"WU_HydroH", 'fcHydroH')  
    arcpy.MakeFeatureLayer_management(globalvars.srcInput, "fcInput")  
    arcpy.MakeFeatureLayer_management(globalvars.srcNWIOpenWater, 'fcNWIOpenWater')  
    logger.info("feature layers ready")  
  
    ## Select the wetland polygons that are attributed as open water, including lakes, rivers, and  
    open
```

```
## water palustrine (aquatic bed, unconsolidated bottom, unconsolidated shore) AND have a
## hydrologic regime that is (permanently flooded, semipermanently flooded, intermittently
exposed)
```

```
## AND are not spoil.
```

```
"strWHERE = ""("ATTRIBUTE" LIKE 'L%' OR "ATTRIBUTE" LIKE 'R%' OR
"ATTRIBUTE" LIKE 'PAB%' OR "ATTRIBUTE" LIKE 'PUB%' OR "ATTRIBUTE" LIKE
'PUS%') AND ("ATTRIBUTE" LIKE '%H%' OR "ATTRIBUTE" LIKE '%G%' OR
"ATTRIBUTE" LIKE '%F%') AND "ATTRIBUTE" NOT LIKE '%S%""'
```

```
arcpy.SelectLayerByAttribute_management("fcEnhWWetland", "NEW_SELECTION",
strWHERE)
```

```
logger.info("wetland polygons that are attributed as open water selected")
```

```
## Create open water layer from selection
```

```
arcpy.CreateFileGDB_management(r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND",
"NWIExports.gdb")
```

```
arcpy.CopyFeatures_management("fcEnhWWetland", globalvars.srcNWIOpenWater)
```

```
arcpy.MakeFeatureLayer_management(globalvars.srcNWIOpenWater, 'fcNWIOpenWater')
```

```
logger.info("open water layer from selection created")"
```

```
## Add field to store HydSW and set initial value to zero
```

```
actions.DeleteField("fcHydroH", "HydSW")
```

```
arcpy.AddField_management("fcHydroH", "HydSW", "SHORT")
```

```
arcpy.CalculateField_management("fcHydroH", "HydSW", "0", "PYTHON", "#")
```

```
logger.info("field HydSW created and initial value set to zero")
```

```
## Select the Wetland Units that intersect or touch NWIOpenWater
```

```
arcpy.SelectLayerByLocation_management("fcHydroH", "INTERSECT",
"fcNWIOpenWater")
```

```
logger.info("Wetland Units that intersect or touch NWIOpenWater selected")
```

```
## Select the Wetland Units that contain open water within their boundaries
```

```
strWHERE = """"("ATTRIBUTE" LIKE 'L%' OR "ATTRIBUTE" LIKE 'R%' OR  
"ATTRIBUTE" LIKE 'PAB%' OR "ATTRIBUTE" LIKE 'PUB%' OR "ATTRIBUTE" LIKE  
'PUS%') AND ("ATTRIBUTE" LIKE '%H%' OR "ATTRIBUTE" LIKE '%G%' OR  
"ATTRIBUTE" LIKE '%F%') AND "ATTRIBUTE" NOT LIKE '%s%""""
```

```
arcpy.SelectLayerByAttribute_management("fcInput", "NEW_SELECTION", strWHERE)  
arcpy.SelectLayerByLocation_management("fcHydroH", "INTERSECT", "fcInput")
```

```
## Assign points to HydSW
```

```
arcpy.CalculateField_management("fcHydroH", "HydSW", "1", "PYTHON", "#")  
arcpy.SelectLayerByAttribute_management("fcHydroH", "CLEAR_SELECTION")  
arcpy.SelectLayerByAttribute_management("fcInput", "CLEAR_SELECTION")  
logger.info("points assigned to HydSW")
```

```
# Clean up
```

### 5.7.50 Karst: Habitat and Ecological Integrity Potential

```
#####  
#  
# File Name: Karst.py  
# Developer: Yibing Han  
# Date 9/20/2017  
# Purpose:  
#   Input to Habitat / Potential / Vegetation / Floristic Quality  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcKarst(WetlandPoly):  
    logger = logging.getLogger("WFA.HabEco.HPotential.Karst")  
  
    # Setting python variables  
    arcpy.MakeFeatureLayer_management(WetlandPoly, "fcWU")  
    arcpy.MakeFeatureLayer_management(globalvars.srcKarstComp, "fcKarstComposite")  
  
    # Clean up if needed  
    if arcpy.Exists("WU_Karst"):  
        arcpy.Delete_management("WU_Karst")
```

```

if arcpy.Exists("WU_Karst1"):
    arcpy.Delete_management("WU_Karst1")
logger.info("feature layers ready")

## Intersect karst and Wetland Units
arcpy.Intersect_analysis(["fcKarstComposite", "fcWU"], "WU_Karst1", "ONLY_FID")
logger.info("Intersect of karst and Wetland Units completed")

## Add field to store karst area.
actions.DeleteField("WU_Karst1","KarstArea")
arcpy.AddField_management("WU_Karst1", "KarstArea", "FLOAT")
arcpy.CalculateField_management("WU_Karst1","KarstArea","[Shape_Area]","VB","#")
arcpy.MakeFeatureLayer_management(r"WU_Karst1","fcWUKarst1")
logger.info("field KarstArea added to store karst area")

## Spatial Join karst selection to Wetland Units and sum karst area.

#####
#####

# SJ: FloodIn

#####
#####

fmSJFLIN = arcpy.FieldMappings()
fmSJFLIN.addTable("fcWU")
fmSJFLIN.addTable("fcWUKarst1")

keepers = []
keepers = ["WUKey","Shape_Length","Shape_Area","KarstArea"]

for field in fmSJFLIN.fields:

```

if field.name not in keepers:

```
fmSJFLIN.removeFieldMap(fmSJFLIN.findFieldMapIndex(field.name))
```

```
fldKeyIndex = fmSJFLIN.findFieldMapIndex("KarstArea")
```

```
fieldmap = fmSJFLIN.getFieldMap(fldKeyIndex)
```

```
fieldmap.mergeRule = "Sum"
```

```
fmSJFLIN.replaceFieldMap(fldKeyIndex, fieldmap)
```

```
arcpy.SpatialJoin_analysis("fcWU","fcWUKarst1","WU_Karst","JOIN_ONE_TO_ONE","KEEP_ALL",fmSJFLIN,"CONTAINS")
```

```
arcpy.MakeFeatureLayer_management("WU_Karst","fcWUKarst")
```

```
logger.info("Spatial Join karst selection to Wetland Units completed")
```

```
## Add fields to store KarstRatio and Karst.
```

```
actions.DeleteField("fcWUKarst","KarstRatio")
```

```
arcpy.AddField_management("fcWUKarst", "KarstRatio", "FLOAT")
```

```
arcpy.AddField_management("fcWUKarst", "Karst", "SHORT")
```

```
arcpy.CalculateField_management("fcWUKarst","Karst","0","VB","#")
```

```
arcpy.CalculateField_management("fcWUKarst","KarstRatio","[KarstArea]/[Shape_Area]","VB","#")
```

```
logger.info("field KarstRatio added to store KarstRatio and Karst")
```

```
## Assign points to Wetland Units for VegHorInt
```

```
strWHERE = """"KarstRatio" > 0.1"""
```

```
arcpy.SelectLayerByAttribute_management("fcWUKarst", "NEW_SELECTION", strWHERE)
```

```
arcpy.CalculateField_management("fcWUKarst","Karst","1","VB","#")
```

```
strWHERE = """"KarstRatio" > 0.33"""
```

```
    arcpy.SelectLayerByAttribute_management("fcWUKarst", "NEW_SELECTION",
strWHERE)
    arcpy.CalculateField_management("fcWUKarst","Karst","2","VB","#")

strWHERE = """"KarstRatio" > 0.67""""
    arcpy.SelectLayerByAttribute_management("fcWUKarst", "NEW_SELECTION",
strWHERE)
    arcpy.CalculateField_management("fcWUKarst","Karst","3","VB","#")
    logger.info("points assigned to Wetland Units for field KarstRatio")

    arcpy.SelectLayerByAttribute_management("fcWUKarst", "CLEAR_SELECTION")

# Clean up
if arcpy.Exists("WU_Karst1"):
    arcpy.Delete_management("WU_Karst1")
```



### 5.7.51 MarlPEM: Habitat and Ecological Integrity Potential

```
#####  
#  
# File Name: MarlPEM.py  
# Developer: Yibing Han  
# Date 9/20/2017  
# Purpose:  
#   Input to Habitat / Potential / Vegetation / Floristic Quality  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcMarlPEM(WetlandPoly):  
    logger = logging.getLogger("WFA.HabEco.HPotential.MarlPEM")  
  
    # Setting python variables  
    arcpy.MakeFeatureLayer_management(WetlandPoly, "fcWU")  
    arcpy.MakeFeatureLayer_management(globalvars.srcMarlSoils, "fcMarlSoils")  
    arcpy.MakeFeatureLayer_management(globalvars.srcInput, "fcENWI")  
  
    # Clean up if needed  
    if arcpy.Exists("WU_MarlPEM"):
```

```

    arcpy.Delete_management("WU_MarlPEM")
if arcpy.Exists("WU_MarlPEM1"):
    arcpy.Delete_management("WU_MarlPEM1")
if arcpy.Exists("VegPEM"):
    arcpy.Delete_management("VegPEM")
logger.info("feature layers ready")

## Select emergent wetlands and export feature class
strWHERE = """"ATTRIBUTE" LIKE 'PEM%'""""
arcpy.SelectLayerByAttribute_management("fcENWI", "NEW_SELECTION", strWHERE)
arcpy.CopyFeatures_management("fcENWI", "VegPEM")
arcpy.MakeFeatureLayer_management(r"VegPEM", "fcVegPEM")
logger.info("emergent wetlands selected and exported as VegPEM")
arcpy.SelectLayerByAttribute_management("fcENWI", "CLEAR_SELECTION")

## Intersect MarlSoils and emergent wetlands (PEM)
arcpy.Intersect_analysis(["fcMarlSoils", "fcVegPEM"], "WU_MarlPEM1", "ONLY_FID")
logger.info("Intersect of MarlSoils and emergent wetland completed")

## Add field to store emergent wetland/marl area.
actions.DeleteField("WU_MarlPEM1", "MarlPEMAre")
arcpy.AddField_management("WU_MarlPEM1", "MarlPEMAre", "FLOAT")

arcpy.CalculateField_management("WU_MarlPEM1", "MarlPEMAre", "[Shape_Area]", "VB", "#
")
arcpy.MakeFeatureLayer_management(r"WU_MarlPEM1", "fcWUMarlPEM1")
logger.info("field MarlPEMAre added to store emergent wetland/marl area")

## Spatial Join MarlPEM to Wetland Units and sum MarlPEM area.

```

```

#####
#####
# SJ: FloodIn

#####
#####

fmSJFLIN = arcpy.FieldMappings()
fmSJFLIN.addTable("fcWU")
fmSJFLIN.addTable("fcWUMarIPEM1")

keepers = []
keepers = ["WUKey", "Shape_Length", "Shape_Area", "MarIPEMAre"]

for field in fmSJFLIN.fields:
    if field.name not in keepers:
        fmSJFLIN.removeFieldMap(fmSJFLIN.findFieldMapIndex(field.name))

fldKeyIndex = fmSJFLIN.findFieldMapIndex("MarIPEMAre")
fieldmap = fmSJFLIN.getFieldMap(fldKeyIndex)
fieldmap.mergeRule = "Sum"
fmSJFLIN.replaceFieldMap(fldKeyIndex, fieldmap)

arcpy.SpatialJoin_analysis("fcWU", "fcWUMarIPEM1", "WU_MarIPEM", "JOIN_ONE_TO_O
NE", "KEEP_ALL", fmSJFLIN, "CONTAINS")
arcpy.MakeFeatureLayer_management("WU_MarIPEM", "fcWUMarIPEM")
logger.info("Spatial Join MarIPEM to Wetland Units completed")

## Add fields to store MarIPEMRat and MarIPEM, and set initial value of MarIPEM = 0.
actions.DeleteField("fcWUMarIPEM", "KarstRatio")

```

```

arcpy.AddField_management("fcWUMarIPEM", "MarIPEMRat", "FLOAT")
arcpy.AddField_management("fcWUMarIPEM", "MarIPEM", "SHORT")
arcpy.CalculateField_management("fcWUMarIPEM","MarIPEM","0","VB","#")
logger.info("field MarIPEM added and initial value set to 0")

## Calculate the ratio of MarIPEM area to total Wetland Unit area.

arcpy.CalculateField_management("fcWUMarIPEM","MarIPEMRat","[MarIPEMAre]/[Shape_
Area]","VB","#")
logger.info("field MarIPEMRat calculated")

## Assign points to Wetland Units
strWHERE = """"MarIPEMAre" > 200""""
arcpy.SelectLayerByAttribute_management("fcWUMarIPEM", "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management("fcWUMarIPEM","MarIPEM","1","VB","#")

strWHERE = """"MarIPEMRat" > 0.5""""
arcpy.SelectLayerByAttribute_management("fcWUMarIPEM", "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management("fcWUMarIPEM","MarIPEM","2","VB","#")

strWHERE = """"MarIPEMAre" > 10000""""
arcpy.SelectLayerByAttribute_management("fcWUMarIPEM", "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management("fcWUMarIPEM","MarIPEM","3","VB","#")
logger.info("points assigned to Wetland Units for field MarIPEM")

arcpy.SelectLayerByAttribute_management("fcWUMarIPEM", "CLEAR_SELECTION")

# Clean up

```

```
if arcpy.Exists("WU_MarlPEM1"):
    arcpy.Delete_management("WU_MarlPEM1")
if arcpy.Exists("VegPEM"):
    arcpy.Delete_management("VegPEM")
```

### 5.7.52 SoilIntact: Habitat and Ecological Integrity Potential

```
#####  
#  
# File Name: SoilIntact.py  
# Developer: Yibing Han  
# Date 9/28/2017  
# Purpose:  
#   Input to Habitat & Ecological Integrity / Potential / SoilH  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcSoilIntact():  
    logger = logging.getLogger("WFA.HabEco.HPotential.SoilIntact")  
  
    # Setting python variables  
    fcDisturb50m = arcpy.mapping.Layer(r"WU_Disturb50m")  
    logger.info("feature layers ready")  
  
    # Clean up if needed  
  
    ## Add SoilIntact field to Wetland Units and set initial point value to zero.
```

```

actions.DeleteField(fcDisturb50m, 'SoilIntact')
arcpy.AddField_management(fcDisturb50m, 'SoilIntact', 'SHORT')
arcpy.CalculateField_management(fcDisturb50m, 'SoilIntact', '0', 'VB', '#')
logger.info("field SoilIntact added and initial value set to 0")

## Assign points to SoilIntact
strWHERE = """"Buffer50mDist_diss_Dist50mRat" = 0""""
arcpy.SelectLayerByAttribute_management(fcDisturb50m, "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management(fcDisturb50m,"SoilIntact","2","VB","#")

strWHERE = """"Buffer50mDist_diss_Dist50mRat" > 0""""
arcpy.SelectLayerByAttribute_management(fcDisturb50m, "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management(fcDisturb50m,"SoilIntact","1","VB","#")

strWHERE = """"Buffer50mDist_diss_Dist50mRat" > 0.5""""
arcpy.SelectLayerByAttribute_management(fcDisturb50m, "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management(fcDisturb50m,"SoilIntact","0","VB","#")
logger.info("points assigned to SoilIntact")
arcpy.SelectLayerByAttribute_management(fcDisturb50m, "CLEAR_SELECTION")

#clean up

```

### 5.7.53 SoilOrgCalc: Habitat and Ecological Integrity Potential

```
#####  
# File Name: SoilOrgCalc.py  
# Developer: Yibing Han  
# Date 9/28/2017  
# Purpose:  
#   Input to Habitat & Ecological Integrity / Potential / SoilH  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcSoilOrgCalc():  
    logger = logging.getLogger("WFA.HabEco.HPotential.SoilOrgCalc")  
  
    # Setting python variables  
    arcpy.MakeFeatureLayer_management(r"WU_Histosol", 'fcHistosol')  
    arcpy.MakeFeatureLayer_management(r"WU_Karst", 'fcKarst')  
  
    # Clean up if needed  
    if arcpy.Exists('WU_SoilOrgCalc'):  
        arcpy.Delete_management('WU_SoilOrgCalc')  
    logger.info("feature layers ready")
```



```

## Spatial Joins to merge fields into one attribute table
fmSJFLIN = arcpy.FieldMappings()
fmSJFLIN.addTable('fcHistosol')
fmSJFLIN.addTable('fcKarst')
keepers = []
keepers = ['WUKey','Shape_Length','Shape_Area','Histosol','Karst']
for field in fmSJFLIN.fields:
    if field.name not in keepers:
        fmSJFLIN.removeFieldMap(fmSJFLIN.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis('fcHistosol', 'fcKarst', 'WU_SoilOrgCalc', 'JOIN_ONE_TO_ONE',
'KEEP_ALL', fmSJFLIN, 'CONTAINS')
arcpy.MakeFeatureLayer_management('WU_SoilOrgCalc', 'fcSoilOrgCalc')
logger.info("Spatial Joins to merge fields into one attribute table completed")

## Add SoilOrgCalc field and set initial point value to zero.
actions.DeleteField('fcSoilOrgCalc', 'SoilOrgCalc')
arcpy.AddField_management('fcSoilOrgCalc', 'SoilOrgCalc', 'SHORT')
arcpy.CalculateField_management('fcSoilOrgCalc', 'SoilOrgCalc', '0', 'VB', '#')
logger.info("SoilOrgCalc field added and initial point value set to zero")

## Assign points to fcSoilH
strWHERE = """"("Histosol" + "Karst") > 0""""
arcpy.SelectLayerByAttribute_management("fcSoilOrgCalc", "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management("fcSoilOrgCalc", "SoilOrgCalc", "1", "VB", "#")
logger.info("points assigned to fcSoilH")

arcpy.SelectLayerByAttribute_management("fcSoilOrgCalc", "CLEAR_SELECTION")
# Clean up

```

### 5.7.54 StrucPatch: Habitat and Ecological Integrity Potential

```
#####  
#  
# File Name: StrucPatch.py  
# Developer: Yibing Han  
# Date 9/29/2017  
# Purpose:  
#   Input to Habitat & Ecological Integrity / Potential / SoilH  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcStrucPatch():  
    logger = logging.getLogger("WFA.HabEco.HPotential.StrucPatch")  
  
    # Setting python variables  
    arcpy.MakeFeatureLayer_management(r"WU_Microtopo", 'fcMicrotopo')  
    arcpy.MakeFeatureLayer_management(r"WU_StreamEdge", 'fcStreamEdge')  
    arcpy.MakeFeatureLayer_management(r"WU_VegVerStr", 'fcVegVerStr')  
  
    # Clean up if needed  
    if arcpy.Exists('WU_StrucPatch1'):
```

```

    arcpy.Delete_management('WU_StrucPatch1')
if arcpy.Exists('WU_StrucPatch'):
    arcpy.Delete_management('WU_StrucPatch')
logger.info("feature layers ready")

## Spatial joins to merge input metrics (VegHorInt, VegVerStr, StreamEdge) into one
attribute table
fmSJFLIN = arcpy.FieldMappings()
fmSJFLIN.addTable('fcMicrotopo')
fmSJFLIN.addTable('fcVegVerStr')
keepers = []
keepers = ['WUKey','Shape_Length','Shape_Area','VegHorInt','VegVerStr']
for field in fmSJFLIN.fields:
    if field.name not in keepers:
        fmSJFLIN.removeFieldMap(fmSJFLIN.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis('fcMicrotopo', 'fcVegVerStr', 'WU_StrucPatch1',
'JOIN_ONE_TO_ONE', 'KEEP_ALL', fmSJFLIN, 'CONTAINS')
arcpy.MakeFeatureLayer_management('WU_StrucPatch1', 'fcStrucPatch1')

fmSJFLIN = arcpy.FieldMappings()
fmSJFLIN.addTable('fcStrucPatch1')
fmSJFLIN.addTable('fcStreamEdge')
keepers = []
keepers = ['WUKey','Shape_Length','Shape_Area','VegHorInt','VegVerStr','StreamRatio']
for field in fmSJFLIN.fields:
    if field.name not in keepers:
        fmSJFLIN.removeFieldMap(fmSJFLIN.findFieldMapIndex(field.name))

```

```

arcpy.SpatialJoin_analysis('fcStrucPatch1', 'fcStreamEdge', 'WU_StrucPatch',
'JOIN_ONE_TO_ONE', 'KEEP_ALL', fmSJFLIN, 'CONTAINS')

arcpy.MakeFeatureLayer_management('WU_StrucPatch', 'fcStrucPatch')

logger.info("Spatial Joins to to merge input metrics (VegHorInt, VegVerStr, StreamEdge)
into one attribute table completed")

```

```

## Add StreamEdge3 field and set initial point value to zero.

```

```

actions.DeleteField('fcStrucPatch', 'StreamEdge3')

arcpy.AddField_management('fcStrucPatch', 'StreamEdge3', 'SHORT')

arcpy.CalculateField_management('fcStrucPatch', 'StreamEdge3', '0', 'VB', '#')

logger.info("StreamEdge3 field added and initial point value set to zero")

```

```

## Assign points to StreamEdge3

```

```

strWHERE = """"StreamRatio" > 0""""

arcpy.SelectLayerByAttribute_management("fcStrucPatch", "NEW_SELECTION",
strWHERE)

arcpy.CalculateField_management("fcStrucPatch","StreamEdge3","1","VB","#")

```

```

strWHERE = """"StreamRatio" > 1.4""""

```

```

arcpy.SelectLayerByAttribute_management("fcStrucPatch", "NEW_SELECTION",
strWHERE)

arcpy.CalculateField_management("fcStrucPatch","StreamEdge3","2","VB","#")

```

```

strWHERE = """"StreamRatio" > 2.4""""

```

```

arcpy.SelectLayerByAttribute_management("fcStrucPatch", "NEW_SELECTION",
strWHERE)

arcpy.CalculateField_management("fcStrucPatch","StreamEdge3","3","VB","#")

logger.info("points assigned to StreamEdge3")

```

```

## Clear previous selection

```

```

arcpy.SelectLayerByAttribute_management("fcStrucPatch", "CLEAR_SELECTION")

```

```

## Add StrucPatch field and set initial point value to zero.
actions.DeleteField('fcStrucPatch', 'StrucPatch')
arcpy.AddField_management('fcStrucPatch', 'StrucPatch', 'SHORT')
arcpy.CalculateField_management('fcStrucPatch', 'StrucPatch', '0', 'VB', '#')
logger.info("StrucPatch field added and initial point value set to zero")

## Assign points to StrucPatch
strWHERE = """"("VegHorInt" + "VegVerStr" + "StreamEdge3") > 1""""
arcpy.SelectLayerByAttribute_management("fcStrucPatch", "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management("fcStrucPatch", "StrucPatch", "1", "VB", "#")

strWHERE = """"("VegHorInt" + "VegVerStr" + "StreamEdge3") > 3""""
arcpy.SelectLayerByAttribute_management("fcStrucPatch", "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management("fcStrucPatch", "StrucPatch", "2", "VB", "#")

strWHERE = """"("VegHorInt" + "VegVerStr" + "StreamEdge3") > 5""""
arcpy.SelectLayerByAttribute_management("fcStrucPatch", "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management("fcStrucPatch", "StrucPatch", "3", "VB", "#")
logger.info("points assigned to StrucPatch")

arcpy.SelectLayerByAttribute_management("fcStrucPatch", "CLEAR_SELECTION")

# Clean up
if arcpy.Exists('WU_StrucPatch1'):
    arcpy.Delete_management('WU_StrucPatch1')

```

### 5.7.55 VegFQ: Habitat and Ecological Integrity Potential

```
#####  
#  
# File Name: VegFQ.py  
# Developer: Yibing Han  
# Date 9/25/2017  
# Purpose:  
#   Input to Habitat and Ecological Integrity / Intrinsic Potential  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcVegFQ():  
    logger = logging.getLogger("WFA.HabEco.HPotential.VegFQ")  
  
    # Setting python variables  
    arcpy.MakeFeatureLayer_management(r'WU_VegPerUng', 'fcVegPerUng')  
    arcpy.MakeFeatureLayer_management(r'WU_VegWoody', 'fcVegWoody')  
    arcpy.MakeFeatureLayer_management(r'WU_MarlPEM', 'fcMarlPEM')  
    arcpy.MakeFeatureLayer_management(r'WU_Histosol', 'fcHistosol')  
    arcpy.MakeFeatureLayer_management(r'WU_Karst', 'fcKarst')  
    arcpy.MakeFeatureLayer_management(r'WU_Disturb50m', 'fcDisturb50m')
```

```

arcpy.MakeFeatureLayer_management(r'WU_LandInteg', 'fcLandInteg')
arcpy.MakeFeatureLayer_management(r'WU_VegAll', 'fcVegAll')

# Clean up if needed
if arcpy.Exists('WU_VegFQ'):
    arcpy.Delete_management('WU_VegFQ')
if arcpy.Exists('WU_VegFQ1'):
    arcpy.Delete_management('WU_VegFQ1')
if arcpy.Exists('WU_VegFQ2'):
    arcpy.Delete_management('WU_VegFQ2')
if arcpy.Exists('WU_VegFQ3'):
    arcpy.Delete_management('WU_VegFQ3')
if arcpy.Exists('WU_VegFQ4'):
    arcpy.Delete_management('WU_VegFQ4')
if arcpy.Exists('WU_VegFQ5'):
    arcpy.Delete_management('WU_VegFQ5')
if arcpy.Exists('WU_VegFQ6'):
    arcpy.Delete_management('WU_VegFQ6')
logger.info("feature layers ready")

## Spatial join to merge VegPerUng1 and VegWoodyFor metrics
fmSJFLIN = arcpy.FieldMappings()
fmSJFLIN.addTable('fcVegPerUng')
fmSJFLIN.addTable('fcVegWoody')
keepers = []
keepers = ['WUKey','Shape_Length','Shape_Area','VegPerUng1','VegWoodyFor']
for field in fmSJFLIN.fields:
    if field.name not in keepers:
        fmSJFLIN.removeFieldMap(fmSJFLIN.findFieldMapIndex(field.name))

```

```

    arcpy.SpatialJoin_analysis('fcVegPerUng', 'fcVegWoody', 'WU_VegFQ1',
'JOIN_ONE_TO_ONE', 'KEEP_ALL', fmSJFLIN, 'CONTAINS')
    arcpy.MakeFeatureLayer_management('WU_VegFQ1', 'fcVegFQ1')

## Spatial join to merge MarlPEM metric
fmSJFLIN = arcpy.FieldMappings()
fmSJFLIN.addTable('fcVegFQ1')
fmSJFLIN.addTable('fcMarlPEM')
keepers = []
keepers = ['WUKey','Shape_Length','Shape_Area','VegPerUng1','VegWoodyFor','MarlPEM']
for field in fmSJFLIN.fields:
    if field.name not in keepers:
        fmSJFLIN.removeFieldMap(fmSJFLIN.findFieldMapIndex(field.name))

    arcpy.SpatialJoin_analysis('fcVegFQ1', 'fcMarlPEM', 'WU_VegFQ2',
'JOIN_ONE_TO_ONE', 'KEEP_ALL', fmSJFLIN, 'CONTAINS')
    arcpy.MakeFeatureLayer_management('WU_VegFQ2', 'fcVegFQ2')
    logger.info("Spatial join to merge MarlPEM metric completed")

## Spatial join to merge Histosol metric
fmSJFLIN = arcpy.FieldMappings()
fmSJFLIN.addTable('fcVegFQ2')
fmSJFLIN.addTable('fcHistosol')
keepers = []
keepers =
['WUKey','Shape_Length','Shape_Area','VegPerUng1','VegWoodyFor','MarlPEM','Histosol']
for field in fmSJFLIN.fields:
    if field.name not in keepers:
        fmSJFLIN.removeFieldMap(fmSJFLIN.findFieldMapIndex(field.name))

```



```

    arcpy.SpatialJoin_analysis('fcVegFQ2', 'fcHistosol', 'WU_VegFQ3', 'JOIN_ONE_TO_ONE',
'KEEP_ALL', fmSJFLIN, 'CONTAINS')
    arcpy.MakeFeatureLayer_management('WU_VegFQ3', 'fcVegFQ3')
    logger.info("Spatial join to merge Histosol metric completed")

## Spatial join to merge Karst metric
fmSJFLIN = arcpy.FieldMappings()
fmSJFLIN.addTable('fcVegFQ3')
fmSJFLIN.addTable('fcKarst')
keepers = []
keepers =
['WUKey','Shape_Length','Shape_Area','VegPerUng1','VegWoodyFor','MarlPEM',"Histosol",
Karst"]
for field in fmSJFLIN.fields:
    if field.name not in keepers:
        fmSJFLIN.removeFieldMap(fmSJFLIN.findFieldMapIndex(field.name))

    arcpy.SpatialJoin_analysis('fcVegFQ3', 'fcKarst', 'WU_VegFQ4', 'JOIN_ONE_TO_ONE',
'KEEP_ALL', fmSJFLIN, 'CONTAINS')
    arcpy.MakeFeatureLayer_management('WU_VegFQ4', 'fcVegFQ4')
    logger.info("Spatial join to merge Karst metric completed")

## Spatial join to merge Dist50mRat
fmSJFLIN = arcpy.FieldMappings()
fmSJFLIN.addTable('fcVegFQ4')
fmSJFLIN.addTable('fcDisturb50m')
keepers = []
keepers =
['WUKey','Shape_Length','Shape_Area','VegPerUng1','VegWoodyFor','MarlPEM',"Histosol",
Karst","Buffer50mDist_diss_Dist50mRat"]

```

```

for field in fmSJFLIN.fields:
    if field.name not in keepers:
        fmSJFLIN.removeFieldMap(fmSJFLIN.findFieldMapIndex(field.name))

    arcpy.SpatialJoin_analysis('fcVegFQ4', 'fcDisturb50m', 'WU_VegFQ5',
'JOIN_ONE_TO_ONE', 'KEEP_ALL', fmSJFLIN, 'CONTAINS')
    arcpy.MakeFeatureLayer_management('WU_VegFQ5', 'fcVegFQ5')
    logger.info("Spatial join to merge Dist50mRat completed")

## Spatial join to merge LandInteg metric
fmSJFLIN = arcpy.FieldMappings()
fmSJFLIN.addTable('fcVegFQ5')
fmSJFLIN.addTable('fcLandInteg')
keepers = []
keepers =
['WUKey','Shape_Length','Shape_Area','VegPerUng1','VegWoodyFor','MarlPEM',"Histosol",
"Karst","Buffer50mDist_diss_Dist50mRat","LandInteg"]
for field in fmSJFLIN.fields:
    if field.name not in keepers:
        fmSJFLIN.removeFieldMap(fmSJFLIN.findFieldMapIndex(field.name))

    arcpy.SpatialJoin_analysis('fcVegFQ5', 'fcLandInteg', 'WU_VegFQ6',
'JOIN_ONE_TO_ONE', 'KEEP_ALL', fmSJFLIN, 'CONTAINS')
    arcpy.MakeFeatureLayer_management('WU_VegFQ6', 'fcVegFQ6')
    logger.info("Spatial join to merge LandInteg metric completed")

## Spatial join to merge VegArea
fmSJFLIN = arcpy.FieldMappings()
fmSJFLIN.addTable('fcVegFQ6')
fmSJFLIN.addTable('fcVegAll')
keepers = []

```

```

keepers =
['WUKey','Shape_Length','Shape_Area','VegPerUng1','VegWoodyFor','MarlPEM',"Histosol","
Karst","Buffer50mDist_diss_Dist50mRat","LandInteg","VegArea"]

for field in fmSJFLIN.fields:
    if field.name not in keepers:
        fmSJFLIN.removeFieldMap(fmSJFLIN.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis('fcVegFQ6', 'fcVegAll', 'WU_VegFQ', 'JOIN_ONE_TO_ONE',
'KEEP_ALL', fmSJFLIN, 'CONTAINS')

arcpy.MakeFeatureLayer_management('WU_VegFQ', 'fcVegFQ')
logger.info("Spatial join to merge VegArea completed")

## Add fields to store Dist50mFQ and VegFQand set initial values to zero
actions.DeleteField('fcVegFQ', 'VegFQ')
arcpy.AddField_management('fcVegFQ', 'Dist50mFQ', 'SHORT')
arcpy.CalculateField_management('fcVegFQ', 'Dist50mFQ', '0', 'VB', '#')
arcpy.AddField_management('fcVegFQ', 'VegFQ', 'SHORT')
arcpy.CalculateField_management('fcVegFQ', 'VegFQ', '0', 'VB', '#')
logger.info("fields added to store Dist50mFQ and VegFQand set initial values to zero")

## Assign points to Dist50mFQ
strWHERE = """"Buffer50mDist_diss_Dist50mRat" < 0.25""""
arcpy.SelectLayerByAttribute_management("fcVegFQ", "NEW_SELECTION", strWHERE)
arcpy.CalculateField_management("fcVegFQ","Dist50mFQ","1","VB","#")

strWHERE = """"Buffer50mDist_diss_Dist50mRat" < 0.1""""
arcpy.SelectLayerByAttribute_management("fcVegFQ", "NEW_SELECTION", strWHERE)
arcpy.CalculateField_management("fcVegFQ","Dist50mFQ","2","VB","#")

strWHERE = """"Buffer50mDist_diss_Dist50mRat" = 0""""

```

```

arcpy.SelectLayerByAttribute_management("fcVegFQ", "NEW_SELECTION", strWHERE)
arcpy.CalculateField_management("fcVegFQ","Dist50mFQ","3","VB","#")
logger.info("points assigned to Dist50mFQ")
arcpy.SelectLayerByAttribute_management("fcVegFQ", "CLEAR_SELECTION")

## Sum all points for VegFQ
arcpy.CalculateField_management('fcVegFQ', 'VegFQ', '[VegPerUng1] + [VegWoodyFor] +
[MarlPEM] + [Histosol] + [Karst] + [Dist50mFQ] + [LandInteg]', 'VB', '#')
logger.info("points summed for VegFQ")

## Reduce VegFQ values to cap of 9 points total
strWHERE = """"VegFQ" > 9""""
arcpy.SelectLayerByAttribute_management("fcVegFQ", "NEW_SELECTION", strWHERE)
arcpy.CalculateField_management("fcVegFQ","VegFQ","9","VB","#")
logger.info("VegFQ values reduced to cap of 9 points total")

## Reduce VegFQ values to zero for unvegetated wetlands
strWHERE = """"VegArea" IS NULL""""
arcpy.SelectLayerByAttribute_management("fcVegFQ", "NEW_SELECTION", strWHERE)
arcpy.CalculateField_management("fcVegFQ","VegFQ","0","VB","#")
logger.info("VegFQ values reduced to zero for unvegetated wetlands")
arcpy.SelectLayerByAttribute_management("fcVegFQ", "CLEAR_SELECTION")

# Clean up
if arcpy.Exists('WU_VegFQ1'):
    arcpy.Delete_management('WU_VegFQ1')
if arcpy.Exists('WU_VegFQ2'):
    arcpy.Delete_management('WU_VegFQ2')
if arcpy.Exists('WU_VegFQ3'):
    arcpy.Delete_management('WU_VegFQ3')

```

```
if arcpy.Exists('WU_VegFQ4'):
    arcpy.Delete_management('WU_VegFQ4')
if arcpy.Exists('WU_VegFQ5'):
    arcpy.Delete_management('WU_VegFQ5')
if arcpy.Exists('WU_VegFQ6'):
    arcpy.Delete_management('WU_VegFQ6')
```

### 5.7.56 VegHorInt: Habitat and Ecological Integrity Potential

```
#####  
#  
# File Name: VegHorInt.py  
# Developer: Yibing Han  
# Date 9/20/2017  
# Purpose:  
#   Input to Habitat / Potential / Vegetation  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcVegHorInt():  
    logger = logging.getLogger("WFA.HabEco.HPotential.VegHorInt")  
  
    # Clean up if needed  
  
    # Setting python variables  
    arcpy.MakeFeatureLayer_management(r"WU_Microtopo","fcWUMicrotopo")  
    logger.info("feature layers ready")  
  
    ## Add new attribute field to store points for VegHorInt and set initial value to zero.
```

```

actions.DeleteField("fcWUMicrotopo","VegHorInt")
arcpy.AddField_management("fcWUMicrotopo", "VegHorInt", "SHORT")
arcpy.CalculateField_management("fcWUMicrotopo","VegHorInt","0","VB","#")
logger.info("field VegHorInt added and initial value set to 0")

## Assign points to Wetland Units for VegHorInt
strWHERE = """"MicroRatio" > 4 AND "Join_Count" > 1""""
arcpy.SelectLayerByAttribute_management("fcWUMicrotopo", "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management("fcWUMicrotopo","VegHorInt","1","VB","#")

strWHERE = """"MicroRatio" > 6 AND "Join_Count" > 2""""
arcpy.SelectLayerByAttribute_management("fcWUMicrotopo", "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management("fcWUMicrotopo","VegHorInt","2","VB","#")

strWHERE = """"MicroRatio" > 10 AND "Join_Count" > 4""""
arcpy.SelectLayerByAttribute_management("fcWUMicrotopo", "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management("fcWUMicrotopo","VegHorInt","3","VB","#")
logger.info("Points assigned to field VegHorInt")

arcpy.SelectLayerByAttribute_management("fcWUMicrotopo", "CLEAR_SELECTION")

# Clean up

```

### 5.7.57 VegVerStr: Habitat and Ecological Integrity Potential

```
#####  
#  
# File Name: VegVerStr.py  
# Developer: Yibing Han  
# Date 9/18/2017  
# Purpose:  
#   Input to Habitat / Potential / Vegetation Factor.  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcVegVerStr():  
    logger = logging.getLogger("WFA.HabEco.HPotential.VegVerStr")  
  
    # Setting python variables  
    arcpy.MakeFeatureLayer_management(r"WU_VegWoody","fcVegWoody")  
    arcpy.MakeFeatureLayer_management(r"WU_VegAll","fcVegAll")  
  
    # Clean up if needed  
    if arcpy.Exists("WU_VegVerStr"):  
        arcpy.Delete_management("WU_VegVerStr")
```



```

logger.info("feature layers ready")

## Retrieve the fields PFOarea (forest area in m2) and PFOratio (ratio of forest area to total
wetland
## area) from the WU_VegWoody feature class.
## Retrieve the fields VegArea (vegetated area in m2) and VegRatio (ratio of vegetated area
to total
## wetland area) from the WU_VegAll feature class.
## Store the fields in a new feature class: WU_VegVerStr.
fmSJFLIN = arcpy.FieldMappings()
fmSJFLIN.addTable("fcVegAll")
fmSJFLIN.addTable("fcVegWoody")

keepers = []
keepers =
["WUKey", "Shape_Length", "Shape_Area", "PFOarea", "PFOratio", "VegArea", "VegRatio"]

for field in fmSJFLIN.fields:
    if field.name not in keepers:
        fmSJFLIN.removeFieldMap(fmSJFLIN.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis("fcVegAll", "fcVegWoody", "WU_VegVerStr", "JOIN_ONE_TO_O
NE", "KEEP_ALL", fmSJFLIN, "CONTAINS")
arcpy.MakeFeatureLayer_management("WU_VegVerStr", "fcWUVegVerStr")
logger.info("spatial join of VegArea and VegAll completed")

## Add new attribute field to store points for VegVerStr and set initial value to zero.
actions.DeleteField("fcWUVegVerStr", "VegVerStr")
arcpy.AddField_management("fcWUVegVerStr", "VegVerStr", "SHORT")
arcpy.CalculateField_management("fcWUVegVerStr", "VegVerStr", "0", "VB", "#")

```

```

logger.info("field VegVerStr added and initial value set to 0")

## Assign points to Wetland Units for VegVerStr
strWHERE = """"VegRatio" > 0.05 AND "VegArea" > 500""""
arcpy.SelectLayerByAttribute_management("fcWUVegVerStr", "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management("fcWUVegVerStr","VegVerStr","1","VB","#")

strWHERE = """"PFOratio" > 0.05 AND "PFOarea" > 500 AND "VegRatio" > 0.5""""
arcpy.SelectLayerByAttribute_management("fcWUVegVerStr", "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management("fcWUVegVerStr","VegVerStr","2","VB","#")

strWHERE = """"PFOratio" > 0.5 AND "PFOarea" > 500""""
arcpy.SelectLayerByAttribute_management("fcWUVegVerStr", "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management("fcWUVegVerStr","VegVerStr","3","VB","#")
logger.info("Points assigned to field VegVerStr")

arcpy.SelectLayerByAttribute_management("fcWUVegVerStr", "CLEAR_SELECTION")

# Clean up

```

5.7.58 Habitat and Ecological Integrity Society

```

#####
#
# File Name: HSociety.py
# Developer: Yibing Han
# Date: 12/12/2017
# Purpose:
#   This script handles the execution of all the Habitat and Ecological Integrity Value to
#   Society metrics.
#
#####
import datetime
import logging
import traceback
import arcpy

from Variables import OwnerAccess, PublicUse
from Factors import HInvest, HUse
from Aspects import HSociety

def procHSociety(WetlandPoly):
    logger = logging.getLogger("WFA.HabEco.HSociety")

    #####
    ## 1. Run Variables
    #####
    OwnerAccess.CalcOwnerAccess(WetlandPoly)
    PublicUse.CalcPublicUse(WetlandPoly)

    #####
    ## 2. Run Factors
    #####
    HInvest.CalcHInvest(WetlandPoly)
    HUse.CalcHUse()

    #####
    ## 3. Run Aspect
    #####
    HSociety.CalcHSociety()

```

### 5.7.59 Habitat and Ecological Integrity Society Aspects

```
#####  
#  
# File Name: HSociety.py  
# Developer: Yibing Han  
# Date: 10/19/2017  
# Purpose:  
#  Habitat Function  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import arcpy  
from utilities import actions  
import logging  
  
def CalcHSociety():  
    logger = logging.getLogger("WFA.HabEco.HSociety.HSociety")  
  
    # Setting python variables  
    fcHInvest = arcpy.mapping.Layer(r"WU_HInvest")  
    fcHUse = arcpy.mapping.Layer(r"WU_HUse")  
    logger.info("feature layers ready")  
  
    # Clean up if needed  
    if arcpy.Exists('WU_HSociety'):  
        arcpy.Delete_management('WU_HSociety')
```

```

## Spatial join to merge WshdPos and AquaAbund into one attribute table
fmSJFLIN = arcpy.FieldMappings()
fmSJFLIN.addTable(fcHInvest)
fmSJFLIN.addTable(fcHUse)
keepers = []
keepers = ['WUKey','Shape_Length','Shape_Area','HInvest','HUse']
for field in fmSJFLIN.fields:
    if field.name not in keepers:
        fmSJFLIN.removeFieldMap(fmSJFLIN.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis(fcHInvest, fcHUse, 'WU_HSociety', 'JOIN_ONE_TO_ONE',
'KEEP_ALL', fmSJFLIN, 'CONTAINS')
fcHSociety = arcpy.mapping.Layer(r"WU_HSociety")
logger.info("spatial join HInvest and HUse completed")

## Add HSociety field to Wetland Units and set initial point value to zero.
actions.DeleteField(fcHSociety, 'HSociety')
arcpy.AddField_management(fcHSociety, 'HSociety', 'SHORT')
arcpy.CalculateField_management(fcHSociety, 'HSociety', '0', 'VB', '#')
logger.info("field HSociety added and initial value set to 0")

## Sum the points for HInvest and HUse
arcpy.CalculateField_management(fcHSociety, 'HSociety', '[HInvest] + [HUse]', 'VB', '#')
logger.info("field HSociety calculated")

# Clean up

```

### 5.7.60 Hinvest: Habitat and Ecological Integrity Society

```
#####  
#  
# File Name: HInvest.py  
# Developer: Yibing Han  
# Date: 10/19/2017  
# Purpose:  
#   Input to Habitat / Value to Society  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcHInvest(WetlandPoly):  
    logger = logging.getLogger("WFA.HabEco.HSociety.HInvest")  
  
    # Clean up if needed  
    if arcpy.Exists("WU_HInvest"):  
        arcpy.Delete_management("WU_HInvest")  
  
    # Setting python variables  
    fcLocalPark = arcpy.mapping.Layer(globalvars.srcLocalPark)  
    fcNF = arcpy.mapping.Layer(globalvars.srcNF)
```

```

fcNP = arcpy.mapping.Layer(globalvars.srcNP)
fcNWR = arcpy.mapping.Layer(globalvars.srcNWR)
fcWMA = arcpy.mapping.Layer(globalvars.srcWMA)
fcSP = arcpy.mapping.Layer(globalvars.srcSP)
fcSF = arcpy.mapping.Layer(globalvars.srcSF)
fcBotanicalAreas = arcpy.mapping.Layer(globalvars.srcBotanicalAreas)
fcProtectedLands = arcpy.mapping.Layer(globalvars.srcProtectedLands)
fcNatStrPreAct = arcpy.mapping.Layer(globalvars.srcNatStrPreAct)
fcILF = arcpy.mapping.Layer(globalvars.srcILF)
fcRestoredWetlands = arcpy.mapping.Layer(globalvars.srcRestoredWetlands)
logger.info("feature layers ready")

## STEP 1: Create feature class and add field to store results; set initial value to zero
arcpy.CopyFeatures_management(WetlandPoly,"WU_HInvest","#","0","0","0")
fcHInvest = arcpy.mapping.Layer(r"WU_HInvest")
logger.info("feature class WU_HInvest created")

actions.DeleteField(fcHInvest, "HInvest")
arcpy.AddField_management(fcHInvest, "HInvest", "SHORT")
arcpy.CalculateField_management(fcHInvest,"HInvest","0","VB","#")
logger.info("field HInvest added and initial value set to 0")

## Low investment
## Select wetlands that intersect state or local public lands
arcpy.SelectLayerByLocation_management(fcHInvest, "INTERSECT", fcSP)
arcpy.SelectLayerByLocation_management(fcHInvest, "INTERSECT", fcWMA, "",
"ADD_TO_SELECTION")
arcpy.SelectLayerByLocation_management(fcHInvest, "INTERSECT", fcSF, "",
"ADD_TO_SELECTION")

```

```

    arcpy.SelectLayerByLocation_management(fcHInvest, "INTERSECT", fcLocalPark, "",
"ADD_TO_SELECTION")
    logger.info("wetlands that intersect state or local public lands selected")

    ## Add wetlands that intersect Natural Streams Preservation Act watersheds to selection
    arcpy.SelectLayerByLocation_management(fcHInvest, "INTERSECT", fcNatStrPreAct, "",
"ADD_TO_SELECTION")
    logger.info("wetlands that intersect Natural Streams Preservation Act watersheds added to
selection")

    ## Add wetlands that intersect Department of Defense Lands to selection
    strWHERE = """"OwnName" = 'Department of Defense (DOD)""""
    arcpy.SelectLayerByAttribute_management(fcProtectedLands, "NEW_SELECTION",
strWHERE)
    arcpy.SelectLayerByLocation_management(fcHInvest, "INTERSECT", fcProtectedLands, "",
"ADD_TO_SELECTION")
    logger.info("wetlands that intersect Department of Defense Lands added to selection")

    ## Assign point and clear selections
    arcpy.CalculateField_management(fcHInvest,"HInvest","1","VB","#")
    logger.info("1 point assigned to qualifying wetland units")
    arcpy.SelectLayerByAttribute_management(fcHInvest, "CLEAR_SELECTION")

    ## Moderate investment
    ## Select lands owned by USFS
    strWHERE = """"Ownership" = 'Forest Service""""
    arcpy.SelectLayerByAttribute_management(fcNF, "NEW_SELECTION", strWHERE)
    ## Select wetlands that intersect selected areas
    arcpy.SelectLayerByLocation_management(fcHInvest, "INTERSECT", fcNF)
    logger.info("wetlands that intersect selected National Forests added to selection")

```



```

## Assign points and clear selections
arcpy.CalculateField_management(fcHInvest,"HInvest","2","VB","#")
logger.info("2 points assigned to qualifying wetland units")
arcpy.SelectLayerByAttribute_management(fcHInvest, "CLEAR_SELECTION")

## High investment
## Select Private Conservation Lands with Gap Status = 1 and USFS Wilderness Areas
strWHERE = """"("Mang_Name" IN ('EWPP-FPE', 'WRP', 'CLRLT', 'Potomac Conservancy',
'The Nature Conservancy (TNC)', 'WVLT', 'Forest Legacy') OR "GAP_Sts" = '1' OR "PdesTp"
= 'Wilderness Area') AND ("PdesTp" <> 'Wild and Scenic River' AND "PdesTp" <> 'National
Wildlife Refuge')""""
arcpy.SelectLayerByAttribute_management(fcProtectedLands, "NEW_SELECTION",
strWHERE)
## Select wetlands that intersect selected areas
arcpy.SelectLayerByLocation_management(fcHInvest, "INTERSECT", fcProtectedLands)
logger.info("wetlands that intersect selected Private Conservation Lands added to selection")

## Add to Selection wetlands that intersect National Wildlife Refuges or National Parks
arcpy.SelectLayerByLocation_management(fcHInvest, "INTERSECT", fcNWR, "",
"ADD_TO_SELECTION")
arcpy.SelectLayerByLocation_management(fcHInvest, "INTERSECT", fcNP, "",
"ADD_TO_SELECTION")
logger.info("wetlands that intersect National Parks and Wildlife Refuges added to selection")

## Add to Selection wetlands that intersect special botanical areas
arcpy.SelectLayerByLocation_management(fcHInvest, "INTERSECT", fcBotanicalAreas, "",
"ADD_TO_SELECTION")
logger.info("wetlands that intersect special botanical areas added to selection")

## Add to Selection wetlands that intersect Mitigation Banks and In-Lieu Fee sites
arcpy.SelectLayerByLocation_management(fcHInvest, "WITHIN_A_DISTANCE", fcILF,
"100 Meters", "ADD_TO_SELECTION")

```

```

logger.info("wetlands that intersect Mitigation Banks and In-Lieu Fee sites added to
selection")

## Add to Selection wetlands that intersect other restored, enhanced or created wetland sites
arcpy.SelectLayerByLocation_management(fcHInvest, "INTERSECT", fcRestoredWetlands,
"", "ADD_TO_SELECTION")

logger.info("wetlands that intersect other restored, enhanced or created wetland sites added to
selection")

## Add to Selection wetlands in WVDNR State Natural Areas
strWHERE = """"Unit_Nm" IN ('Canaan Valley Resort State Park', 'Cathedral State Park',
'Beartown State Park')""""
arcpy.SelectLayerByAttribute_management(fcSP, "NEW_SELECTION", strWHERE)
## Select wetlands that intersect selected areas
arcpy.SelectLayerByLocation_management(fcHInvest, "INTERSECT", fcSP, "",
"ADD_TO_SELECTION")
logger.info("wetlands in WVDNR State Natural Areas added to selection")

## Assign points and clear selections
arcpy.CalculateField_management(fcHInvest, "HInvest", "3", "VB", "#")
logger.info("3 points assigned to qualifying wetland units")
arcpy.SelectLayerByAttribute_management(fcHInvest, "CLEAR_SELECTION")
arcpy.SelectLayerByAttribute_management(fcNF, "CLEAR_SELECTION")
arcpy.SelectLayerByAttribute_management(fcProtectedLands, "CLEAR_SELECTION")

# Clean up

```

### 5.7.61 HUse: Habitat and Ecological Integrity Society

```
#####  
#  
# File Name: HUse.py  
# Developer: Yibing Han  
# Date: 10/18/2017  
# Purpose:  
#  Habitat Function / Value to Society  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcHUse():  
    logger = logging.getLogger("WFA.HabEco.HSociety.HUse")  
  
    # Setting python variables  
    fcOwnerAccess = arcpy.mapping.Layer(r"WU_OwnerAccess")  
    fcPublicUse = arcpy.mapping.Layer(r"WU_PublicUse")  
    logger.info("feature layers ready")  
  
    # Clean up if needed  
    if arcpy.Exists('WU_HUse'):
```

```

arcpy.Delete_management('WU_HUse')

## Spatial join to merge WshdPos and AquaAbund into one attribute table
fmSJFLIN = arcpy.FieldMappings()
fmSJFLIN.addTable(fcOwnerAccess)
fmSJFLIN.addTable(fcPublicUse)
keepers = []
keepers = ['WUKey','Shape_Length','Shape_Area','OwnerAccess','PublicUse']
for field in fmSJFLIN.fields:
    if field.name not in keepers:
        fmSJFLIN.removeFieldMap(fmSJFLIN.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis(fcOwnerAccess, fcPublicUse, 'WU_HUse',
'JOIN_ONE_TO_ONE', 'KEEP_ALL', fmSJFLIN, 'CONTAINS')
fcHUse = arcpy.mapping.Layer(r"WU_HUse")
logger.info("spatial join PublicUse and OwnerAccess completed")

## Add HUse field to Wetland Units and set initial point value to zero.
actions.DeleteField(fcHUse, 'HUse')
arcpy.AddField_management(fcHUse, 'HUse', 'SHORT')
arcpy.CalculateField_management(fcHUse, 'HUse', '0', 'VB', '#')
logger.info("field HUse added and initial value set to 0")

## Sum the points for OwnerAccess and PublicUse
arcpy.CalculateField_management(fcHUse, 'HUse', '[OwnerAccess] + [PublicUse]', 'VB', '#')
logger.info("field HUse calculated")

# Clean up

```

### 5.7.62 OwnerAccess: Habitat and Ecological Integrity Society

```
#####  
#  
# File Name: OwnerAccess.py  
# Developer: Yibing Han  
# Date: 10/17/2017  
# Purpose:  
#   Input to Habitat / Value to Society / HUse  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcOwnerAccess(WetlandPoly):  
    logger = logging.getLogger("WFA.HabEco.HSociety.OwnerAccess")  
  
    # Clean up if needed  
    if arcpy.Exists("WU_OwnerAccess"):  
        arcpy.Delete_management("WU_OwnerAccess")  
  
    # Setting python variables  
    fcLocalPark = arcpy.mapping.Layer(globalvars.srcLocalPark)  
    fcNF = arcpy.mapping.Layer(globalvars.srcNF)
```

```
fcNP = arcpy.mapping.Layer(globalvars.srcNP)
fcNWR = arcpy.mapping.Layer(globalvars.srcNWR)
fcDNRLands = arcpy.mapping.Layer(globalvars.srcWMA)
fcSP = arcpy.mapping.Layer(globalvars.srcSP)
fcSF = arcpy.mapping.Layer(globalvars.srcSF)
fcProtectedLands = arcpy.mapping.Layer(globalvars.srcProtectedLands)
fcILF = arcpy.mapping.Layer(globalvars.srcILF)
fcInfrastructure = arcpy.mapping.Layer(globalvars.srcInfrastructure)
logger.info("feature layers ready")
```

```
## STEP 1: Create feature class and add field to store results; set initial value to zero
arcpy.CopyFeatures_management(WetlandPoly,"WU_OwnerAccess", "#", "0", "0", "0")
fcOwnerAccess = arcpy.mapping.Layer(r"WU_OwnerAccess")
logger.info("feature class WU_OwnerAccess created")
```

```
actions.DeleteField(fcOwnerAccess, "OwnerAccess")
arcpy.AddField_management(fcOwnerAccess, "OwnerAccess", "SHORT")
arcpy.CalculateField_management(fcOwnerAccess,"OwnerAccess","0","VB","#")
logger.info("field OwnerAccess added and initial value set to 0")
```

```
## STEP 2: Private lands with seasonal, partial, or case-by-case public access
## Select wetlands that intersect partial-access Protected Lands
strWHERE = """"P_Des_Nm" IN ('Harewood (Washington)', 'Ice Mountain (Riverbirch
Inc.)', 'Upper Shavers Fork')""""
arcpy.SelectLayerByAttribute_management(fcProtectedLands, "NEW_SELECTION",
strWHERE)

arcpy.SelectLayerByLocation_management(fcOwnerAccess, "INTERSECT",
fcProtectedLands)

logger.info("wetlands that intersect partial-access Protected Lands selected")
```

```
## Add wetlands that intersect InfrastructureWetlands, all of which have at least partial access
```

```
arcpy.SelectLayerByLocation_management(fcOwnerAccess, "INTERSECT", fcInfrastructure, "", "ADD_TO_SELECTION")
```

```
logger.info("wetlands that intersect InfrastructureWetlands added")
```

```
## Add wetlands that intersect partial-access RIBITS and ILF sites
```

```
## strWHERE = """"Project_Name" = 'Tygart Valley'""""
```

```
## arcpy.SelectLayerByAttribute_management(fcILF, "NEW_SELECTION", strWHERE)
```

```
## arcpy.SelectLayerByLocation_management(fcOwnerAccess, "WITHIN_A_DISTANCE", fcILF, "100 Meters", "ADD_TO_SELECTION")
```

```
## logger.info("wetlands that intersect partial-access RIBITS and ILF sites added")
```

```
## Assign point and clear selections
```

```
arcpy.CalculateField_management(fcOwnerAccess, "OwnerAccess", "1", "VB", "#")
```

```
logger.info("1 point assigned to qualifying wetland units")
```

```
arcpy.SelectLayerByAttribute_management(fcOwnerAccess, "CLEAR_SELECTION")
```

```
## STEP 3: Public Ownership
```

```
## Select wetlands that intersect state or local public lands
```

```
arcpy.SelectLayerByLocation_management(fcOwnerAccess, "INTERSECT", fcSP)
```

```
arcpy.SelectLayerByLocation_management(fcOwnerAccess, "INTERSECT", fcDNRLands, "", "ADD_TO_SELECTION")
```

```
arcpy.SelectLayerByLocation_management(fcOwnerAccess, "INTERSECT", fcSF, "", "ADD_TO_SELECTION")
```

```
arcpy.SelectLayerByLocation_management(fcOwnerAccess, "INTERSECT", fcLocalPark, "", "ADD_TO_SELECTION")
```

```
logger.info("wetlands that intersect state or local public lands selected")
```

```
## Add National Parks and Wildlife Refuges to selection
arcpy.SelectLayerByLocation_management(fcOwnerAccess, "INTERSECT", fcNP, "",
"ADD_TO_SELECTION")
arcpy.SelectLayerByLocation_management(fcOwnerAccess, "INTERSECT", fcNWR, "",
"ADD_TO_SELECTION")
logger.info("wetlands that intersect National Parks and Wildlife Refuges added to selection")
```

```
## Add U.S. Army Corps of Engineers lands to selection
strWHERE = """"Mang_Name" = 'US Army Corps of Engineers'""""
arcpy.SelectLayerByAttribute_management(fcProtectedLands, "NEW_SELECTION",
strWHERE)
arcpy.SelectLayerByLocation_management(fcOwnerAccess, "INTERSECT",
fcProtectedLands, "", "ADD_TO_SELECTION")
logger.info("wetlands that intersect U.S. Army Corps of Engineers lands added to selection")
```

```
## Add National Forests to selection
strWHERE = """"Ownership" = 'Forest Service'""""
arcpy.SelectLayerByAttribute_management(fcNF, "NEW_SELECTION", strWHERE)
arcpy.SelectLayerByLocation_management(fcOwnerAccess, "INTERSECT", fcNF, "",
"ADD_TO_SELECTION")
logger.info("wetlands that intersect National Forests added to selection")
```

```
## Assign points and clear selections
arcpy.CalculateField_management(fcOwnerAccess, "OwnerAccess", "2", "VB", "#")
logger.info("2 points assigned to qualifying wetland units")
arcpy.SelectLayerByAttribute_management(fcOwnerAccess, "CLEAR_SELECTION")
```

```
## STEP 4: Select private lands with permanent public access
strWHERE = """"P_Des_Nm" IN ('Brush Creek (McPherson/Robertson)', 'Bear Rocks Lake
Wildlife Management Area', 'Brooklyn Heights (Hills)', 'Cranesville Swamp Preserve', 'Eidolon
Nature Preserve', 'Greenland Gap (Amendment)(Greenland Lodge Inc)', 'Hungry Beech',
'Murphy Preserve', 'Pike Knob', 'Pike Knob (Smith)', 'Slaty Mountain (Westvaco)', 'Yankauer
```



```
Nature Preserve', 'Canaan Valley/Dolly Sods (Moshein)', 'Core Arboretum' ) OR "Comments" = 'Stauffer's Marsh (PVAS)''''''
```

```
arcpy.SelectLayerByAttribute_management(fcProtectedLands, "NEW_SELECTION", strWHERE)
```

```
logger.info("private lands with permanent public access selected")
```

```
## Select wetlands that intersect selected areas
```

```
arcpy.SelectLayerByLocation_management(fcOwnerAccess, "INTERSECT", fcProtectedLands)
```

```
## Select open-access wetlands from the InfrastructureWetlands feature class
```

```
strWHERE = """"Access" = 'public'""""
```

```
arcpy.SelectLayerByAttribute_management(fcInfrastructure, "NEW_SELECTION", strWHERE)
```

```
logger.info("open-access wetlands selected")
```

```
## Select wetlands that intersect selected areas
```

```
arcpy.SelectLayerByLocation_management(fcOwnerAccess, "INTERSECT", fcInfrastructure, "", "ADD_TO_SELECTION")
```

```
logger.info("wetlands that intersect selected areas added to selection")
```

```
## Assign point and clear selections
```

```
arcpy.CalculateField_management(fcOwnerAccess, "OwnerAccess", "2", "VB", "#")
```

```
logger.info("2 points assigned to qualifying wetland units")
```

```
arcpy.SelectLayerByAttribute_management(fcOwnerAccess, "CLEAR_SELECTION")
```

```
arcpy.SelectLayerByAttribute_management(fcProtectedLands, "CLEAR_SELECTION")
```

```
arcpy.SelectLayerByAttribute_management(fcILF, "CLEAR_SELECTION")
```

```
arcpy.SelectLayerByAttribute_management(fcNF, "CLEAR_SELECTION")
```

```
arcpy.SelectLayerByAttribute_management(fcInfrastructure, "CLEAR_SELECTION")
```

```
# Clean up
```

### 5.7.63 PublicUse: Habitat and Ecological Integrity Society

```
#####  
#  
# File Name: PublicUse.py  
# Developer: Yibing Han  
# Date: 10/17/2017  
# Purpose:  
#   Input to Habitat / Value to Society / HUse  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcPublicUse(WetlandPoly):  
    logger = logging.getLogger("WFA.HabEco.HSociety.PublicUse")  
  
    # Clean up if needed  
    if arcpy.Exists("WU_PublicUse"):  
        arcpy.Delete_management("WU_PublicUse")  
  
    # Setting python variables  
    fcLocalPark = arcpy.mapping.Layer(globalvars.srcLocalPark)  
    fcNWR = arcpy.mapping.Layer(globalvars.srcNWR)
```

```

fcWMA = arcpy.mapping.Layer(globalvars.srcWMA)
fcSP = arcpy.mapping.Layer(globalvars.srcSP)
fcFishAccess = arcpy.mapping.Layer(globalvars.srcFishAccess)
fcBotanicalAreas = arcpy.mapping.Layer(globalvars.srcBotanicalAreas)
fcPropertyBoundary = arcpy.mapping.Layer(globalvars.srcPropertyBoundary)
fcEBird = arcpy.mapping.Layer(globalvars.srcEBird)
fcTrails = arcpy.mapping.Layer(globalvars.srcTrails)
fcExemp_Branked = arcpy.mapping.Layer(globalvars.srcExempBranked)
fcInfrastructure = arcpy.mapping.Layer(globalvars.srcInfrastructure)
logger.info("feature layers ready")

## STEP 1: Create feature class and add field to store results; set initial value to zero
arcpy.CopyFeatures_management(WetlandPoly,"WU_PublicUse", "#", "0", "0", "0")
fcPublicUse = arcpy.mapping.Layer(r"WU_PublicUse")
logger.info("feature class WU_PublicUse created")

actions.DeleteField(fcPublicUse, "PublicUse")
arcpy.AddField_management(fcPublicUse, "PublicUse", "SHORT")
arcpy.CalculateField_management(fcPublicUse,"PublicUse", "0", "VB", "#")
logger.info("field PublicUse added and initial value set to 0")

## STEP 2: Moderate public use
## Select WMAs and State Forests identified as hunting/trapping areas for wetland species
strWHERE = """"hWaterfowl" = 1 OR "hGrouse" = 1 OR "hWoodcock" = 1 OR "tBeaver"
= 1 OR "tMink" = 1 OR "tMuskrat" = 1 OR "hDeer" = 1 OR "hBear" = 1 OR "hRabbit" = 1
OR "tBobcat" = 1 OR "tCoyote" = 1 OR "tRedFox" = 1 OR "tRaccoon" = 1 OR "tOpossum"
= 1""""
arcpy.SelectLayerByAttribute_management(fcPropertyBoundary, "NEW_SELECTION",
strWHERE)

```

```

    arcpy.SelectLayerByLocation_management(fcPublicUse, "INTERSECT",
fcPropertyBoundary)

    logger.info("WMAs and State Forests identified as hunting/trapping areas for wetland species
selected")

## Assign point and clear selections
arcpy.CalculateField_management(fcPublicUse,"PublicUse","1","VB","#")
logger.info("1 point assigned to qualifying wetland units")
arcpy.SelectLayerByAttribute_management(fcPublicUse, "CLEAR_SELECTION")

## STEP 3: High public use
## Select wetlands within 10 m of a mapped trail or a public fishing access point
arcpy.SelectLayerByLocation_management(fcPublicUse, "WITHIN_A_DISTANCE",
fcTrails, "10 Meters", "NEW_SELECTION")
arcpy.SelectLayerByLocation_management(fcPublicUse, "WITHIN_A_DISTANCE",
fcFishAccess, "10 Meters", "ADD_TO_SELECTION")

    logger.info("wetlands within 10 m of a mapped trail or a public fishing access point
selected")

## Add to Selection wetlands in National Wildlife Refuges
arcpy.SelectLayerByLocation_management(fcPublicUse, "INTERSECT", fcNWR, "",
"ADD_TO_SELECTION")
    logger.info("wetlands that intersect National Parks and Wildlife Refuges added to selection")

## Add to Selection wetlands in special botanical areas supporting long-term research
arcpy.SelectLayerByLocation_management(fcPublicUse, "INTERSECT", fcBotanicalAreas,
"", "ADD_TO_SELECTION")
    logger.info("wetlands in special botanical areas supporting long-term research added to
selection")

## Add to Selection wetlands in certain state parks

```

```
strWHERE = """"Unit_Nm" IN ('Blackwater Falls State Park', 'Canaan Valley Resort State Park', 'Cathedral State Park')"""
```

```
arcpy.SelectLayerByAttribute_management(fcSP, "NEW_SELECTION", strWHERE)
```

```
arcpy.SelectLayerByLocation_management(fcPublicUse, "INTERSECT", fcSP, "", "ADD_TO_SELECTION")
```

```
logger.info("wetlands in certain state parks added to selection")
```

```
## Add to Selection wetlands in certain local parks
```

```
strWHERE = """"Unit_Nm" IN ('WV Botanic Garden', 'Meadowood Park', 'McDonough Wildlife Refuge ', 'Johnson T. Janes Nature Preserve and Conservation Park')"""
```

```
arcpy.SelectLayerByAttribute_management(fcLocalPark, "NEW_SELECTION", strWHERE)
```

```
arcpy.SelectLayerByLocation_management(fcPublicUse, "INTERSECT", fcLocalPark, "", "ADD_TO_SELECTION")
```

```
logger.info("wetlands in certain local parks added to selection")
```

```
## Add to Selection wetlands in certain WMAs
```

```
strWHERE = """"Unit_Nm" IN ('Fairfax Pond / Rehe Wildlife Management Area', 'Green Bottom Wildlife Management Area', 'Little Canaan Wildlife Management Area', 'McClintic Wildlife Management Area', 'Meadow River Wildlife Management Area', 'Pleasant Creek Wildlife Management Area', 'Short Mountain Wildlife Management Area', 'Valley Bend Wetlands Wildlife Management Area')"""
```

```
arcpy.SelectLayerByAttribute_management(fcWMA, "NEW_SELECTION", strWHERE)
```

```
arcpy.SelectLayerByLocation_management(fcPublicUse, "INTERSECT", fcWMA, "", "ADD_TO_SELECTION")
```

```
logger.info("wetlands in certain WMAs added to selection")
```

```
## Add to Selection certain Exemplary Wetlands not already selected
```

```
strWHERE = """"Name" IN ('Alder Run Bog', 'Altona-Piedmont Marsh', 'Bear Rocks Bog',  
'Cranesville Swamp', 'Harewood Marsh', 'Spruce Knob Lake inlet', 'Spruce Knob Lake outlet',  
'Winfield Swamp')"""
```

```
arcpy.SelectLayerByAttribute_management(fcExemp_Branked, "NEW_SELECTION",  
strWHERE)
```

```
arcpy.SelectLayerByLocation_management(fcPublicUse, "INTERSECT",  
fcExemp_Branked, "", "ADD_TO_SELECTION")
```

```
logger.info("wetlands in certain WMAs added to selection")
```

```
## Add to Selection wetlands from the InfrastructureWetlands feature class
```

```
arcpy.SelectLayerByLocation_management(fcPublicUse, "INTERSECT", fcInfrastructure,  
"", "ADD_TO_SELECTION")
```

```
logger.info("wetlands in certain Infrastructure Wetlands added to selection")
```

```
## Add to Selection wetlands within 100 meters of an eBird birding hotspot
```

```
arcpy.SelectLayerByLocation_management(fcPublicUse, "WITHIN_A_DISTANCE",  
fcEBird, "100 Meters", "ADD_TO_SELECTION")
```

```
logger.info("wetlands within 100 meters of an eBird birding hotspot added to selection")
```

```
## Assign points and clear selections
```

```
arcpy.CalculateField_management(fcPublicUse, "PublicUse", "2", "VB", "#")
```

```
logger.info("2 points assigned to qualifying wetland units")
```

```
arcpy.SelectLayerByAttribute_management(fcPublicUse, "CLEAR_SELECTION")
```

```
arcpy.SelectLayerByAttribute_management(fcPropertyBoundary, "CLEAR_SELECTION")
```

```
arcpy.SelectLayerByAttribute_management(fcSP, "CLEAR_SELECTION")
```

```
arcpy.SelectLayerByAttribute_management(fcLocalPark, "CLEAR_SELECTION")
```

```
arcpy.SelectLayerByAttribute_management(fcWMA, "CLEAR_SELECTION")
```

```
arcpy.SelectLayerByAttribute_management(fcExemp_Branked, "CLEAR_SELECTION")
```

```
# Clean up
```

### 5.7.64 Actions: Utilities

```
#####  
#  
# File Name: actions.py  
# Developer: Chad Ashworth  
# Date 7/8/2015  
# Purpose:  
#     This script is a module that contains functions that perform  
#     actions against python object (delete/update/etc)  
#  
#####  
#!/usr/bin/python  
import arcpy, sys  
import sqlite3 as lite  
  
def CreateGeoDB(gdbName):  
    strFullPath = ""  
    #strWorkspace = GetGISData("Workspace")  
    strWorkspace =  
    "M:\\wr\\WTRSHD_BRANCH_INTERNAL\\WETLAND\\WetlandFunctionResults\\test"  
    arcpy.CreateFileGDB_management(strWorkspace, gdbName)  
  
    strFullPath = strWorkspace + "\\\" + gdbName  
    return strFullPath  
    ""  
  
def GetGISData(lyrName):  
    con = None  
    data = ""  
    strLayerLoc = ""
```

```

try:
    con = lite.connect(r"db\wetlandFA.db")
    cur = con.cursor()
    strSelect = "select d_location from dataSource where d_name = " + lyrName + ""
    cur.execute(strSelect)
    data = cur.fetchone()
    strLayerLoc = data[0]

except lite.Error, e:

    print "Error %s:" % e.args[0]
    sys.exit(1)

finally:

    if con:
        con.close()
    return str(strLayerLoc)

def CheckFieldExists(table,field):
    lstFields = arcpy.ListFields(table,field)
    fieldCount = len(lstFields)
    if fieldCount == 1:
        retVal = True
    elif fieldCount == 0:
        retVal = False

    return retVal

```



```

def DeleteField(table,field):
retVal = ""
blnFieldFind = CheckFieldExists(table,field)

#commented out screen prints so code will work with ArcMap Toolbox code
#if blnFieldFind == True:
#    retVal = raw_input("\nThe " + str(field) + " field in the " + str(table) + " table already
exists.\nDo you wish to delete the field(Y/N): ")

if retVal.upper() == "Y":
    blnFieldFind = False
elif retVal.upper() == "N":
    #print "field " + str(field) + " did not exist"
    exit()

if blnFieldFind == True:
    arcpy.DeleteField_management(table, field)

def UpdateTable(table,fields,ufield,value,where):
with arcpy.da.UpdateCursor(table,fields,where) as cUT:
    for rUT in cUT:
        rUT[ufield] = value
        cUT.updateRow(rUT)

```

### 5.7.65 ActiveRiverArea: Utilities

```
#####  
#  
# File Name: ActiveRiverArea.py  
# Developer: Chad Ashworth  
# Date 5/1/2015  
# Purpose:  
#     This script determines if a wetland polygon is in an active river area.  
#  
#####  
#!/usr/bin/python  
import arcpy  
from utilities import actions  
  
def WetlandInARA(WetlandPoly):  
# setting the work environment  
arcpy.CheckOutExtension("Spatial")  
lyrARA =  
arcpy.mapping.Layer("M:\\wr\\WTRSHD_BRANCH_INTERNAL\\WETLAND\\ActiveRiver  
Area_gdb\\ActiveRiverArea.gdb\\ara_wv_514")  
strARA_WV_514_NMC_POLY_SHP =  
"M:\\wr\\WTRSHD_BRANCH_INTERNAL\\WETLAND\\" + str(WetlandPoly) +  
"_ARA_TEMP.shp"  
  
#clean up if needed  
strRefDelLyr = str(WetlandPoly) + "_DevLyr"  
if arcpy.Exists(strRefDelLyr):  
    arcpy.Delete_management(strRefDelLyr)  
strRefARA = str(WetlandPoly) + "_ARA"  
if arcpy.Exists(strRefARA):  
    arcpy.Delete_management(strRefARA)
```

```

strRefWetIsecARA = str(WetlandPoly) + "_WetIsecARA"
if arcpy.Exists(strRefWetIsecARA):
    arcpy.Delete_management(strRefWetIsecARA)
if arcpy.Exists(strARA_WV_514_NMC_POLY_SHP):
    arcpy.Delete_management(strARA_WV_514_NMC_POLY_SHP)

# adding/deleting the Floodplain_FEMA
actions.DeleteField(WetlandPoly,"Floodplain_ARA")
arcpy.AddField_management(WetlandPoly, "Floodplain_ARA", "TEXT",1)

#####
#####

# 1.
sql = "DESC_SHORT NOT LIKE 'Material Contribution Zone%'"
outExtractByAtrb = arcpy.sa.ExtractByAttributes(lyrARA,sql)
outExtractByAtrb.save(strRefARA)

# 2.
arcpy.RasterToPolygon_conversion(strRefARA, strARA_WV_514_NMC_POLY_SHP,
"NO_SIMPLIFY")

# 3.
arcpy.Intersect_analysis([[WetlandPoly], strARA_WV_514_NMC_POLY_SHP],
strRefWetIsecARA,"ALL")

arcpy.MakeFeatureLayer_management(strRefWetIsecARA, strRefDelLyr)
strWetlandPolyPK = "FID_" + str(WetlandPoly) # dynamically createing the foreign key field
to the WetlandPoly
arcpy.AddJoin_management(strRefDelLyr, strWetlandPolyPK, str(WetlandPoly),
"OBJECTID") # join to WetlandPoly

```

```

#arcpy.CopyFeatures_management(strRefDelLyr, strRefDelLyr)

# declaring what fields i need to calculate the percent intersect
## EDIT TO DYNAMICALLY CREATE FIELD NAMES
strWetlandId = str(WetlandPoly) + ".OBJECTID"
strWetlandShapeArea = str(WetlandPoly) + ".Shape_Area"
strWetlandFlARA = str(WetlandPoly) + ".Floodplain_ARA"
fldsDL = [strWetlandId,strRefWetIsecARA +
".Shape_Area",strWetlandShapeArea,strWetlandFlARA]

#####
#####

#arcpy.CopyFeatures_management("development_layer", "development_layer")

edit = arcpy.da.Editor(arcpy.env.workspace)
edit.startEditing(False, True)
edit.startOperation()

# updating the UA field with a Y if 10% or more are in an urban area
with arcpy.da.SearchCursor(strRefDelLyr, fldsDL) as curWetlandAll:
    for rWetlandAll in curWetlandAll:
        intPercentIntersect = int(rWetlandAll[1]/rWetlandAll[2]*100)
        if intPercentIntersect >= 10:
            strWhere = "OBJECTID = " + str(rWetlandAll[0])
            actions.UpdateTable(WetlandPoly,["Floodplain_ARA"],0,"Y",strWhere)

# updating the rest of the fields to N
strWhere = "Floodplain_ARA is null"
actions.UpdateTable(WetlandPoly,["Floodplain_ARA"],0,"N",strWhere)

```

```
#####
```

```
# ADD CODE TO SELECT NOTHING
```

```
#####
```

```
edit.stopEditing(True)
```

```
arcpy.Delete_management(strRefWetIsecARA)
```

```
arcpy.Delete_management(strRefDelLyr)
```

```
arcpy.Delete_management(strRefARA)
```

### 5.7.66 AllResults: Utilities

```
#####  
#  
# File Name: AllResults.py  
# Developer: Yibing Han  
# Date: 02/25/2018  
# Purpose:  
# This script calculates the total assessment scores of wetland units  
#  
#  
#####  
#!/usr/bin/python  
import logging  
import datetime  
import arcpy  
import actions  
from globalvars import globalvars  
  
def CalcAllResults(WetlandPoly):  
    logger = logging.getLogger("WFA.AllResults")  
  
    # Setting python variables  
    arcpy.MakeFeatureLayer_management(WetlandPoly, "fcWU")  
    arcpy.MakeFeatureLayer_management(r"WU_Function", "fcWUFunction")  
    arcpy.MakeFeatureLayer_management(globalvars.srcInput, "fcENWI")  
    logger.info("feature layers ready")  
  
    # Clean up if needed  
    if arcpy.Exists('WU_AllResults1'):
```

```

    arcpy.Delete_management('WU_AllResults1')
if arcpy.Exists('WU_AllResults'):
    arcpy.Delete_management('WU_AllResults')
if arcpy.Exists('AllResultsTable'):
    arcpy.Delete_management('AllResultsTable')

## STEP 1: Add the identifier fields (link to original input polygons) to Wetland units scoring
fields

fmSJAll0 = arcpy.FieldMappings()
fmSJAll0.addTable("fcENWI")
fmSJAll0.addTable("fcWU")
keepers = []
keepers = ['SiteCode','WetlandName','SurveyDate',"WUKey"]
for field in fmSJAll0.fields:
    if field.name not in keepers:
        fmSJAll0.removeFieldMap(fmSJAll0.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis("fcWU","fcENWI","WU_AllResults1","JOIN_ONE_TO_ONE","KEEP_ALL",fmSJAll0,"INTERSECT")

arcpy.MakeFeatureLayer_management("WU_AllResults1","fcWUAllResults1")
logger.info("identifier fields joined to WU_Function")

## STEP 2: Add the scoring fields
# Make Query Table to join all scoring fields
#fc_not_needed = [WetlandPoly,
"Buffer10m","Buffer1km","Buffer300m","Buffer50m","DrainageArea", "WU_BRank",
"WU_FAFunction", "WU_FAOpportun", "WU_FAPotential", "WU_FASociety",
"WU_Function", "WU_HFunction", "WU_HFunctionNoBR", "WU_HOpportun",
"WU_HPotential", "WU_HSociety", "WU_WQFunction", "WU_WQOpportun",
"WU_WQPotential", "WU_WQSociety", "WUPoint"];

#arcpy.MakeQueryTable_management(in_table="WU_AllResults1;WU_AquaAbund;WU_Con

```

nect;WU\_ClayOrganic;WU\_Clay;WU\_ChemTime;WU\_BufferPerim;WU\_BufferLand;WU\_B  
 RankHUC;WU\_BufferContig;WU\_ConsFocus;WU\_Depressions;WU\_Discharges;WU\_Disturb  
 50m;WU\_DisturbWshd;WU\_EconRisk;WU\_Fisheries;WU\_FloodArea;WU\_FloodIn;WU\_Flo  
 dway;WU\_Headwater;WU\_HInvest;WU\_Histosol;WU\_HUC12WQ;WU\_HUse;WU\_HydroH;  
 WU\_ImpairedIn;WU\_ImpairedOut;WU\_IrrEdge;WU\_Karst;WU\_LandEco;WU\_LandHydro;W  
 U\_LandInteg;WU\_LandPos;WU\_LowSlope;WU\_MarlPEM;WU\_Microtopo;WU\_Organic;WU  
 \_OwnerAccess;WU\_PublicUse;WU\_RoadRail;WU\_Runoff;WU\_Runoff50m;WU\_RunoffWsh  
 d;WU\_SeasonPond;WU\_SLOPE;WU\_SlopeWshd;WU\_SoilH;WU\_SoilOrgCalc;WU\_StreamE  
 dge;WU\_StrucPatch;WU\_SWOutflow;WU\_VegAll;WU\_VegByLP;WU\_VegFA;WU\_VegFQ;  
 WU\_VegH;WU\_VegPerUng;WU\_VegVerStr;WU\_VegWoody;WU\_VegWQ;WU\_WaterSuppl  
 y;WU\_WetlandBird;WU\_WflowPath;WU\_WQPlan;WU\_WQUse;WU\_WshdPos;WU\_WshdU  
 niq", out\_table="AllResultsTable", in\_key\_field\_option="NO\_KEY\_FIELD", in\_key\_field="",  
 in\_field="WU\_AllResults1.WetlandName #;WU\_AllResults1.SurveyDate  
 #;WU\_AllResults1.WUKey #;WU\_AquaAbund.AquaAbund #;WU\_Connect.ConnectFL  
 #;WU\_ClayOrganic.ClayOrganic #;WU\_Clay.Clay #;WU\_ChemTime.ChemTime  
 #;WU\_BufferPerim.BufferPerim #;WU\_BufferLand.BufferLand  
 #;WU\_BRankHUC.BRankHUC #;WU\_BufferContig.BufferContig  
 #;WU\_ConsFocus.ConsFocus #;WU\_Depressions.Depressions #;WU\_Discharges.Discharges  
 #;WU\_Disturb50m.Disturb50m #;WU\_Disturb50m.SoilIntact  
 #;WU\_DisturbWshd.DisturbWshd #;WU\_EconRisk.EconRisk #;WU\_Fisheries.Fisheries  
 #;WU\_FloodArea.FloodArea #;WU\_FloodArea.Floodplain #;WU\_FloodIn.FloodIn  
 #;WU\_Floodway.Floodway #;WU\_Headwater.Headwater #;WU\_HInvest.HInvest  
 #;WU\_Histosol.Histosol #;WU\_HUC12WQ.HUC12WQ #;WU\_HUse.HUse  
 #;WU\_HydroH.HydIntact #;WU\_HydroH.HydSW #;WU\_HydroH.HydroH  
 #;WU\_ImpairedIn.ImpairedIn #;WU\_ImpairedOut.ImpairedOut #;WU\_IrrEdge.IrrEdge  
 #;WU\_Karst.Karst #;WU\_LandEco.LandEco #;WU\_LandHydro.LandHydro  
 #;WU\_LandInteg.LandResil #;WU\_LandInteg.LandInteg #;WU\_LandPos.LandPos  
 #;WU\_LowSlope.LowSlope #;WU\_MarlPEM.MarlPEM #;WU\_Microtopo.Microtopo  
 #;WU\_Microtopo.VegHorInt #;WU\_Organic.Organic #;WU\_OwnerAccess.OwnerAccess  
 #;WU\_PublicUse.PublicUse #;WU\_RoadRail.RoadRail #;WU\_Runoff.Runoff  
 #;WU\_Runoff50m.Runoff50m #;WU\_RunoffWshd.RunoffWshd  
 #;WU\_SeasonPond.SeaPondRatio #;WU\_SeasonPond.SeasonPond #;WU\_SLOPE.SLOPE  
 #;WU\_SlopeWshd.SlopeWshd #;WU\_SoilH.SoilH #;WU\_SoilOrgCalc.SoilOrgCalc  
 #;WU\_StreamEdge.StreamEdge #;WU\_StrucPatch.StrucPatch #;WU\_SWOutflow.SWOutflow  
 #;WU\_SWOutflow.SWOutflow2 #;WU\_VegAll.VegAll #;WU\_VegByLP.VegByLP  
 #;WU\_VegFA.VegFA #;WU\_VegFQ.Dist50mFQ #;WU\_VegFQ.VegFQ #;WU\_VegH.VegH  
 #;WU\_VegPerUng.VegPerUng #;WU\_VegPerUng.VegPerUng4  
 #;WU\_VegPerUng.VegPerUng1 #;WU\_VegVerStr.VegVerStr #;WU\_VegWoody.VegWoody  
 #;WU\_VegWoody.VegWoody4 #;WU\_VegWoody.VegWoodyFor #;WU\_VegWQ.VegWQ  
 #;WU\_WaterSupply.WaterSupply #;WU\_WetlandBird.WetldBird  
 #;WU\_WflowPath.WFlowPath #;WU\_WQPlan.WQPlan #;WU\_WQUse.WQUse



```

#;WU_WshdPos.WshdPos #;WU_WshdUniq.WshdUniq #",
where_clause="WU_AllResults1.WUKey =
WU_AquaAbund.WU_AquaAbund2_WU_AquaAbund1_WUKey AND
WU_AllResults1.WUKey = WU_BRankHUC.WUKey AND WU_AllResults1.WUKey =
WU_BufferContig.WUKey AND WU_AllResults1.WUKey = WU_BufferLand.WUKey AND
WU_AllResults1.WUKey = WU_BufferPerim.WUKey AND WU_AllResults1.WUKey =
WU_ChemTime.WUKey AND WU_AllResults1.WUKey = WU_Clay.WUKey AND
WU_AllResults1.WUKey = WU_ClayOrganic.WUKey AND WU_AllResults1.WUKey =
WU_Connect.WUKey AND WU_AllResults1.WUKey = WU_ConsFocus.WUKey AND
WU_AllResults1.WUKey = WU_EconRisk.WUKey AND WU_AllResults1.WUKey =
WU_DisturbWshd.WU_DisturbWshd1_WUKey AND WU_AllResults1.WUKey =
WU_Discharges.WUKey AND WU_AllResults1.WUKey =
WU_Disturb50m.WU_Disturb50m1_WUKey AND WU_AllResults1.WUKey =
WU_Depressions.WUKey AND WU_AllResults1.WUKey = WU_Fisheries.WUKey AND
WU_AllResults1.WUKey = WU_FloodArea.WUKey AND WU_AllResults1.WUKey =
WU_FloodIn.WUKey AND WU_AllResults1.WUKey = WU_Floodway.WUKey AND
WU_AllResults1.WUKey = WU_Headwater.WUKey AND WU_AllResults1.WUKey =
WU_HInvest.WUKey AND WU_AllResults1.WUKey = WU_Histosol.WUKey AND
WU_AllResults1.WUKey = WU_HUC12WQ.WUKey AND WU_AllResults1.WUKey =
WU_HUse.WUKey AND WU_AllResults1.WUKey = WU_HydroH.WUKey AND
WU_AllResults1.WUKey = WU_ImpairedIn.WUKey AND WU_AllResults1.WUKey =
WU_ImpairedOut.WUKey AND WU_AllResults1.WUKey = WU_IrrEdge.WUKey AND
WU_AllResults1.WUKey = WU_Karst.WUKey AND WU_AllResults1.WUKey =
WU_LandEco.WUKey AND WU_AllResults1.WUKey = WU_LandHydro.WUKey AND
WU_AllResults1.WUKey = WU_LandInteg.WU_LandResil1_WU_LandInteg0_WUKey AND
WU_AllResults1.WUKey = WU_LandPos.WUKey AND WU_AllResults1.WUKey =
WU_LowSlope.WUKey AND WU_AllResults1.WUKey = WU_MarlPEM.WUKey AND
WU_AllResults1.WUKey = WU_Microtopo.WUKey AND WU_AllResults1.WUKey =
WU_Organic.WUKey AND WU_AllResults1.WUKey = WU_OwnerAccess.WUKey AND
WU_AllResults1.WUKey = WU_PublicUse.WUKey AND WU_AllResults1.WUKey =
WU_RoadRail.WUKey AND WU_AllResults1.WUKey = WU_Runoff.WUKey AND
WU_AllResults1.WUKey = WU_Runoff50m.WU_Runoff50m1_WUKey AND
WU_AllResults1.WUKey = WU_RunoffWshd.WU_RunoffWshd1_WUKey AND
WU_AllResults1.WUKey = WU_VegAll.WUKey AND WU_AllResults1.WUKey =
WU_SWOutflow.WUKey AND WU_AllResults1.WUKey = WU_StrucPatch.WUKey AND
WU_AllResults1.WUKey = WU_StreamEdge.WUKey AND WU_AllResults1.WUKey =
WU_SoilOrgCalc.WUKey AND WU_AllResults1.WUKey = WU_SoilH.WUKey AND
WU_AllResults1.WUKey = WU_SlopeWshd.WU_SlopeWshd1_WUKey AND
WU_AllResults1.WUKey = WU_SLOPE.WUKey AND WU_AllResults1.WUKey =
WU_SeasonPond.WUKey AND WU_AllResults1.WUKey = WU_VegByLP.WUKey AND
WU_AllResults1.WUKey = WU_VegFA.WUKey AND WU_AllResults1.WUKey =

```

WU\_VegFQ.WUKey AND WU\_AllResults1.WUKey = WU\_VegH.WUKey AND  
WU\_AllResults1.WUKey = WU\_VegPerUng.WU\_VegPerUng1\_WUKey AND  
WU\_AllResults1.WUKey = WU\_VegVerStr.WUKey AND WU\_AllResults1.WUKey =  
WU\_VegWoody.WUKey AND WU\_AllResults1.WUKey = WU\_VegWQ.WUKey AND  
WU\_AllResults1.WUKey = WU\_WaterSupply.WUKey AND WU\_AllResults1.WUKey =  
WU\_WetlandBird.WUKey AND WU\_AllResults1.WUKey = WU\_WflowPath.WUKey AND  
WU\_AllResults1.WUKey = WU\_WQPlan.WUKey AND WU\_AllResults1.WUKey =  
WU\_WQUse.WUKey AND WU\_AllResults1.WUKey = WU\_WshdPos.WUKey AND  
WU\_AllResults1.WUKey = WU\_WshdUniq.WUKey")

in\_tables =

"WU\_AllResults1;WU\_AquaAbund;WU\_Connect;WU\_ClayOrganic;WU\_Clay;WU\_ChemTime;WU\_BufferPerim;WU\_BufferLand;WU\_BRankHUC;WU\_BufferContig;WU\_ConsFocus;WU\_Depressions;WU\_Discharges;WU\_Disturb50m;WU\_DisturbWshd;WU\_EconRisk;WU\_Fisheries;WU\_FloodArea;WU\_FloodIn;WU\_Floodway;WU\_Headwater;WU\_HInvest;WU\_Histosol;WU\_HUC12WQ;WU\_HUse;WU\_HydroH;WU\_ImpairedIn;WU\_ImpairedOut;WU\_IrrEdge;WU\_Karst;WU\_LandEco;WU\_LandHydro;WU\_LandInteg;WU\_LandPos;WU\_LowSlope;WU\_MarlPEM;WU\_Microtopo;WU\_Organic;WU\_OwnerAccess;WU\_PublicUse;WU\_RoadRail;WU\_Runoff;WU\_Runoff50m;WU\_RunoffWshd;WU\_SeasonPond;WU\_SLOPE;WU\_SlopeWshd;WU\_SoilH;WU\_SoilOrgCalc;WU\_StreamEdge;WU\_StrucPatch;WU\_SWOutflow;WU\_VegAll;WU\_VegByLP;WU\_VegFA;WU\_VegFQ;WU\_VegH;WU\_VegPerUng;WU\_VegVerStr;WU\_VegWoody;WU\_VegWQ;WU\_WaterSupply;WU\_WetlandBird;WU\_WflowPath;WU\_WQPlan;WU\_WQUse;WU\_WshdPos;WU\_WshdUniq"

in\_fields = "WU\_AllResults1.WetlandName #;WU\_AllResults1.SurveyDate #;"

if len(arcpy.ListFields("fcWUAllResults1", "SiteCode")) > 0:

in\_fields += "WU\_AllResults1.SiteCode #;"

in\_fields += "WU\_AllResults1.WUKey #;WU\_AquaAbund.AquaAbund #;WU\_Connect.ConnectFL #;WU\_ClayOrganic.ClayOrganic #;WU\_Clay.Clay #;WU\_ChemTime.ChemTime #;WU\_BufferPerim.BufferPerim #;WU\_BufferLand.BufferLand #;WU\_BRankHUC.BRankHUC #;WU\_BufferContig.BufferContig #;WU\_ConsFocus.ConsFocus #;WU\_Depressions.Depressions #;WU\_Discharges.Discharges #;WU\_Disturb50m.Disturb50m #;WU\_Disturb50m.SoilIntact #;WU\_DisturbWshd.DisturbWshd #;WU\_EconRisk.EconRisk #;WU\_Fisheries.Fisheries #;WU\_FloodArea.FloodArea #;WU\_FloodArea.Floodplain #;WU\_FloodIn.FloodIn #;WU\_Floodway.Floodway #;WU\_Headwater.Headwater #;WU\_HInvest.HInvest #;WU\_Histosol.Histosol #;WU\_HUC12WQ.HUC12WQ #;WU\_HUse.HUse #;WU\_HydroH.HydIntact #;WU\_HydroH.HydSW #;WU\_HydroH.HydroH #;WU\_ImpairedIn.ImpairedIn #;WU\_ImpairedOut.ImpairedOut #;WU\_IrrEdge.IrrEdge #;WU\_Karst.Karst #;WU\_LandEco.LandEco #;WU\_LandHydro.LandHydro #;WU\_LandInteg.LandResil #;WU\_LandInteg.LandInteg #;WU\_LandPos.LandPos

#;WU\_LowSlope.LowSlope #;WU\_MarlPEM.MarlPEM #;WU\_Microtopo.Microtopo  
 #;WU\_Microtopo.VegHorInt #;WU\_Organic.Organic #;WU\_OwnerAccess.OwnerAccess  
 #;WU\_PublicUse.PublicUse #;WU\_RoadRail.RoadRail #;WU\_Runoff.Runoff  
 #;WU\_Runoff50m.Runoff50m #;WU\_RunoffWshd.RunoffWshd  
 #;WU\_SeasonPond.SeaPondRatio #;WU\_SeasonPond.SeasonPond #;WU\_SLOPE.SLOPE  
 #;WU\_SlopeWshd.SlopeWshd #;WU\_SoilH.SoilH #;WU\_SoilOrgCalc.SoilOrgCalc  
 #;WU\_StreamEdge.StreamEdge #;WU\_StrucPatch.StrucPatch #;WU\_SWOutflow.SWOutflow  
 #;WU\_SWOutflow.SWOutflow2 #;WU\_VegAll.VegAll #;WU\_VegByLP.VegByLP  
 #;WU\_VegFA.VegFA #;WU\_VegFQ.Dist50mFQ #;WU\_VegFQ.VegFQ #;WU\_VegH.VegH  
 #;WU\_VegPerUng.VegPerUng #;WU\_VegPerUng.VegPerUng4  
 #;WU\_VegPerUng.VegPerUng1 #;WU\_VegVerStr.VegVerStr #;WU\_VegWoody.VegWoody  
 #;WU\_VegWoody.VegWoody4 #;WU\_VegWoody.VegWoodyFor #;WU\_VegWQ.VegWQ  
 #;WU\_WaterSupply.WaterSupply #;WU\_WetlandBird.WetldBird  
 #;WU\_WflowPath.WFlowPath #;WU\_WQPlan.WQPlan #;WU\_WQUse.WQUse  
 #;WU\_WshdPos.WshdPos #;WU\_WshdUniq.WshdUniq #"

where\_clause = "WU\_AllResults1.WUKey =  
 WU\_AquaAbund.WU\_AquaAbund2\_WU\_AquaAbund1\_WUKey AND  
 WU\_AllResults1.WUKey = WU\_BRankHUC.WUKey AND WU\_AllResults1.WUKey =  
 WU\_BufferContig.WUKey AND WU\_AllResults1.WUKey = WU\_BufferLand.WUKey AND  
 WU\_AllResults1.WUKey = WU\_BufferPerim.WUKey AND WU\_AllResults1.WUKey =  
 WU\_ChemTime.WUKey AND WU\_AllResults1.WUKey = WU\_Clay.WUKey AND  
 WU\_AllResults1.WUKey = WU\_ClayOrganic.WUKey AND WU\_AllResults1.WUKey =  
 WU\_Connect.WUKey AND WU\_AllResults1.WUKey = WU\_ConsFocus.WUKey AND  
 WU\_AllResults1.WUKey = WU\_EconRisk.WUKey AND WU\_AllResults1.WUKey =  
 WU\_DisturbWshd.WU\_DisturbWshd1\_WUKey AND WU\_AllResults1.WUKey =  
 WU\_Discharges.WUKey AND WU\_AllResults1.WUKey =  
 WU\_Disturb50m.WU\_Disturb50m1\_WUKey AND WU\_AllResults1.WUKey =  
 WU\_Depressions.WUKey AND WU\_AllResults1.WUKey = WU\_Fisheries.WUKey AND  
 WU\_AllResults1.WUKey = WU\_FloodArea.WUKey AND WU\_AllResults1.WUKey =  
 WU\_FloodIn.WUKey AND WU\_AllResults1.WUKey = WU\_Floodway.WUKey AND  
 WU\_AllResults1.WUKey = WU\_Headwater.WUKey AND WU\_AllResults1.WUKey =  
 WU\_HInvest.WUKey AND WU\_AllResults1.WUKey = WU\_Histosol.WUKey AND  
 WU\_AllResults1.WUKey = WU\_HUC12WQ.WUKey AND WU\_AllResults1.WUKey =  
 WU\_HUse.WUKey AND WU\_AllResults1.WUKey = WU\_HydroH.WUKey AND  
 WU\_AllResults1.WUKey = WU\_ImpairedIn.WUKey AND WU\_AllResults1.WUKey =  
 WU\_ImpairedOut.WUKey AND WU\_AllResults1.WUKey = WU\_IrrEdge.WUKey AND  
 WU\_AllResults1.WUKey = WU\_Karst.WUKey AND WU\_AllResults1.WUKey =  
 WU\_LandEco.WUKey AND WU\_AllResults1.WUKey = WU\_LandHydro.WUKey AND  
 WU\_AllResults1.WUKey = WU\_LandInteg.WU\_LandResil1\_WU\_LandInteg0\_WUKey AND  
 WU\_AllResults1.WUKey = WU\_LandPos.WUKey AND WU\_AllResults1.WUKey =  
 WU\_LowSlope.WUKey AND WU\_AllResults1.WUKey = WU\_MarlPEM.WUKey AND

```

WU_AllResults1.WUKey = WU_Microtopo.WUKey AND WU_AllResults1.WUKey =
WU_Organic.WUKey AND WU_AllResults1.WUKey = WU_OwnerAccess.WUKey AND
WU_AllResults1.WUKey = WU_PublicUse.WUKey AND WU_AllResults1.WUKey =
WU_RoadRail.WUKey AND WU_AllResults1.WUKey = WU_Runoff.WUKey AND
WU_AllResults1.WUKey = WU_Runoff50m.WU_Runoff50m1_WUKey AND
WU_AllResults1.WUKey = WU_RunoffWshd.WU_RunoffWshd1_WUKey AND
WU_AllResults1.WUKey = WU_VegAll.WUKey AND WU_AllResults1.WUKey =
WU_SWOutflow.WUKey AND WU_AllResults1.WUKey = WU_StrucPatch.WUKey AND
WU_AllResults1.WUKey = WU_StreamEdge.WUKey AND WU_AllResults1.WUKey =
WU_SoilOrgCalc.WUKey AND WU_AllResults1.WUKey = WU_SoilH.WUKey AND
WU_AllResults1.WUKey = WU_SlopeWshd.WU_SlopeWshd1_WUKey AND
WU_AllResults1.WUKey = WU_SLOPE.WU_SLOPE1_WUKey AND
WU_AllResults1.WUKey = WU_SeasonPond.WUKey AND WU_AllResults1.WUKey =
WU_VegByLP.WUKey AND WU_AllResults1.WUKey = WU_VegFA.WUKey AND
WU_AllResults1.WUKey = WU_VegFQ.WUKey AND WU_AllResults1.WUKey =
WU_VegH.WUKey AND WU_AllResults1.WUKey =
WU_VegPerUng.WU_VegPerUng1_WUKey AND WU_AllResults1.WUKey =
WU_VegVerStr.WUKey AND WU_AllResults1.WUKey = WU_VegWoody.WUKey AND
WU_AllResults1.WUKey = WU_VegWQ.WUKey AND WU_AllResults1.WUKey =
WU_WaterSupply.WUKey AND WU_AllResults1.WUKey = WU_WetlandBird.WUKey AND
WU_AllResults1.WUKey = WU_WflowPath.WUKey AND WU_AllResults1.WUKey =
WU_WQPlan.WUKey AND WU_AllResults1.WUKey = WU_WQUse.WUKey AND
WU_AllResults1.WUKey = WU_WshdPos.WUKey AND WU_AllResults1.WUKey =
WU_WshdUniq.WUKey"

```

```

arcpy.MakeQueryTable_management(in_tables, "AllResultsTable", "NO_KEY_FIELD", "",
in_fields, where_clause)

```

```

arcpy.TableToGeodatabase_conversion("AllResultsTable",arcpy.env.workspace)

```

```

arcpy.MakeTableView_management(arcpy.env.workspace +
"\AllResultsTable","tvAllResults")

```

```

## STEP 3: Join output table to WU_Function

```

```

arcpy.AddJoin_management("fcWUFunction","WUKey","tvAllResults","WU_AllResults1_W
UKey")

```

```

arcpy.FeatureClassToFeatureClass_conversion("fcWUFunction", arcpy.env.workspace,
"WU_AllResults")

```

```

arcpy.RemoveJoin_management("fcWUFunction")

```

```

arcpy.MakeFeatureLayer_management("WU_AllResults", "fcWUAllResults")
logger.info("output table joined to WU_Function")

# Clean and simplify field names
arcpy.DeleteField_management("fcWUAllResults",["AllResultsTable_OBJECTID",
"AllResultsTable_WU_AllResults1_WUKey"])
fields = arcpy.ListFields("fcWUAllResults")
for field in fields:
    if len(field.name.split("_")) == 3:
        newFieldName = field.name.split("_")[2]
        arcpy.AddField_management("fcWUAllResults", newFieldName, field.type)
        arcpy.CalculateField_management("fcWUAllResults", newFieldName, "!" + field.name
+ "!", "PYTHON")
        arcpy.DeleteField_management("fcWUAllResults", field.name)
    else if len(field.name.split("_")) == 4:
        newFieldName = field.name.split("_")[3]
        arcpy.AddField_management("fcWUAllResults", newFieldName, field.type)
        arcpy.CalculateField_management("fcWUAllResults", newFieldName, "!" + field.name
+ "!", "PYTHON")
        arcpy.DeleteField_management("fcWUAllResults", field.name)
logger.info("field names cleaned and simplified")

## STEP 4: Export to personal geodatabase in preparation for Access Database merge
strOutputName = "AllResults_" + str(datetime.date.today().year) +
'{:02}'.format(datetime.date.today().month) + '{:02}'.format(datetime.date.today().day)
arcpy.FeatureClassToFeatureClass_conversion("fcWUAllResults",
r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\WetlandFunctionResults\test\WVWR
AMGISresults.mdb", strOutputName)

# Clean up
if arcpy.Exists('WU_AllResults1'):

```

```
    arcpy.Delete_management('WU_AllResults1')
if arcpy.Exists('AllResultsTable'):
    arcpy.Delete_management('AllResultsTable')
```

### 5.7.67 CalcFunction: Utilities

```
#####  
#  
# File Name: CalcFunction.py  
# Developer: Yibing Han  
# Date: 02/25/2018  
# Purpose:  
# This script calculates the total assessment scores of wetland units  
#  
#  
#####  
#!/usr/bin/python  
import logging  
import arcpy  
import actions  
  
def CalcFunction():  
    logger = logging.getLogger("WFA.FinalRun")  
  
    # Setting python variables  
    arcpy.MakeFeatureLayer_management(r"WU_WQFunction","fcWQFunction")  
    arcpy.MakeFeatureLayer_management(r"WU_FAFunction","fcFAFunction")  
    arcpy.MakeFeatureLayer_management(r"WU_HFunction","fcHFunction")  
    logger.info("feature layers ready")  
  
    # Clean up if needed  
    if arcpy.Exists('WU_Function1'):  
        arcpy.Delete_management('WU_Function1')  
    if arcpy.Exists('WU_Function2'):
```

```

    arcpy.Delete_management('WU_Function2')
if arcpy.Exists('WU_Function'):
    arcpy.Delete_management('WU_Function')

## STEP 1: Calculate the value of HCondition
## Add field HCondition to feature class WU_HFunction and set initial value
actions.DeleteField("fcHFunction", 'HCondition')
arcpy.AddField_management("fcHFunction", 'HCondition', 'SHORT')
arcpy.CalculateField_management("fcHFunction", 'HCondition', '!HPotential! +
!HOpportun!', 'PYTHON', '#')
logger.info("field HCondition added and initial value calculated")

## Select B6 wetlands and re-calculate HCondition
strWHERE = """"BRank" = 'B6'""""
arcpy.SelectLayerByAttribute_management("fcHFunction", "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management("fcHFunction", 'HCondition', '!HPotB6! + !HOpportun!',
'PYTHON', '#')
logger.info("B6 wetlands selected and HCondition re-calculated")

## Select B5 wetlands and re-calculate HCondition
strWHERE = """"BRank" = 'B5'""""
arcpy.SelectLayerByAttribute_management("fcHFunction", "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management("fcHFunction", 'HCondition', '!HOpportun! + 30',
'PYTHON', '#')
logger.info("B5 wetlands selected and HCondition re-calculated")

## Select B1-B4 wetlands and re-calculate HCondition
strWHERE = """"BRank" IN ('B1', 'B2', 'B3', 'B4')""""

```



```

    arcpy.SelectLayerByAttribute_management("fcHFunction", "NEW_SELECTION",
strWHERE)

    arcpy.CalculateField_management("fcHFunction", 'HCondition', '!HFunction!', 'PYTHON',
'#')

    logger.info("B1-B4 wetlands selected and HCondition re-calculated")

    arcpy.SelectLayerByAttribute_management("fcHFunction", "CLEAR_SELECTION")

## STEP 2: Spatial Join to merge metrics and create feature class to store Function
fmSJ = arcpy.FieldMappings()
fmSJ.addTable("fcWQFunction")
fmSJ.addTable("fcFAFunction")

keepers = []

keepers =
['WUKey','Shape_Length','Shape_Area','WQFunction','WQOpportun','WQPotential','WQSociet
y','FAFunction','FAOpportun','FAPotential','FASociety']

for field in fmSJ.fields:
    if field.name not in keepers:
        fmSJ.removeFieldMap(fmSJ.findFieldMapIndex(field.name))

    arcpy.SpatialJoin_analysis("fcWQFunction", "fcFAFunction", 'WU_Function1',
'JOIN_ONE_TO_ONE', 'KEEP_ALL', fmSJ, 'CONTAINS')

    arcpy.MakeFeatureLayer_management(r"WU_Function1", "fcFunction1")

    logger.info("spatial join WQFunction and FAFunction completed")

fmSJ = arcpy.FieldMappings()
fmSJ.addTable("fcFunction1")
fmSJ.addTable("fcHFunction")

keepers = []

keepers =
['WUKey','Shape_Length','Shape_Area','WQFunction','WQOpportun','WQPotential','WQSociet

```

```
y','FAFunction','FAOpportun','FAPotential','FASociety','HFunction','HOpportun','HPotential','H  
Society','HCondition','BRank','HFuncNoBR']
```

```
for field in fmSJ.fields:
```

```
    if field.name not in keepers:
```

```
        fmSJ.removeFieldMap(fmSJ.findFieldMapIndex(field.name))
```

```
    arcpy.SpatialJoin_analysis("fcFunction1", "fcHFunction", 'WU_Function2',  
'JOIN_ONE_TO_ONE', 'KEEP_ALL', fmSJ, 'CONTAINS')
```

```
    arcpy.MakeFeatureLayer_management(r"WU_Function2", "fcFunction2")
```

```
    logger.info("spatial join Function1 and HFunction completed")
```

```
## STEP 3: Add Function field to Wetland Units and set initial point value to zero.
```

```
actions.DeleteField("fcFunction2", 'Function')
```

```
arcpy.AddField_management("fcFunction2", 'Function', 'SHORT')
```

```
arcpy.CalculateField_management("fcFunction2", 'Function', '!WQFunction! + !FAFunction!  
+ !HFunction!', 'PYTHON', '#')
```

```
logger.info("field Function added and calculated")
```

```
## STEP 4: Add and calculate fields to store roll-up scores Condition, RegFunction, and  
DNRLandAcq
```

```
actions.DeleteField("fcFunction2", "Condition")
```

```
arcpy.AddField_management("fcFunction2", "Condition", "SHORT")
```

```
arcpy.CalculateField_management("fcFunction2", "Condition", "!WQPotential! +  
!FAPotential! + !HCondition!", "PYTHON", "#")
```

```
actions.DeleteField("fcFunction2", "RegFunction")
```

```
arcpy.AddField_management("fcFunction2", "RegFunction", "SHORT")
```

```
arcpy.CalculateField_management("fcFunction2", "RegFunction", "!Condition! +  
!WQOpportun! + !FAOpportun!", "PYTHON", "#")
```

```
actions.DeleteField("fcFunction2", "DNRLandAcq")
```

```

arcpy.AddField_management("fcFunction2", "DNRLandAcq", "SHORT")
arcpy.CalculateField_management("fcFunction2","DNRLandAcq","!Condition! +
!WQSociety! + !FASociety! + !HSociety!", "PYTHON", "#")

logger.info("fields added and calculated to store roll-up scores Condition, RegFunction, and
DNRLandAcq")

### Select B1-B4 wetlands and re-calculate DNRLandAcq
strWHERE = """"BRank" IN ('B1', 'B2', 'B3', 'B4')""""

arcpy.SelectLayerByAttribute_management("fcFunction2", "NEW_SELECTION",
strWHERE)

arcpy.CalculateField_management("fcFunction2", 'DNRLandAcq', '!Condition! +
!WQSociety! + !FASociety!', 'PYTHON', '#')

logger.info("B1-B4 wetlands selected and DNRLandAcq re-calculated")

arcpy.SelectLayerByAttribute_management("fcFunction2", "CLEAR_SELECTION")

### Reorder fields
new_field_order = ["WUKey", "Function", "RegFunction", "Condition", "DNRLandAcq",
"BRank", "FAFunction", "FAOpportun", "FAPotential", "FASociety", "HCondition",
"HFuncNoBR", "HFunction", "HOpportun", "HPotential", "HSociety", "WQFunction",
"WQOpportun", "WQPotential", "WQSociety"]

existing_fields = arcpy.ListFields("fcFunction2")
existing_mapping = arcpy.FieldMappings()
existing_mapping.addTable("fcFunction2")
new_mapping = arcpy.FieldMappings()

for field_name in new_field_order:
    mapping_index = existing_mapping.findFieldMapIndex(field_name)
    if mapping_index != -1:
        field_map = existing_mapping.fieldMappings[mapping_index]
        new_mapping.addFieldMap(field_map)
arcpy.Merge_management("fcFunction2", "WU_Function", new_mapping)

```

```
logger.info("fields reordered")
```

```
# Clean up
```

```
if arcpy.Exists('WU_Function1'):
```

```
    arcpy.Delete_management('WU_Function1')
```

```
if arcpy.Exists('WU_Function2'):
```

```
    arcpy.Delete_management('WU_Function2')
```

### 5.7.68 CreateBasicGeom: Utilities

```
#####  
#  
# File Name: CreateBasicGeom.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 1/27/2017 (modified 11/1/2017)  
# Purpose:  
#   Create 50m buffers for wetland units  
#  
#####  
#!/usr/bin/python  
import datetime  
import time  
import logging  
import arcpy  
import actions  
  
def CreateBasicGeom(WetlandPoly):  
    logger = logging.getLogger("WFA.initRequest.CreateBasicGeom")  
  
    # Clean up if needed  
    if arcpy.Exists("WUpoint"):  
        arcpy.Delete_management("WUpoint")  
    if arcpy.Exists("Buffer10m"):  
        arcpy.Delete_management("Buffer10m")  
    if arcpy.Exists("Buffer50m"):  
        arcpy.Delete_management("Buffer50m")  
    if arcpy.Exists("Buffer300m"):  
        arcpy.Delete_management("Buffer300m")
```

```

if arcpy.Exists("WU_Buffer1km"):
    arcpy.Delete_management("WU_Buffer1km")

# Setting python variables
# fcDrainageAreas =
arcpy.mappng.Layer(r"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\WorkingFiles\T
AGIS\wetlands_27m.gdb\drainageareas")

# logger.info("feature layers ready")

# Create Wetland Units Points
arcpy.FeatureToPoint_management(WetlandPoly, "WUPoint", "INSIDE")
logger.info("Wetland Units Points layer created")

# Create Buffer Wetland Units by 10/50/300/1000 meters
arcpy.Buffer_analysis(WetlandPoly,"Buffer10m","10
Meters","OUTSIDE_ONLY","ROUND","NONE","#")
arcpy.Buffer_analysis(WetlandPoly,"Buffer50m","50
Meters","OUTSIDE_ONLY","ROUND","NONE","#")
arcpy.Buffer_analysis(WetlandPoly,"Buffer300m","300
Meters","OUTSIDE_ONLY","ROUND","NONE","#")
arcpy.Buffer_analysis(WetlandPoly,"Buffer1km","1000
Meters","OUTSIDE_ONLY","ROUND","NONE","#")
fcBuffer10m = arcpy.mapping.Layer(r"Buffer10m")
fcBuffer50m = arcpy.mapping.Layer(r"Buffer50m")
fcBuffer300m = arcpy.mapping.Layer(r"Buffer300m")
fcBuffer1km = arcpy.mapping.Layer(r"Buffer1km")
logger.info("buffers layers of Wetland Units created")

# Add field to store buffer area
actions.DeleteField(fcBuffer10m, "BufferArea")
arcpy.AddField_management(fcBuffer10m, "Buf10Area", "FLOAT")

```

```
arcpy.CalculateField_management(fcBuffer10m, "Buf10Area", "!Shape_Area!",
"PYTHON", "#")
```

```
actions.DeleteField(fcBuffer50m, "BufferArea")
```

```
arcpy.AddField_management(fcBuffer50m, "BufferArea", "FLOAT")
```

```
arcpy.CalculateField_management(fcBuffer50m, "BufferArea", "!Shape_Area!",
"PYTHON", "#")
```

```
actions.DeleteField(fcBuffer300m, "Buf300Area")
```

```
arcpy.AddField_management(fcBuffer300m, "Buf300Area", "FLOAT")
```

```
arcpy.CalculateField_management(fcBuffer300m, "Buf300Area", "!Shape_Area!",
"PYTHON", "#")
```

```
actions.DeleteField(fcBuffer1km,"Buf1kArea")
```

```
arcpy.AddField_management(fcBuffer1km, "Buf1kArea", "FLOAT")
```

```
arcpy.CalculateField_management(fcBuffer1km, "Buf1kArea", "!Shape_Area!",
"PYTHON", "#")
```

```
logger.info("field BufferArea created and calculated for each buffer layer")
```

```
# Create DrainageArea27m
```

```
'''
```

```
actions.DeleteField(fcDrainageAreas,"WUKey")
```

```
arcpy.AddField_management(fcDrainageAreas, "WUKey", "LONG")
```

```
arcpy.CalculateField_management(fcDrainageAreas, "WUKey", "!grid_code! + 1",
"PYTHON", "#")
```

```
arcpy.Dissolve_management(fcDrainageAreas,"DrainageArea27m","WUKey","", "MULTI_PA
RT", "DISSOLVE_LINES")
```

```
logger.info("layer DraomageArea27m created")
```

```
'''
```

### 5.7.69 CreateWetlandUnits: Utilities

```
#####  
#  
# File Name: CreateWetlandUnits.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 7/8/2015 (modified 12/14/2017, 1/26/2022)  
# Purpose:  
# This script intersects is to create wetland units from  
# NWI polygons.  
#  
# Note: The numbers in the comments reflect the number in  
# "2b Creating Wetland Units from NWI polygons.docx"  
#  
#####  
#!/usr/bin/python  
import datetime  
import time  
import logging  
import arcpy  
import actions  
  
def CreateWetlandUnits(WetlandPoly):  
    logger = logging.getLogger("WFA.initRequest.CreateWetlandUnits")  
  
    #fcWetlandUnits = uid + "_" + str(time.strftime("%Y%m%d_%H%M%S"))  
    now = datetime.datetime.now()  
    intCurMonth = datetime.date.today().month  
    intCurDay = datetime.date.today().day
```



```
fcWetlandUnits = "WU_" + str(datetime.date.today().year) + '{:02}'.format(intCurMonth) +
'{:02}'.format(intCurDay)
```

```
# Clean up if needed
```

```
if arcpy.Exists(fcWetlandUnits):
```

```
    arcpy.Delete_management(fcWetlandUnits)
```

```
if arcpy.Exists("WUWorkingDS"):
```

```
    arcpy.Delete_management("WUWorkingDS")
```

```
if arcpy.Exists("WUdissolve"):
```

```
    arcpy.Delete_management("WUdissolve")
```

```
## Create new feature class that contains all palustrine wetlands, vegetated riverine wetlands,
and vegetated lacustrine wetlands
```

```
strWHERE = """"ATTRIBUTE" LIKE 'P%' OR "ATTRIBUTE" LIKE 'R2AB%' OR
"ATTRIBUTE" LIKE 'R3AB%' OR "ATTRIBUTE" LIKE 'R2US5%' OR "ATTRIBUTE"
LIKE 'R3US5%' OR "ATTRIBUTE" LIKE 'R2EM%' OR "ATTRIBUTE" LIKE 'R3EM%' OR
"ATTRIBUTE" LIKE 'R4SB7%' OR "ATTRIBUTE" LIKE 'L2AB%' OR "ATTRIBUTE"
LIKE 'L2US5%' OR "ATTRIBUTE" LIKE 'L2EM%'""""
```

```
arcpy.SelectLayerByAttribute_management(WetlandPoly, "NEW_SELECTION",
strWHERE)
```

```
arcpy.CopyFeatures_management(WetlandPoly, "WUWorkingDS")
```

```
fcWorkingDS = arcpy.mapping.Layer("WUWorkingDS")
```

```
logger.info("WUWorkingDS created to store wetland units that doesn't contain permanently
flooded and unvegetated rivers and lakes, and industrial and waste disposal ponds")
```

```
## Dissolve NWI polygons
```

```
arcpy.Dissolve_management(fcWorkingDS, "WUdissolve", "", "", "SINGLE_PART", "DISSOLVE
_LINES")
```

```
arcpy.MakeFeatureLayer_management("WUdissolve", "fcWUDissolve")
```

```
logger.info("NWI polygons dissolved")
```

```

# Create output feature class
lyrWUDissolve = arcpy.mapping.Layer("WUdissolve")
arcpy.FeatureClassToFeatureClass_conversion(lyrWUDissolve, arcpy.env.workspace,
fcWetlandUnits)

arcpy.RepairGeometry_management(fcWetlandUnits)
arcpy.AddSpatialIndex_management(fcWetlandUnits)
logger.info("output feature class created for Wetland Units")

# Add unique ID field for Wetland Units
actions.DeleteField(fcWetlandUnits,"WUKey")
arcpy.AddField_management(fcWetlandUnits, "WUKey", "LONG")
arcpy.CalculateField_management(fcWetlandUnits, "WUKey", "!OBJECTID!", "PYTHON")
logger.info("field WUKey added to Wetland Units")

# Clean up
if arcpy.Exists("WUWorkingDS"):
    arcpy.Delete_management("WUWorkingDS")
if arcpy.Exists("WUdissolve"):
    arcpy.Delete_management("WUdissolve")
return fcWetlandUnits

```

### 5.7.70 DrainageArea: Utilities

```
#####  
#  
# File Name: DrainageArea.py  
# Developer: Yibing Han  
# Date: 01/26/2018  
# Purpose:  
#   Input to Flood Attenuation Function / Opportunity aspect  
#  
#####  
#!/usr/bin/python  
import sys, os, gc  
sys.path.append("../..")  
gc.enable()  
  
import logging  
import arcpy  
from arcpy.sa import *  
from globalvars import globalvars  
import actions  
  
def DetermineDrainageArea(WetlandPoly):  
    arcpy.CheckOutExtension("Spatial")  
    logger = logging.getLogger("WFA.DrainageArea")  
  
    # Clean up if needed  
    if arcpy.Exists(r"DrainageArea0"):  
        arcpy.Delete_management(r"DrainageArea0")  
    if arcpy.Exists(r"DrainageArea"):
```

```

arcpy.Delete_management(r"DrainageArea")

# Setting python variables
orig_dir = arcpy.env.workspace
temp_dir =
"M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\WorkingFiles\drainage_area_temp
"

if not os.path.exists(temp_dir):
    os.mkdir(temp_dir)
if arcpy.Exists(temp_dir + "\\tempGDB.gdb"):
    arcpy.Delete_management(temp_dir + "\\tempGDB.gdb")
arcpy.CreateFileGDB_management(temp_dir, "tempGDB")
## Create feature class to hold watershed polygon output
sr = arcpy.SpatialReference(26917)
arcpy.CreateFeatureclass_management(orig_dir, "DrainageArea0", "POLYGON", "", "", "", sr)
actions.DeleteField("DrainageArea0", "Gridcode")
arcpy.AddField_management("DrainageArea0", "Gridcode", "LONG")
logger.info("feature class DrainageArea0 created to hold watershed polygon")

## BEGIN LOOP; start with WUKey = 1 and repeat until all Wetland Units are processed
arcpy.FeatureClassToFeatureClass_conversion(WetlandPoly, temp_dir + "\\tempGDB.gdb",
"WU_temp")
arcpy.env.workspace = temp_dir + "\\tempGDB.gdb"
arcpy.env.overwriteOutput = True
arcpy.env.extent = globalvars.srcFlowDir
arcpy.env.snapRaster = globalvars.srcFlowDir
with arcpy.da.SearchCursor("WU_temp", "WUKey") as cursor:
    for row in cursor:
        # Copy Wetland Unit polygon to a temporary feature class
        strWhere = "WUKey = " + str(row[0])

```

```

    #tmpName = "temp_{0}".format(row[0])
    arcpy.FeatureClassToFeatureClass_conversion("WU_temp", arcpy.env.workspace,
"temppoly", strWhere)
    # Convert temporary feature class to a temporary grid
    arcpy.PolygonToRaster_conversion(arcpy.env.workspace + "\\temppoly", "WUKey",
"tempras", "CELL_CENTER", "", 27)
    if arcpy.GetRasterProperties_management(arcpy.env.workspace + "\\tempras",
"ALLNODATA").getOutput(0) == '1':
        arcpy.Buffer_analysis(arcpy.env.workspace + "\\temppoly", "temppolyB", 27)
        arcpy.PolygonToRaster_conversion(arcpy.env.workspace + "\\temppolyB",
"WUKey", "tempras", "CELL_CENTER", "WUKey", 27)
        # Run watershed command using temporary grid as input
        #outWatershed = arcpy.sa.Watershed(globalvars.srcFlowDir, "tempras", "Value")
        #outWatershed.save("temprasout.tif")
        #arcpy.gp.Watershed_sa(globalvars.srcFlowDir,arcpy.env.workspace +
"\\tempras","temprasout","Value")
        outWatershed = Watershed(globalvars.srcFlowDir,arcpy.env.workspace +
"\\tempras","Value")

    # Convert watershed grid to a polygon
    #arcpy.RasterToPolygon_conversion(arcpy.env.workspace + "\\temprasout",
"temppolyout", "NO_SIMPLIFY", "Value")
    arcpy.RasterToPolygon_conversion(outWatershed, "temppolyout", "NO_SIMPLIFY",
"Value")

    # Append polygon to DrainageArea0 feature class
    arcpy.Append_management(arcpy.env.workspace + "\\temppolyout", orig_dir +
"\\DrainageArea0", "NO_TEST")
    logger.info("Row " + str(row[0]) + " appended to feature class")
    del row, cursor
    gc.collect()
## END LOOP when all Wetland Units are processed

```

```

arcpy.env.workspace = orig_dir

#arcpy.FeatureClassToFeatureClass_conversion("DrainageArea0",orig_dir,"DrainageArea1",""
""Gridcode" > 0"")

logger.info("All Wetland Units have now been added to DrainageArea0")

## Add field to DrainageArea feature class to store WUKey
actions.DeleteField("DrainageArea0", "WUKey")
arcpy.AddField_management("DrainageArea0", "WUKey", "LONG")
arcpy.CalculateField_management("DrainageArea0", "WUKey", "!Gridcode!", "PYTHON")

arcpy.Dissolve_management("DrainageArea0","DrainageArea","WUKey","", "MULTI_PART",
"DISSOLVE_LINES")

logger.info("field WUKey added to DrainageArea")

## Add field to store Contributing Watershed Area
actions.DeleteField("DrainageArea", "CntrWshd")
arcpy.AddField_management("DrainageArea", "CntrWshd", "LONG")
arcpy.CalculateField_management("DrainageArea", "CntrWshd", "int(!Shape_Area!)",
"PYTHON")

# Clean Up
if arcpy.Exists(r"DrainageArea0"):
    arcpy.Delete_management(r"DrainageArea0")

```

### 5.7.71 FloodArea: Utilities

```
#####  
#  
# File Name: FloodArea.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 3/8/2017 (modified 11/10/2017)  
# Purpose:  
# Floodplain (Y/N): Input to numerous Water Quality and Flood Attenuation metrics  
# FloodArea: Input to Flood Attenuation / Opportunity; Max 2 points (all wetlands, but only  
Floodplain wetlands will score high enough to get points)  
#  
#####  
#!/usr/bin/python  
  
import sys  
sys.path.append("../..")  
  
  
import logging  
import arcpy  
from globalvars import globalvars  
import actions  
  
def DetermineFloodArea(WetlandPoly):  
    logger = logging.getLogger("WFA.FloodArea")  
  
    ## Clean up if needed  
    if arcpy.Exists("WU_FloodArea1"):  
        arcpy.Delete_management("WU_FloodArea1")  
    if arcpy.Exists("WU_FloodArea"):  
        arcpy.Delete_management("WU_FloodArea")
```

```

## Setting python variables
arcpy.MakeFeatureLayer_management(WetlandPoly,"fcWU")
arcpy.MakeFeatureLayer_management(globalvars.srcFPARAFEMA,"fcFPARAFEMA")
arcpy.MakeFeatureLayer_management(globalvars.srcPeatlands,"fcPeatlands")
logger.info("feature layers ready")

## Intersect floodplain and Wetland Units
arInputs = ["fcFPARAFEMA","fcWU"]
arcpy.Intersect_analysis(arInputs,"WU_FloodArea1","ONLY_FID","#","INPUT")
arcpy.MakeFeatureLayer_management(r"WU_FloodArea1","fcWUFloodArea1")
logger.info("floodplain intersected with wetland units")

## Add field to store floodplain area
actions.DeleteField("fcWUFloodArea1","FloodAreaAF")
arcpy.AddField_management("fcWUFloodArea1", "FloodAreaAF", "FLOAT")

arcpy.CalculateField_management("fcWUFloodArea1","FloodAreaAF","!Shape_Area!","PYT
HON","#")

logger.info("field FloodAreaAF added to store floodplain area")

#####
#####

## Spatial join floodplain selection to Wetland Units and sum floodplain area.

#####
#####

fieldmappings = arcpy.FieldMappings()
fieldmappings.addTable("fcWU")
fieldmappings.addTable("fcWUFloodArea1")

```



```

fldKeyIndex = fieldmappings.findFieldMapIndex("FloodAreaAF")
fieldmap = fieldmappings.getFieldMap(fldKeyIndex)
fieldmap.mergeRule = "sum"
fieldmappings.replaceFieldMap(fldKeyIndex, fieldmap)
keepers = ["Shape_Length","Shape_Area","WUKey","FloodAreaAF"]

```

```

for field in fieldmappings.fields:
    if field.name not in keepers:
        fieldmappings.removeFieldMap(fieldmappings.findFieldMapIndex(field.name))

```

```

arcpy.SpatialJoin_analysis("fcWU","fcWUFloodArea1","WU_FloodArea","JOIN_ONE_TO_ONE",
"KEEP_ALL",fieldmappings)
arcpy.MakeFeatureLayer_management("WU_FloodArea","fcWUFloodArea")
logger.info("spatuak join completed to sum floodplain area")

```

```

#####
#####

```

```

## Add fields to store Flood Area Ratio and Flood Area points
actions.DeleteField("fcWUFloodArea","FloodRatio")
arcpy.AddField_management("fcWUFloodArea", "FloodRatio", "FLOAT")
arcpy.CalculateField_management("fcWUFloodArea","FloodRatio","0","PYTHON","#")
logger.info("field FloodRatio added and initial point value set to 0")

```

```

actions.DeleteField("fcWUFloodArea","FloodArea")
arcpy.AddField_management("fcWUFloodArea", "FloodArea", "SHORT")
arcpy.CalculateField_management("fcWUFloodArea","FloodArea","0","PYTHON","#")
logger.info("field FloodArea added and initial point value set to 0")

```

```

## Calculate the ratio of floodplain are to total Wetland Units Area

```

```

arcpy.CalculateField_management("fcWUFloodArea","FloodRatio","!FloodAreaAF!/!Shape_Area!", "PYTHON", "#")

logger.info("field FloodRation calculated")

## Assign Points

arcpy.SelectLayerByAttribute_management("fcWUFloodArea","NEW_SELECTION", """"FloodRatio" > 0.1""")

arcpy.CalculateField_management("fcWUFloodArea","FloodArea","1","PYTHON", "#")

arcpy.SelectLayerByAttribute_management("fcWUFloodArea","NEW_SELECTION", """"FloodRatio" > 0.5""")

arcpy.CalculateField_management("fcWUFloodArea","FloodArea","2","PYTHON", "#")

logger.info("points assigned to field FloodArea")

arcpy.SelectLayerByAttribute_management("fcWUFloodArea", "CLEAR_SELECTION")

## Select Wetland Units that contain peat deposits

arcpy.SelectLayerByLocation_management("fcWUFloodArea","INTERSECT","fcPeatlands", "#", "NEW_SELECTION")

arcpy.CalculateField_management("fcWUFloodArea","FloodArea","0","PYTHON", "#")

logger.info("points assigned to wetland units that contain peat deposits")

arcpy.SelectLayerByAttribute_management("fcWUFloodArea", "CLEAR_SELECTION")

## Add field Floodplain to Wetland Units attribute table and set initial value to "N"

actions.DeleteField("fcWUFloodArea","Floodplain")

arcpy.AddField_management("fcWUFloodArea", "Floodplain", "TEXT",2)

arcpy.CalculateField_management("fcWUFloodArea","Floodplain","N","PYTHON", "#")

logger.info("field Floodplain added and initial value set to 'N'")

```

```
## Select Wetland Units that have at least 10% of their area in a FEMA floodplain or Active River Area
```

```
arcpy.SelectLayerByAttribute_management("fcWUFloodArea","NEW_SELECTION","""FloodArea" > 0""")
```

```
arcpy.CalculateField_management("fcWUFloodArea","Floodplain","Y","PYTHON","#")
```

```
logger.info("field Floodplain identified in selected wetland units")
```

```
arcpy.SelectLayerByAttribute_management("fcWUFloodArea", "CLEAR_SELECTION")
```

```
## Clean up
```

```
if arcpy.Exists("WU_FloodArea1"):
```

```
arcpy.Delete_management("WU_FloodArea1")
```

### 5.7.72 Floodplain: Utilities

```
#####  
#  
# File Name: floodplain.py  
# Developer: Chad Ashworth  
# Date 4/24/2015  
# Purpose:  
#     This script intersects the WVWRAP wetland polygons and the FEMA  
#     floodplain polygons and determines if the WVWRAP wetland is  
#     10% or more in the FEMA floodplain.  
#  
#####  
#!/usr/bin/python  
import arcpy  
from utilities import actions  
arcpy.env.overwriteOutput = True  
  
def WetlandInFloodplain(WetlandPoly):  
    ## cleaning up if needed  
    if arcpy.Exists("WETLAND_FP_INTERSECT"):  
        arcpy.Delete_management("WETLAND_FP_INTERSECT")  
    if arcpy.Exists("lyrWetlandAllData"):  
        arcpy.Delete_management("lyrWetlandAllData")  
  
    ## reference to the floodzone layer  
    fcFP = actions.GetGISData("FloodZone")  
  
    # adding/deleting the Floodplain_FEMA  
    actions.DeleteField(WetlandPoly,"Floodplain_FEMA")
```

```

arcpy.AddField_management(WetlandPoly, "Floodplain_FEMA", "TEXT",1)

## Perform an intersect between WWWRAP sites & FloodPlain feature classes
arcpy.Intersect_analysis([[WetlandPoly], [fcFP]], "WETLAND_FP_INTERSECT","ALL")

## Join intersecting feature class with lyrWetlandAllData
arcpy.MakeFeatureLayer_management("WETLAND_FP_INTERSECT", "lyrWetlandAllData")
arcpy.AddJoin_management("lyrWetlandAllData", "FID_wvFldZone_20130410_wgs84wmA",
fcFP, "OBJECTID") # join to Flood Zone Data
strWetlandPolyPK = "FID_" + str(WetlandPoly) # dynamically creating the foreign key field
to the WetlandPoly
arcpy.AddJoin_management("lyrwetlandalldata", strWetlandPolyPK, str(WetlandPoly),
"OBJECTID") # join to WetlandPoly

arcpy.CopyFeatures_management("lyrWetlandAllData", "lyrWetlandAllData")

#####
edit = arcpy.da.Editor(arcpy.env.workspace)
edit.startEditing(False, True)
edit.startOperation()

# declaring what fields i need to calculate the percent intersect
strWetlandId = str(WetlandPoly) + ".OBJECTID"
strWetlandShapeArea = str(WetlandPoly) + ".Shape_Area"
strWetlandFIFEMA = str(WetlandPoly) + ".Floodplain_FEMA"
fldsDL =
[strWetlandId,"WETLAND_FP_INTERSECT.Shape_Area",strWetlandShapeArea,strWetlandF
IFEMA]

# updating the UA field with a Y if 10% or more are in an urban area
with arcpy.da.SearchCursor("lyrWetlandAllData", fldsDL) as curWetlandAll:

```

```

for rWetlandAll in curWetlandAll:
    intPercentIntersect = int(rWetlandAll[1]/rWetlandAll[2]*100)
    if intPercentIntersect >= 10:
        strWhere = "OBJECTID = " + str(rWetlandAll[0])

        actions.UpdateTable(WetlandPoly,["Floodplain_FEMA"],0,"Y",strWhere)

# updating the rest of the fields to N
strWhere = "Floodplain_FEMA is null"
actions.UpdateTable(WetlandPoly,["Floodplain_FEMA"],0,"N",strWhere)

edit.stopEditing(True)

arcpy.Delete_management("lyrWetlandAllData")
arcpy.Delete_management("WETLAND_FP_INTERSECT")
arcpy.Delete_management("lyrWetlandAllData")

```

### 5.7.73 InitRequest: Utilities

```
#####  
#  
# File Name: initRequest.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 10/24/2015 (modified 02/2018)  
# Purpose:  
# This script starts the Wetland Functional Assessment process by creating wetland unit  
# polygons, basic geometries and flood-related layers.  
#  
#####  
#!/usr/bin/python  
import sys, os  
import arcpy  
import logging  
import traceback  
import actions  
from CreateWetlandUnits import *  
from CreateBasicGeom import *  
from FloodArea import *  
from DrainageArea import *  
#from Floodplain import *  
#from ActiveRiverArea import *  
  
def MainUtil(WetlandPoly):  
    logger = logging.getLogger("WFA.initRequest")  
    ## 1. Check Geometry  
    "sr = arcpy.SpatialReference(26917)  
    arcpy.CreateFeatureDataset_management(arcpy.env.workspace,"CONUS_wetlands", sr)  
    arcpy.CreateFeatureDataset_management(arcpy.env.workspace,"CONUS_projects", sr)
```

```

    arcpy.FeatureClassToFeatureClass_conversion(WetlandPoly, arcpy.env.workspace +
"\\CONUS_wetlands","CONUS_wet_poly")

    arcpy.FeatureClassToFeatureClass_conversion("WUboundary", arcpy.env.workspace +
"\\CONUS_projects","CONUS_wet_projects")

    arcpy.AddField_management(r"CONUS_wetlands\CONUS_wet_poly", "QAQC_CODE",
"TEXT")

    arcpy.AddField_management(r"CONUS_wetlands\CONUS_wet_poly",
"WETLAND_TYPE", "TEXT")

    arcpy.AddField_management(r"CONUS_wetlands\CONUS_wet_poly", "ACRES",
"FLOAT")

    arcpy.AddField_management(r"CONUS_projects\CONUS_wet_projects", "ACRES",
"FLOAT")

    arcpy.CreateTopology_management(r"CONUS_wetlands","CONUS_wet_poly_Topology")
    logger.info("Wetland database schema for QAQC set up")

arcpy.ImportToolbox('M:\wr\WTRSHD_BRANCH_INTERNAL\WETLAND\NWI_QAQC_T
ool\NWI_QAQC_Tool.tbx')

    arcpy.Model_QAQC(arcpy.env.workspace,"Name","CONUS","true")

    logger.info("QAQC completed for input wetlands")

    arcpy.CopyFeatures_management(r"CONUS_wetlands\CONUS_wet_poly",
"WetlandInput_QAQC")

    WetlandPoly = arcpy.mapping.Layer("WetlandInput_QAQC")

    arcpy.Delete_management(r"CONUS_projects")
    arcpy.Delete_management(r"CONUS_wetlands")"""

## 2. Create Wetland Units

logger.info("Creating wetland Units")

try:
    strWU = CreateWetlandUnits(WetlandPoly)
except arcpy.ExecuteError:
    msgs = "EXECUTE ERRORS:\n" + arcpy.GetMessages(2) + "\n"
    arcpy.AddError(msgs)

```



```

logger.error(msgs)
logger.error("Failed to create Wetland Units")
sys.exit(1)
except:
    tb = sys.exc_info()[2]
    tbinfo = traceback.format_tb(tb)[0]
    pymsg = "PYTHON ERRORS:\nTraceback info:\n" + tbinfo + "\nError Info:\n" +
str(sys.exc_info()[1])
    msgs = "ArcPy ERRORS:\n" + arcpy.GetMessages(2) + "\n"

arcpy.AddError(pymsg)
arcpy.AddError(msgs)
logger.error(pymsg)
logger.error(msgs)
logger.error("Failed to create Wetland Units")
sys.exit(1)

## 3. Create basic geometries used for assessment of Wetland Units
logger.info("Creating basic geometries used for assessment of Wetland Units")
try:
    CreateBasicGeom(strWU)
except arcpy.ExecuteError:
    msgs = "EXECUTE ERRORS:\n" + arcpy.GetMessages(2) + "\n"
    arcpy.AddError(msgs)
    logger.error(msgs)
    logger.error("Failed to create basic geometries used for assessment of Wetland Units")
    sys.exit(1)
except:
    tb = sys.exc_info()[2]
    tbinfo = traceback.format_tb(tb)[0]

```

```

    pymsg = "PYTHON ERRORS:\nTraceback info:\n" + tbinfo + "\nError Info:\n" +
str(sys.exc_info()[1])
    msgsg = "ArcPy ERRORS:\n" + arcpy.GetMessages(2) + "\n"

    arcpy.AddError(pymsg)
    arcpy.AddError(msgsg)
    logger.error(pymsg)
    logger.error(msgsg)
    logger.error("Failed to create basic geometries used for assessment of Wetland Units")
    sys.exit(1)

```

#### ## 4. Floodplain

```
try:
```

```
    DetermineFloodArea(strWU)
```

```
except arcpy.ExecuteError:
```

```
    msgsg = "EXECUTE ERRORS:\n" + arcpy.GetMessages(2) + "\n"
```

```
    arcpy.AddError(msgsg)
```

```
    logger.error(msgsg)
```

```
    logger.error("Failed to calculate flood area")
```

```
    sys.exit(1)
```

```
except:
```

```
    tb = sys.exc_info()[2]
```

```
    tbinfo = traceback.format_tb(tb)[0]
```

```
    pymsg = "PYTHON ERRORS:\nTraceback info:\n" + tbinfo + "\nError Info:\n" +
str(sys.exc_info()[1])
```

```
    msgsg = "ArcPy ERRORS:\n" + arcpy.GetMessages(2) + "\n"
```

```
    arcpy.AddError(pymsg)
```

```
    arcpy.AddError(msgsg)
```

```
    logger.error(pymsg)
```

```
logger.error(msgs)
logger.error("Failed to calculate flood area")
sys.exit(1)
```

### ## 5. DrainageArea

```
try:
```

```
    DetermineDrainageArea(strWU)
```

```
except arcpy.ExecuteError:
```

```
    msgs = "EXECUTE ERRORS:\n" + arcpy.GetMessages(2) + "\n"
```

```
    arcpy.AddError(msgs)
```

```
    logger.error(msgs)
```

```
    logger.error("Failed to calculate flood area")
```

```
    sys.exit(1)
```

```
except:
```

```
    tb = sys.exc_info()[2]
```

```
    tbinfo = traceback.format_tb(tb)[0]
```

```
    pymsg = "PYTHON ERRORS:\nTraceback info:\n" + tbinfo + "\nError Info:\n" +
str(sys.exc_info()[1])
```

```
    msgs = "ArcPy ERRORS:\n" + arcpy.GetMessages(2) + "\n"
```

```
    arcpy.AddError(pymsg)
```

```
    arcpy.AddError(msgs)
```

```
    logger.error(pymsg)
```

```
    logger.error(msgs)
```

```
    logger.error("Failed to calculate flood area")
```

```
    sys.exit(1)
```

```
return strWU
```

### 5.7.74 Water Quality

```
#####  
#  
# File Name: WQuality.py  
# Developer: Yibing Han  
# Date: 12/13/2017  
# Purpose:  
# This script handles the execution of all metrics within the Water Quality module.  
#  
#####  
#!/usr/bin/python  
import sys  
import arcpy  
import datetime  
import logging  
import traceback  
  
from WQPotential import WQPotential  
from WQOpportun import WQOpportun  
from WQSociety import WQSociety  
from WQFunction import WQFunction  
  
logger = logging.getLogger("WFA.WQuality")  
  
def RunWaterQuality(WetlandPoly):  
  
    ## 1. Run Water Quality Potential Variables/Aspects/Factors  
    logger.info("Running Water Quality Potential Variables/Aspects/Factors...")  
    try:
```

```

WQPotential.procWQPotential(WetlandPoly)
logger.info("Water Quality Potential Variables/Aspects/Factors completed")
except arcpy.ExecuteError:
    msgs = "EXECUTE ERRORS:\n" + arcpy.GetMessages(2) + "\n"
    arcpy.AddError(msgs)
    logger.error(msgs)
    sys.exit(1)
except:
    tb = sys.exc_info()[2]
    tbinfo = traceback.format_tb(tb)[0]
    pymsg = "PYTHON ERRORS:\nTraceback info:\n" + tbinfo + "\nError Info:\n" +
str(sys.exc_info()[1])
    msgs = "ArcPy ERRORS:\n" + arcpy.GetMessages(2) + "\n"

    arcpy.AddError(pymsg)
    arcpy.AddError(msgs)
    logger.error(pymsg)
    logger.error(msgs)
    sys.exit(1)

## 2. Run Water Quality Opportunity Variables/Aspects/Factors
logger.info("Running Water Quality Opportunity Variables/Aspects/Factors...")
try:
    WQOpportun.procWQOpportun(WetlandPoly)
    logger.info("Water Quality Opportunity Variables/Aspects/Factors completed")
except arcpy.ExecuteError:
    msgs = "EXECUTE ERRORS:\n" + arcpy.GetMessages(2) + "\n"
    arcpy.AddError(msgs)
    logger.error(msgs)
    sys.exit(1)

```

```

except:
    tb = sys.exc_info()[2]
    tbinfo = traceback.format_tb(tb)[0]
    pymsg = "PYTHON ERRORS:\nTraceback info:\n" + tbinfo + "\nError Info:\n" +
str(sys.exc_info()[1])
    msg = "ArcPy ERRORS:\n" + arcpy.GetMessages(2) + "\n"

    arcpy.AddError(pymsg)
    arcpy.AddError(msg)
    logger.error(pymsg)
    logger.error(msg)
    sys.exit(1)

```

## 3. Run Water Quality Society Variables/Aspects/Factors

```

logger.info("Running Water Quality Society Variables/Aspects/Factors...")

```

```

try:

```

```

    WQSociety.procWQSociety(WetlandPoly)

```

```

    logger.info("Water Quality Society Variables/Aspects/Factors completed")

```

```

except arcpy.ExecuteError:

```

```

    msg = "EXECUTE ERRORS:\n" + arcpy.GetMessages(1) + "\n"

```

```

    arcpy.AddError(msg)

```

```

    logger.error(msg)

```

```

    sys.exit(1)

```

```

except:

```

```

    tb = sys.exc_info()[2]

```

```

    tbinfo = traceback.format_tb(tb)[0]

```

```

    pymsg = "PYTHON ERRORS:\nTraceback info:\n" + tbinfo + "\nError Info:\n" +
str(sys.exc_info()[1])

```

```

    msg = "ArcPy ERRORS:\n" + arcpy.GetMessages(2) + "\n"

```

```
arcpy.AddError(pymsg)
arcpy.AddError(msgs)
logger.error(pymsg)
logger.error(msgs)
sys.exit(1)
```

#### ## 4. Run Water Quality Function to roll up Variables/Aspects/Factors

```
logger.info("Running Water Quality Function to roll up Variables/Aspects/Factors...")
```

```
try:
```

```
    WQFunction.DetermineWQFunction(WetlandPoly)
```

```
    logger.info("Water Quality Function to roll up Variables/Aspects/Factors completed")
```

```
except arcpy.ExecuteError:
```

```
    msgs = "EXECUTE ERRORS:\n" + arcpy.GetMessages(2) + "\n"
```

```
    arcpy.AddError(msgs)
```

```
    logger.error(msgs)
```

```
    sys.exit(1)
```

```
except:
```

```
    tb = sys.exc_info()[2]
```

```
    tbinfo = traceback.format_tb(tb)[0]
```

```
    pymsg = "PYTHON ERRORS:\nTraceback info:\n" + tbinfo + "\nError Info:\n" +
str(sys.exc_info()[1])
```

```
    msgs = "ArcPy ERRORS:\n" + arcpy.GetMessages(2) + "\n"
```

```
arcpy.AddError(pymsg)
```

```
arcpy.AddError(msgs)
```

```
logger.error(pymsg)
```

```
logger.error(msgs)
```

```
sys.exit(1)
```

### 5.7.75 Water Quality Function

```
#####  
#  
# File Name: WQFunction.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 3/13/2017 (modified 11/02/2017)  
# Purpose:  
#   Water Quality Function  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import arcpy  
from utilities import actions  
import logging  
  
def DetermineWQFunction(WetlandPoly):  
    logger = logging.getLogger("WFA.WQuality.WQFunction")  
  
    # Clean up if needed  
    if arcpy.Exists("WU_WQFunction0"):  
        arcpy.Delete_management("WU_WQFunction0")  
    if arcpy.Exists("WU_WQFunction1"):  
        arcpy.Delete_management("WU_WQFunction1")  
    if arcpy.Exists("WU_WQFunction2"):  
        arcpy.Delete_management("WU_WQFunction2")  
    if arcpy.Exists("WU_WQFunction"):
```



```

arcpy.Delete_management("WU_WQFunction")

# Setting python variables
arcpy.MakeFeatureLayer_management(r"WU_WQPotential","fcWQPotential")
arcpy.MakeFeatureLayer_management(r"WU_WQOpportun","fcWQOpportun")
arcpy.MakeFeatureLayer_management(r"WU_WQSociety","fcWQSociety")
logger.info("feature layers ready")

## Create feature class to store WQFunction
arcpy.CopyFeatures_management(WetlandPoly, "WU_WQFunction0")
arcpy.MakeFeatureLayer_management("WU_WQFunction0","fcWUWQFunction0")
logger.info("feature class WU_WQFunction0 created")

## Spatial join to bring in aspect values

#####
#####

# SJ: WQPotential

#####
#####

fmSJWQPO = arcpy.FieldMappings()
fmSJWQPO.addTable("fcWUWQFunction0")
fmSJWQPO.addTable("fcWQPotential")

keepers = []
keepers = ["WUKey","Shape_Length","Shape_Area","WQPotential"]

for field in fmSJWQPO.fields:
    if field.name not in keepers:
        fmSJWQPO.removeFieldMap(fmSJWQPO.findFieldMapIndex(field.name))

```

```

arcpy.SpatialJoin_analysis("fcWUWQFunction0","fcWQPotential","WU_WQFunction1","JOI
N_ONE_TO_ONE","KEEP_ALL",fmSJWQPO,"CONTAINS")
    arcpy.MakeFeatureLayer_management("WU_WQFunction1","fcWQFunction1")
    logger.info("Spatial Join completed to add variable WQPotential")

```

```

#####
#####

```

```

# SJ: WQOpportun

```

```

#####
#####

```

```

fmSJWQOP = arcpy.FieldMappings()
fmSJWQOP.addTable("fcWQFunction1")
fmSJWQOP.addTable("fcWQOpportun")

```

```

keepers = []
keepers = ["WUKey","Shape_Length","Shape_Area","WQPotential","WQOpportun"]

```

```

for field in fmSJWQOP.fields:
    if field.name not in keepers:
        fmSJWQOP.removeFieldMap(fmSJWQOP.findFieldMapIndex(field.name))

```

```

arcpy.SpatialJoin_analysis("fcWQFunction1","fcWQOpportun","WU_WQFunction2","JOIN_
ONE_TO_ONE","KEEP_ALL",fmSJWQOP,"CONTAINS")
    arcpy.MakeFeatureLayer_management("WU_WQFunction2","fcWQFunction2")
    logger.info("Spatial Join completed to add variable WQOpportun")

```

```

#####
#####
# SJ: WQSociety

#####
#####

fmSJWQS = arcpy.FieldMappings()
fmSJWQS.addTable("fcWQFunction2")
fmSJWQS.addTable("fcWQSociety")

keepers = []
keepers =
["WUKey","Shape_Length","Shape_Area","WQPotential","WQOpportun","WQSociety"]

for field in fmSJWQS.fields:
    if field.name not in keepers:
        fmSJWQS.removeFieldMap(fmSJWQS.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis("fcWQFunction2","fcWQSociety","WU_WQFunction","JOIN_ON
E_TO_ONE","KEEP_ALL",fmSJWQS,"CONTAINS")
arcpy.MakeFeatureLayer_management("WU_WQFunction","fcWQFunction")
logger.info("Spatial Join completed to add variable WQSociety")

## Add WQFunction field to Wetland Units and set initial point value to 0
actions.DeleteField("fcWQFunction","WQFunction")
arcpy.AddField_management("fcWQFunction", "WQFunction", "SHORT")
arcpy.CalculateField_management("fcWQFunction","WQFunction","0","VB","#")
logger.info("WQFunction field added to Wetland Units and initial point values set to zero")

```

```
## Sum the points for each aspect of Water Quality Function for Wetland Units

arcpy.CalculateField_management("fcWQFunction","WQFunction","[WQPotential]+[WQOpp
ortun]+[WQSociety]","VB","#")

logger.info("points summed for WQFunction")

## Clean up
if arcpy.Exists("WU_WQFunction0"):
    arcpy.Delete_management("WU_WQFunction0")
if arcpy.Exists("WU_WQFunction1"):
    arcpy.Delete_management("WU_WQFunction1")
if arcpy.Exists("WU_WQFunction2"):
    arcpy.Delete_management("WU_WQFunction2")
```

### 5.7.76 Water Quality Opportunity

```
#####  
#  
# File Name: WQOpportun.py  
# Developer: Yibing Han  
# Date: 12/13/2017  
# Purpose:  
# This script handles the execution of all the Water Quality Opportunity metrics.  
#  
#####  
import datetime  
import logging  
import traceback  
import arcpy  
  
from Factors import Discharges, ImpairedIn, RoadRail, Disturb50m, DisturbWshd  
from Aspects import WQOpportun  
  
def procWQOpportun(WetlandPoly):  
    logger = logging.getLogger("WFA.WQuality.WQOpportun")  
  
    #####  
    ## 1. Run Variables  
    #####  
  
    # None  
  
    #####  
    ## 2. Run Factors
```

#####

Discharges.DetermineDischarges(WetlandPoly)

ImpairedIn.DetermineImpairedIn()

RoadRail.CalcRoadRail(WetlandPoly)

Disturb50m.DetermineDisturb50m(WetlandPoly)

DisturbWshd.DetermineDisturbWshd(WetlandPoly)

#####

## 3. Run Aspect

#####

WQOpportun.DetermineWQOpportun(WetlandPoly)

### 5.7.77 Water Quality Opportunity Aspects

```
#####  
#  
# File Name: WQOpportun.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 6/15/2016 (modified 11/02/2017)  
# Purpose:  
#   Water Quality Function  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import arcpy  
from utilities import actions  
import logging  
  
def DetermineWQOpportun(WetlandPoly):  
    logger = logging.getLogger("WFA.WQuality.WQOpportun")  
  
    # Clean up if needed  
    if arcpy.Exists("WU_WQOpportun0"):  
        arcpy.Delete_management("WU_WQOpportun0")  
    if arcpy.Exists("WU_WQOpportun1"):  
        arcpy.Delete_management("WU_WQOpportun1")  
    if arcpy.Exists("WU_WQOpportun2"):  
        arcpy.Delete_management("WU_WQOpportun2")  
    if arcpy.Exists("WU_WQOpportun3"):
```

```

    arcpy.Delete_management("WU_WQOpportun3")
if arcpy.Exists("WU_WQOpportun4"):
    arcpy.Delete_management("WU_WQOpportun4")
if arcpy.Exists("WU_WQOpportun5"):
    arcpy.Delete_management("WU_WQOpportun5")
if arcpy.Exists("WU_WQOpportun"):
    arcpy.Delete_management("WU_WQOpportun")

```

```

# Setting python variables

```

```

arcpy.MakeFeatureLayer_management(WetlandPoly,"WU_WQOpportun0")
arcpy.MakeFeatureLayer_management(r"WU_Discharges","fcDischarges")
arcpy.MakeFeatureLayer_management(r"WU_ImpairedIn","fcImpairedIn")
arcpy.MakeFeatureLayer_management(r"WU_RoadRail","fcRoadRail")
arcpy.MakeFeatureLayer_management(r"WU_Disturb50m","fcDisturb50m")
arcpy.MakeFeatureLayer_management(r"WU_DisturbWshd","fcDisturbWshd")
arcpy.MakeFeatureLayer_management(r"WU_FloodArea","fcFloodplain")
logger.info("feature layers ready")

```

```

# Spatial join to bring in factor values

```

```

#####
#####

```

```

# SJ: Discharges

```

```

#####
#####

```

```

fmSJDis = arcpy.FieldMappings()
fmSJDis.addTable("WU_WQOpportun0")
fmSJDis.addTable("fcDischarges")

```

```

keepers = []

```



```
keepers = ["WUKey","Shape_Length","Shape_Area","Discharges"]
```

```
for field in fmSJDis.fields:
```

```
    if field.name not in keepers:
```

```
        fmSJDis.removeFieldMap(fmSJDis.findFieldMapIndex(field.name))
```

```
arcpy.SpatialJoin_analysis("WU_WQOpportun0","fcDischarges","WU_WQOpportun1","JOIN  
_ONE_TO_ONE","KEEP_ALL",fmSJDis,"CONTAINS")
```

```
arcpy.MakeFeatureLayer_management("WU_WQOpportun1","fcWQOpportun1")
```

```
logger.info("Spatial Join completed to add variable Discharges")
```

```
#####  
#####
```

```
# SJ: ImpairedIn
```

```
#####  
#####
```

```
fmSJII = arcpy.FieldMappings()
```

```
fmSJII.addTable("fcWQOpportun1")
```

```
fmSJII.addTable("fcImpairedIn")
```

```
keepers = []
```

```
keepers = ["WUKey","Shape_Length","Shape_Area","Discharges","ImpairedIn"]
```

```
for field in fmSJII.fields:
```

```
    if field.name not in keepers:
```

```
        fmSJII.removeFieldMap(fmSJII.findFieldMapIndex(field.name))
```

```

arcpy.SpatialJoin_analysis("fcWQOpportun1","fcImpairedIn","WU_WQOpportun2","JOIN_O
NE_TO_ONE","KEEP_ALL",fmSJII,"CONTAINS")
    arcpy.MakeFeatureLayer_management("WU_WQOpportun2","fcWQOpportun2")
    logger.info("Spatial Join completed to add variable ImpairedIn")

#####
#####

# SJ: RoadRail

#####
#####

fmSJRR = arcpy.FieldMappings()
fmSJRR.addTable("WU_WQOpportun2")
fmSJRR.addTable("fcRoadRail")

keepers = []
keepers = ["WUKey","Shape_Length","Shape_Area","Discharges","ImpairedIn","RoadRail"]

for field in fmSJRR.fields:
    if field.name not in keepers:
        fmSJRR.removeFieldMap(fmSJRR.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis("fcWQOpportun2","fcRoadRail","WU_WQOpportun3","JOIN_ON
E_TO_ONE","KEEP_ALL",fmSJRR,"CONTAINS")
    arcpy.MakeFeatureLayer_management("WU_WQOpportun3","fcWQOpportun3")
    logger.info("Spatial Join completed to add variable RoadRail")

```

```
#####  
#####
```

```
# SJ: Distrub50m
```

```
#####  
#####
```

```
fmSJD50 = arcpy.FieldMappings()  
fmSJD50.addTable("fcWQOpportun3")  
fmSJD50.addTable("fcDisturb50m")
```

```
keepers = []  
keepers =  
["WUKey", "Shape_Length", "Shape_Area", "Discharges", "ImpairedIn", "RoadRail", "Disturb50m"  
"]
```

```
for field in fmSJD50.fields:  
    if field.name not in keepers:  
        fmSJD50.removeFieldMap(fmSJD50.findFieldMapIndex(field.name))
```

```
arcpy.SpatialJoin_analysis("fcWQOpportun3", "fcDisturb50m", "WU_WQOpportun4", "JOIN_O  
NE_TO_ONE", "KEEP_ALL", fmSJD50, "CONTAINS")  
arcpy.MakeFeatureLayer_management("WU_WQOpportun4", "fcWQOpportun4")  
logger.info("Spatial Join completed to add variable Distrub50m")
```

```
#####  
#####
```

```
# SJ: DistrubWshd
```

```
#####  
#####
```

```

fmSJDW = arcpy.FieldMappings()
fmSJDW.addTable("fcWQOpportun4")
fmSJDW.addTable("fcDisturbWshd")

keepers = []
keepers =
["WUKey","Shape_Length","Shape_Area","Discharges","ImpairedIn","RoadRail","Disturb50m
","DisturbWshd"]

for field in fmSJDW.fields:
    if field.name not in keepers:
        fmSJDW.removeFieldMap(fmSJDW.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis("fcWQOpportun4","fcDisturbWshd","WU_WQOpportun5","JOIN_
ONE_TO_ONE","KEEP_ALL",fmSJDW,"CONTAINS")
arcpy.MakeFeatureLayer_management("WU_WQOpportun5","fcWQOpportun5")
logger.info("Spatial Join completed to add variable DistrubWshd")

#####
#####

# SJ: Floodplain

#####
#####

fmSJFP = arcpy.FieldMappings()
fmSJFP.addTable("fcWQOpportun5")
fmSJFP.addTable("fcFloodplain")

keepers = []

```

```
keepers =  
["WUKey", "Shape_Length", "Shape_Area", "Discharges", "ImpairedIn", "RoadRail", "Disturb50m",  
"DisturbWshd", "Floodplain"]
```

```
for field in fmSJFP.fields:
```

```
    if field.name not in keepers:
```

```
        fmSJFP.removeFieldMap(fmSJFP.findFieldMapIndex(field.name))
```

```
arcpy.SpatialJoin_analysis("fcWQOpportun5", "fcFloodplain", "WU_WQOpportun", "JOIN_ON  
E_TO_ONE", "KEEP_ALL", fmSJFP, "CONTAINS")
```

```
arcpy.MakeFeatureLayer_management("WU_WQOpportun", "fcWQOpportun")
```

```
logger.info("Spatial Join completed to add variable Floodplain")
```

```
# Add WQOpportun field and set initial value to 0
```

```
actions.DeleteField("fcWQOpportun", "WQOpportun")
```

```
arcpy.AddField_management("fcWQOpportun", "WQOpportun", "SHORT")
```

```
arcpy.CalculateField_management("fcWQOpportun", "WQOpportun", "0", "VB", "#")
```

```
logger.info("WQOpportun field added to Wetland Units and initial point values set to zero")
```

```
# Sum the factor points
```

```
arcpy.CalculateField_management("fcWQOpportun", "WQOpportun", "[Discharges] +  
[ImpairedIn] + [RoadRail] + [Disturb50m] + [DisturbWshd]", "VB", "#")
```

```
logger.info("points summed for WQOpportun")
```

```
# Reduce values that exceed the maximum allowable points
```

```
arcpy.SelectLayerByAttribute_management("fcWQOpportun", "NEW_SELECTION", """"Flood  
plain" = 'Y' AND "WQOpportun" > 5""")
```

```
arcpy.CalculateField_management("fcWQOpportun", "WQOpportun", "5", "VB", "#")
```

```
arcpy.SelectLayerByAttribute_management("fcWQOpportun", "CLEAR_SELECTION")
```

```

arcpy.SelectLayerByAttribute_management("fcWQOpportun","NEW_SELECTION","""Flood
plain" = 'N' AND "WQOpportun" > 4""")
    arcpy.CalculateField_management("fcWQOpportun","WQOpportun","4","VB","#")
arcpy.SelectLayerByAttribute_management("fcWQOpportun", "CLEAR_SELECTION")
logger.info("points reduced to maximum allowed for WQOpportun")

# Clean up
if arcpy.Exists("WU_WQOpportun0"):
    arcpy.Delete_management("WU_WQOpportun0")
if arcpy.Exists("WU_WQOpportun1"):
    arcpy.Delete_management("WU_WQOpportun1")
if arcpy.Exists("WU_WQOpportun2"):
    arcpy.Delete_management("WU_WQOpportun2")
if arcpy.Exists("WU_WQOpportun3"):
    arcpy.Delete_management("WU_WQOpportun3")
if arcpy.Exists("WU_WQOpportun4"):
    arcpy.Delete_management("WU_WQOpportun4")
if arcpy.Exists("WU_WQOpportun5"):
    arcpy.Delete_management("WU_WQOpportun5")

```

### 5.7.78 Discharges: Water Quality Opportunity

```
#####  
#  
# File Name: Discharges.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 6/8/2016 (modified 12/01/2017)  
# Purpose:  
#   Water Quality Function  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def DetermineDischarges(WetlandPoly):  
    logger = logging.getLogger("WFA.WQuality.WQOpportun.Discharges")  
  
    # Clean up if needed  
    if arcpy.Exists("WU_Discharges"):  
        arcpy.Delete_management("WU_Discharges")  
  
    # Setting python variables  
    arcpy.MakeFeatureLayer_management(globalvars.srcSeptic, "fcSeptic")  
    arcpy.MakeFeatureLayer_management(globalvars.srcOWRNPDES, "fcOWRNPDES")
```

```

arcpy.MakeFeatureLayer_management(globalvars.srcOWRNPDESOutlets,
"fcOWRNPDESOutlets")
arcpy.MakeFeatureLayer_management(globalvars.srcHPU, "fcHPU")
arcpy.MakeFeatureLayer_management(globalvars.srcAMLAMD, "fcAMLAMD")
arcpy.MakeFeatureLayer_management(globalvars.srcWellPads, "fcWellPads")
arcpy.MakeFeatureLayer_management(globalvars.srcNPLPoint, "fcNPLPoint")
arcpy.MakeFeatureLayer_management(globalvars.srcNPLBndry, "fcNPLBndry")

# Create feature class to store Discharges variable
arcpy.CopyFeatures_management(WetlandPoly, "WU_Discharges")
fcWUDischarges = arcpy.mapping.Layer(r"WU_Discharges")
logger.info("feature layers ready")

# Add Discharges field to Wetland Units and set the initial value to zero
actions.DeleteField(fcWUDischarges, "Discharges")
arcpy.AddField_management(fcWUDischarges, "Discharges", "SHORT")
arcpy.CalculateField_management(fcWUDischarges, "Discharges", "0", "VB")
logger.info("field Discharges added and initial value set to 0")

#####
#
## PART 1: Select the owrnpdes_ records that are not deep injection points
## and not septic tanks, then select wetlands within 100m of selected points or septic

#####
#
strWHERE = """"perm_type" = '401 Certification' OR "perm_type" = 'Industrial' OR
"perm_type" = 'Sewage' OR "perm_type" = 'UIC Sewage' OR "perm_type" = 'UIC Stormwater
Industrial""""
arcpy.SelectLayerByAttribute_management("fcOWRNPDES", "NEW_SELECTION",
strWHERE)

```



```

# Select Wetland Units within 100m of Septic or selected NPDES records and assign 1 point

arcpy.SelectLayerByLocation_management(fcWUDischarges,"INTERSECT","fcSeptic","100
Meters","NEW_SELECTION")

arcpy.SelectLayerByLocation_management(fcWUDischarges,"INTERSECT","fcOWRNPDES"
,"100 Meters","ADD_TO_SELECTION")

logger.info("Wetland Units within 100m of Septic or selected NPDES records selected")

arcpy.CalculateField_management(fcWUDischarges,"Discharges","1","VB","#")
logger.info("1 point assigned to selected wetland units")

arcpy.SelectLayerByAttribute_management(fcWUDischarges, "CLEAR_SELECTION")
arcpy.SelectLayerByAttribute_management("fcSeptic", "CLEAR_SELECTION")
arcpy.SelectLayerByAttribute_management("fcOWRNPDES", "CLEAR_SELECTION")

#####
#####

## PART 2: Select relevant records from ownrpdes_outlets that are not deep injection

#####
#####

strWHERE = """"perm_type" = 'Industrial' OR "perm_type" = 'Sewage' OR "perm_type" =
'UIC Sewage' OR "perm_type" = 'UIC Stormwater Industrial'""""

arcpy.SelectLayerByAttribute_management("fcOWRNPDESOutlets",
"NEW_SELECTION", strWHERE)

# Select relevant records (outlets with open status) from Hydrologic Protection Units
#strWHERE = """"stat_flag" = 'O' AND "insp_type" = 'OUTLT'"""" #Field names change
3/15/2017 MCA

strWHERE = """"STATUS_FL A" = 'O' AND "INSPECTA_1" = 'OUTLT'""""

```

```

arcpy.SelectLayerByAttribute_management("fcHPU", "NEW_SELECTION", strWHERE)
logger.info("relevant records (outlets with open status) from Hydrologic Protection Units
selected")

# Select Wetland Units within 100m of potential discharges and assign 2 points

arcpy.SelectLayerByLocation_management(fcWUDischarges,"INTERSECT","fcOWRNPDES
Outlets","100 Meters","NEW_SELECTION")

arcpy.SelectLayerByLocation_management(fcWUDischarges,"INTERSECT","fcHPU","100
Meters","ADD_TO_SELECTION")

arcpy.SelectLayerByLocation_management(fcWUDischarges,"INTERSECT","fcAMLAMD","
100 Meters","ADD_TO_SELECTION")

arcpy.SelectLayerByLocation_management(fcWUDischarges,"INTERSECT","fcWellPads","10
0 Meters","ADD_TO_SELECTION")

arcpy.SelectLayerByLocation_management(fcWUDischarges,"INTERSECT","fcNPLPoint","1
00 Meters","ADD_TO_SELECTION")

arcpy.SelectLayerByLocation_management(fcWUDischarges,"INTERSECT","fcNPLBndry","
100 Meters","ADD_TO_SELECTION")

logger.info("Wetland Units within 100m of potential discharges selected")

arcpy.CalculateField_management(fcWUDischarges,"Discharges","2","VB","#")
logger.info("2 points assigned to selected wetland units")

arcpy.SelectLayerByAttribute_management(fcWUDischarges, "CLEAR_SELECTION")
arcpy.SelectLayerByAttribute_management("fcOWRNPDESOutlets",
"CLEAR_SELECTION")
arcpy.SelectLayerByAttribute_management("fcHPU", "CLEAR_SELECTION")
arcpy.SelectLayerByAttribute_management("fcAMLAMD", "CLEAR_SELECTION")
arcpy.SelectLayerByAttribute_management("fcWellPads", "CLEAR_SELECTION")

```

```
arcpy.SelectLayerByAttribute_management("fcNPLPoint", "CLEAR_SELECTION")  
arcpy.SelectLayerByAttribute_management("fcNPLBndry", "CLEAR_SELECTION")
```

### 5.7.79 Distrub50: Water Quality Opportunity

```
#####  
#  
# File Name: Disturb50m.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 6/16/2016 (modified 10/31/2017)  
# Purpose:  
#   Water Quality Function / Opportunity aspect  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def DetermineDisturb50m(WetlandPoly):  
    logger = logging.getLogger("WFA.WQuality.WQOpportun.Disturb50m")  
  
    # Clean up if needed  
    if arcpy.Exists("Buffer50mDist"):  
        arcpy.Delete_management("Buffer50mDist")  
    if arcpy.Exists("Buffer50mDist_diss"):  
        arcpy.Delete_management("Buffer50mDist_diss")  
    if arcpy.Exists("WU_Disturb50m"):  
        arcpy.Delete_management("WU_Disturb50m")
```

```

if arcpy.Exists("WU_Disturb50m1"):
    arcpy.Delete_management("WU_Disturb50m1")

# Setting python variables
fcDisturbedLand = arcpy.mapping.Layer(globalvars.srcDisturbedLand)
fcBuffer50m = arcpy.mapping.Layer(globalvars.srcBuffer50m)
logger.info("feature layers ready")

## Create feature class to store intermediate results for Disturb50m
arcpy.CopyFeatures_management(WetlandPoly,"WU_Disturb50m1","#","0","0","0")
arcpy.MakeFeatureLayer_management("WU_Disturb50m1", "fcWUDisturb50m1")
logger.info("feature class WU_Disturb50m1 created")

# Intersect the 50m buffers and the disturbed land uses
arInputData = [fcBuffer50m,fcDisturbedLand]
arcpy.Intersect_analysis(arInputData,"Buffer50mDist","ALL",output_type="INPUT")
fcBuffer50mDist = arcpy.mapping.Layer(r"Buffer50mDist")
logger.info("intersected disturbed land uses with 50m buffers")

# Dissolve disturbed lands by wetland buffer
arcpy.Dissolve_management(fcBuffer50mDist,"Buffer50mDist_diss","WUKey","BufferArea
FIRST","MULTI_PART","DISSOLVE_LINES")
fcBuffer50mDist_diss = arcpy.mapping.Layer(r"Buffer50mDist_diss")
logger.info("dissolved disturbed lands by wetland buffer")

# Add field and calculate ration of disturbed are to total drainage
actions.DeleteField(fcBuffer50mDist_diss,"Dist50mRat")
arcpy.AddField_management(fcBuffer50mDist_diss, "Dist50mRat", "FLOAT")

```

```

arcpy.CalculateField_management(fcBuffer50mDist_diss,"Dist50mRat","[Shape_Area]/[FIRST
_BufferArea]","VB","#")
    logger.info("field Dist50mRat added and calculated")

# Join ratio of Disturbed land to Wetland Units

arcpy.AddJoin_management("fcWUDisturb50m1","WUKey","Buffer50mDist_diss","WUKey",
"KEEP_ALL")
    logger.info("ratio of Disturbed land joined to Wetland Units")

# Export joined data
#arcpy.CopyFeatures_management("fcWUDisturb50m1","WU_Disturb50m","#","0","0","0")

arcpy.FeatureClassToFeatureClass_conversion("fcWUDisturb50m1",arcpy.env.workspace,"W
U_Disturb50m")
    fcWUDisturb50m = arcpy.mapping.Layer(r"WU_Disturb50m")
    logger.info("joined data exported")

## Remove Join
arcpy.RemoveJoin_management("fcWUDisturb50m1")
    logger.info("joined removed")

# Update Null records to 0 in the Dist50mRat field

arcpy.SelectLayerByAttribute_management(fcWUDisturb50m,"NEW_SELECTION","""Buff
er50mDist_diss_Dist50mRat" IS NULL""")

arcpy.CalculateField_management(fcWUDisturb50m,"Buffer50mDist_diss_Dist50mRat","0","
VB","#")
    logger.info("Null records updated to 0 in the Dist50mRat field")

```

```

# Add field to Wetland Units and set initial point value to zero
actions.DeleteField(fcWUDisturb50m,"Disturb50m")
arcpy.AddField_management(fcWUDisturb50m, "Disturb50m", "SHORT")
arcpy.CalculateField_management(fcWUDisturb50m,"Disturb50m","0","VB","#")
logger.info("field Disturb50m added to Wetland Units and initial point value set to zero")

# Assign Points

arcpy.SelectLayerByAttribute_management(fcWUDisturb50m,"NEW_SELECTION","""Buffer50mDist_diss_Dist50mRat" > 0.1""")
arcpy.CalculateField_management(fcWUDisturb50m,"Disturb50m","1","VB","#")

arcpy.SelectLayerByAttribute_management(fcWUDisturb50m,"NEW_SELECTION","""Buffer50mDist_diss_Dist50mRat" > 0.25""")
arcpy.CalculateField_management(fcWUDisturb50m,"Disturb50m","2","VB","#")

arcpy.SelectLayerByAttribute_management(fcWUDisturb50m,"NEW_SELECTION","""Buffer50mDist_diss_Dist50mRat" > 0.5""")
arcpy.CalculateField_management(fcWUDisturb50m,"Disturb50m","3","VB","#")
logger.info("points assigned to wetland units")
arcpy.SelectLayerByAttribute_management(fcWUDisturb50m, "CLEAR_SELECTION")

# Update NULL values with 0

arcpy.SelectLayerByAttribute_management(fcWUDisturb50m,"NEW_SELECTION","""Disturb50m" IS NULL""")
arcpy.CalculateField_management(fcWUDisturb50m,"Disturb50m","0","VB","#")
arcpy.SelectLayerByAttribute_management(fcWUDisturb50m, "CLEAR_SELECTION")
logger.info("Null records updated to 0 in the Disturb50m field")

```

```
# Clean up
if arcpy.Exists("Buffer50mDist"):
    arcpy.Delete_management("Buffer50mDist")
if arcpy.Exists("Buffer50mDist_diss"):
    arcpy.Delete_management("Buffer50mDist_diss")
if arcpy.Exists("WU_Disturb50m1"):
    arcpy.Delete_management("WU_Disturb50m1")
```



### 5.7.80 DisturbWshd: Water Quality Opportunity

```
#####  
#  
# File Name: DisturbWshd.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 5/27/2016 (modified 11/10/2017)  
# Purpose:  
# Water Quality Function / Opportunity aspect  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def DetermineDisturbWshd(WetlandPoly):  
    logger = logging.getLogger("WFA.WQuality.WQOpportun.DisturbWshd")  
  
    # Clean up if needed  
    #if arcpy.Exists("DrainAreaDist"):  
        #arcpy.Delete_management("DrainAreaDist")  
    if arcpy.Exists("DrainAreaDist_diss"):  
        arcpy.Delete_management("DrainAreaDist_diss")  
    if arcpy.Exists("WU_DisturbWshd"):  
        arcpy.Delete_management("WU_DisturbWshd")
```

```

if arcpy.Exists("WU_DisturbWshd1"):
    arcpy.Delete_management("WU_DisturbWshd1")

# Setting python variables
fcDA27m = arcpy.mapping.Layer(globalvars.srcDrainageArea)
fcDL = arcpy.mapping.Layer(globalvars.srcDisturbedLand)
logger.info("feature layers ready")

## Create feature class to store intermediate results for Disturb50m
arcpy.CopyFeatures_management(WetlandPoly,"WU_DisturbWshd1","#","0","0","0")
arcpy.MakeFeatureLayer_management("WU_DisturbWshd1", "fcWUDisturbWshd1")
logger.info("feature class WU_DisturbWshd1 created")

# Intersect the drainage areas and the disturbed land uses (Takes 32 minutes 23 seconds to
run)
#arInputData = [fcDA27m,fcDL]
#arcpy.Intersect_analysis(arInputData,"DrainAreaDist","ALL","#","INPUT")
fcDrainAreaDist = arcpy.mapping.Layer(r"DrainAreaDist")
logger.info("drainage areas and the disturbed land uses intersected")

# Dissolve disturbed lands by drainage area (Takes around 23 hours)
arcpy.Dissolve_management(fcDrainAreaDist,"DrainAreaDist_diss","WUKey","CntrWshd
FIRST","MULTI_PART","DISSOLVE_LINES")
fcDrainAreaDistDiss = arcpy.mapping.Layer(r"DrainAreaDist_diss")
logger.info("disturbed lands dissolved by drainage area")

# Add field to DrainAreaDist_diss and calculate ratio of disturbed area to total drainage
actions.DeleteField(fcDrainAreaDistDiss,"DistWshdRat")
arcpy.AddField_management(fcDrainAreaDistDiss, "DistWshdRat", "FLOAT")

```

```

    arcpy.CalculateField_management(fcDrainAreaDistDiss, "DistWshdRat",
"[SHAPE_Area]/[FIRST_CntrWshd]", "VB")
    logger.info("field DistWshdRat added to DrainAreaDist_diss and calculated")

# Join ratio of disturbed land to Wetland Units

arcpy.AddJoin_management("fcWUDisturbWshd1","WUKey",fcDrainAreaDistDiss,"WUKey",
"KEEP_ALL")
    logger.info("ratio of disturbed land joined to wetland units")

# Export joined data
#arcpy.CopyFeatures_management("fcWUDisturbWshd1", "WU_DisturbWshd")

arcpy.FeatureClassToFeatureClass_conversion("fcWUDisturbWshd1",arcpy.env.workspace,"W
U_DisturbWshd")
    fcDisturbWshd = arcpy.mapping.Layer(r"WU_DisturbWshd")
    logger.info("joined data exported")
    arcpy.RemoveJoin_management("fcWUDisturbWshd1")

# Set NULL values in the DistWshdRat to 0

arcpy.SelectLayerByAttribute_management(fcDisturbWshd,"NEW_SELECTION","""DrainAr
eaDist_diss_DistWshdRat" IS NULL""")

arcpy.CalculateField_management(fcDisturbWshd,"DrainAreaDist_diss_DistWshdRat","0","V
B","#")
    logger.info("null values in DistWshdRat set to 0")
    arcpy.SelectLayerByAttribute_management(fcDisturbWshd, "CLEAR_SELECTION")

# Add field to Wetland Units and set initial point value to zero
actions.DeleteField(fcDisturbWshd,"DisturbWshd")
arcpy.AddField_management(fcDisturbWshd, "DisturbWshd", "SHORT")

```

```
arcpy.CalculateField_management(fcDisturbWshd, "DisturbWshd", "0", "VB")
logger.info("field DisturbWshd added to Wetland Units and initial point value set to zero")
```

```
# Assign points
```

```
arcpy.SelectLayerByAttribute_management(fcDisturbWshd,"NEW_SELECTION","""DrainAr
eaDist_diss_DistWshdRat" > 0.1""")
```

```
arcpy.CalculateField_management(fcDisturbWshd, "DisturbWshd", "1", "VB")
```

```
logger.info("points assigned to field DisturbWshd")
```

```
arcpy.SelectLayerByAttribute_management(fcDisturbWshd, "CLEAR_SELECTION")
```

```
# Clean up
```

```
if arcpy.Exists("DrainAreaDist"):
```

```
    arcpy.Delete_management("DrainAreaDist")
```

```
if arcpy.Exists("DrainAreaDist_diss"):
```

```
    arcpy.Delete_management("DrainAreaDist_diss")
```

```
if arcpy.Exists("WU_DisturbWshd1"):
```

```
    arcpy.Delete_management("WU_DisturbWshd1")
```

### 5.7.81 ImpairedIn: Water Quality Opportunity

```
#####  
#  
# File Name: ImpairedIn.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 6/10/2016 (modified 12/06/2017)  
# Purpose:  
#   Water Quality Function, Opportunity Aspect  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def DetermineImpairedIn():  
    logger = logging.getLogger("WFA.WQuality.WQOpportun.ImpairedIn")  
  
    # Clean up if needed  
    if arcpy.Exists("WU_ImpairedIn"):  
        arcpy.Delete_management("WU_ImpairedIn")  
  
    # Setting python variables  
    fcPublicFishing = arcpy.mapping.Layer(globalvars.srcPublicFishingLakes)  
    fcAlgalStreams = arcpy.mapping.Layer(globalvars.srcAlgalStreams)
```

```

fcAlgalLakes = arcpy.mapping.Layer(globalvars.srcAlgalLakes)
fcDA27m = arcpy.mapping.Layer(globalvars.srcDrainageArea)
fcWV202IS24kNHD = arcpy.mapping.Layer(globalvars.srcImpairedStreams)
#fcEPAOverlist24KNHD = arcpy.mapping.Layer(globalvars.srcEPAOverlist)

# Create feature class to store ImpairedIn variable
arcpy.CopyFeatures_management(r"WU_FloodArea", "WU_ImpairedIn")
fcWUImpairedIn = arcpy.mapping.Layer(r"WU_ImpairedIn")
logger.info("feature layers ready")

# Add ImpairedIn field to Wetland Units and set the initial value to zero
actions.DeleteField(fcWUImpairedIn,"ImpairedIn")
arcpy.AddField_management(fcWUImpairedIn, "ImpairedIn", "SHORT")
arcpy.CalculateField_management(fcWUImpairedIn, "ImpairedIn", "0", "VB")
logger.info("field ImpairedIn added and initial value set to 0")

# Add field to DrainageArea27m and set initial value to "N"
actions.DeleteField(fcDA27m,"ImpairSrc")
arcpy.DeleteField_management(fcDA27m,"ImpairSrc")
arcpy.AddField_management(fcDA27m, "ImpairSrc", "TEXT", 2)
arcpy.CalculateField_management(fcDA27m,"ImpairSrc","N","PYTHON_9.3")
logger.info("field ImpairSrc added and initial value set to 'N'")

# Select lakes with power boat use
strWHERE = """"BoatType" NOT LIKE 'No%""""
arcpy.SelectLayerByAttribute_management(fcPublicFishing, "NEW_SELECTION",
strWHERE)
logger.info("lakes with power boat use selected")

# Select Drainage Areas with power boat use

```

```
arcpy.SelectLayerByLocation_management(fcDA27m,"INTERSECT",fcPublicFishing,"#","NEW_SELECTION")
```

```
logger.info("Drainage Areas with power boat use selected")
```

```
# Select Drainage Areas with algal lakes
```

```
arcpy.SelectLayerByLocation_management(fcDA27m,"INTERSECT",fcAlgalLakes,"#","ADD_TO_SELECTION")
```

```
logger.info("Drainage Areas with algal lakes selected")
```

```
# Select Drainage Areas with algal streams
```

```
arcpy.SelectLayerByLocation_management(fcDA27m,"INTERSECT",fcAlgalStreams,"#","ADD_TO_SELECTION")
```

```
logger.info("Drainage Areas with algal streams selected")
```

```
# Select Drainage Area with impaired streams
```

```
arcpy.SelectLayerByLocation_management(fcDA27m,"INTERSECT",fcWV202IS24kNHD,"#","ADD_TO_SELECTION")
```

```
#arcpy.SelectLayerByLocation_management(fcDA27m,"INTERSECT",fcEPAOverlist24KNHD,"#","ADD_TO_SELECTION")
```

```
logger.info("Drainage Area with impaired streams selected")
```

```
# Set ImpairSrc to yes for Drainage Areas with an impaired water source
```

```
arcpy.CalculateField_management(fcDA27m,"ImpairSrc","Y","PYTHON_9.3")
```

```
logger.info("ImpairSrc set to yes for Drainage Areas with an impaired water source")
```

```
arcpy.SelectLayerByAttribute_management(fcWUImpairedIn, "CLEAR_SELECTION")
```

```
arcpy.SelectLayerByAttribute_management(fcPublicFishing, "CLEAR_SELECTION")
```

```

arcpy.SelectLayerByAttribute_management(fcAlgalLakes, "CLEAR_SELECTION")
arcpy.SelectLayerByAttribute_management(fcAlgalStreams, "CLEAR_SELECTION")
arcpy.SelectLayerByAttribute_management(fcWV202IS24kNHD, "CLEAR_SELECTION")

# Join Drainage Areas to Wetland Units

arcpy.JoinField_management(fcWUImpairedIn,"WUKey",fcDA27m,"WUKey","WUKey;ImpairSrc")

logger.info("Drainage Areas joined to Wetland Units")

# Assign 1 point to floodplain Wetland Units with impaired waters in their Drainage Area
strWHERE = """"Floodplain" = 'Y' AND "ImpairSrc" = 'Y'"""
arcpy.SelectLayerByAttribute_management(fcWUImpairedIn, "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management(fcWUImpairedIn, "ImpairedIn", "1", "VB")
logger.info("1 point assigned to floodplain Wetland Units with impaired waters in their
Drainage Area")

# Clear selections
arcpy.SelectLayerByAttribute_management(fcWUImpairedIn, "CLEAR_SELECTION")
arcpy.SelectLayerByAttribute_management(fcDA27m, "CLEAR_SELECTION")

# Select lakes with power boat use
strWHERE = """"BoatType" NOT LIKE 'No%'"""
arcpy.SelectLayerByAttribute_management(fcPublicFishing, "NEW_SELECTION",
strWHERE)
logger.info("lakes with power boat use selected")

# Select Wetland Units adjacent to lakes with power boat use

```



```
arcpy.SelectLayerByLocation_management(fcWUImpairedIn,"INTERSECT",fcPublicFishing,"5 Meters","NEW_SELECTION")
```

```
logger.info("Wetland Units adjacent to lakes with power boat use selected")
```

```
# Select Wetland Units adjacent to algal lakes
```

```
arcpy.SelectLayerByLocation_management(fcWUImpairedIn,"INTERSECT",fcAlgalLakes,"5 Meters","ADD_TO_SELECTION")
```

```
logger.info("Wetland Units adjacent to algal lakes selected")
```

```
# Select Wetland Units adjacent to algal streams
```

```
arcpy.SelectLayerByLocation_management(fcWUImpairedIn,"INTERSECT",fcAlgalStreams,"5 Meters","ADD_TO_SELECTION")
```

```
logger.info("Wetland Units adjacent to algal streams selected")
```

```
# Select Wetland Units adjacent to impaired streams
```

```
arcpy.SelectLayerByLocation_management(fcWUImpairedIn,"INTERSECT",fcWV202IS24kNHD,"5 Meters","ADD_TO_SELECTION")
```

```
#arcpy.SelectLayerByLocation_management(fcWUImpairedIn,"INTERSECT",fcEPAOverlist24KNHD,"#", "ADD_TO_SELECTION")
```

```
logger.info("Wetland Units adjacent to impaired streams selected")
```

```
# Assign 2 points to floodplain Wetland Units adjacent to impaired waters in their Drainage Area
```

```
arcpy.CalculateField_management(fcWUImpairedIn,"ImpairedIn","2","PYTHON_9.3")
```

```
logger.info("1 point assigned to floodplain Wetland Units adjacent to impaired waters in their Drainage Area")
```

```
# Clear selections
```

```
arcpy.SelectLayerByAttribute_management(fcWUImpairedIn, "CLEAR_SELECTION")
arcpy.SelectLayerByAttribute_management(fcPublicFishing, "CLEAR_SELECTION")
arcpy.SelectLayerByAttribute_management(fcAlgalLakes, "CLEAR_SELECTION")
arcpy.SelectLayerByAttribute_management(fcAlgalStreams, "CLEAR_SELECTION")
arcpy.SelectLayerByAttribute_management(fcWV202IS24kNHD, "CLEAR_SELECTION")
```

### 5.7.82 RoadRail: Water Quality Opportunity

```
#####  
#  
# File Name: RoadRail.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 3/15/2016 (modified 11/28/2017)  
# Purpose:  
#     Water Quality Function, Opportunity aspect  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcRoadRail(WetlandPoly):  
    logger = logging.getLogger("WFA.WQuality.WQOpportun.RoadRail")  
  
    # Clean up if needed  
    if arcpy.Exists("WU_RoadRail"):  
        arcpy.Delete_management("WU_RoadRail")  
  
    WVRailway = arcpy.mapping.Layer(globalvars.srcRailway)  
    WVTransUTMAllRoads = arcpy.mapping.Layer(globalvars.srcTransUTMAllRoads)
```

```

# Create feature class to store RoadRail variable
arcpy.CopyFeatures_management(WetlandPoly, "WU_RoadRail")
WURoadRail = arcpy.mapping.Layer(r"WU_RoadRail")
logger.info("feature layers ready")

# Add RoadRail field to Wetland Units and set initial point value to zero
actions.DeleteField(WURoadRail,"RoadRail")
arcpy.AddField_management(WURoadRail, "RoadRail", "SHORT")
arcpy.CalculateField_management(WURoadRail,"RoadRail","0","VB","#")
logger.info("RoadRail field added and initial value set to 0")

# Select the Wetland Units withing 50 meters of a road of railroad track and assign 1 points
arcpy.SelectLayerByLocation_management(WURoadRail,"WITHIN_A_DISTANCE",WVTransUTMAllRoads,"50 Meters","NEW_SELECTION")
arcpy.SelectLayerByLocation_management(WURoadRail,"WITHIN_A_DISTANCE",WVRailway,"50 Meters","ADD_TO_SELECTION")
arcpy.CalculateField_management(WURoadRail,"RoadRail","1","VB","#")
logger.info("1 point assigned to certain wetland units")
arcpy.SelectLayerByAttribute_management(WURoadRail, "CLEAR_SELECTION")

# Select the Wetland Units withing 5 meters of a road of railroad track and assign 2 points
arcpy.SelectLayerByLocation_management(WURoadRail,"WITHIN_A_DISTANCE",WVTransUTMAllRoads,"5 Meters","NEW_SELECTION")
arcpy.SelectLayerByLocation_management(WURoadRail,"WITHIN_A_DISTANCE",WVRailway,"5 Meters","ADD_TO_SELECTION")
arcpy.CalculateField_management(WURoadRail,"RoadRail","2","VB","#")
logger.info("2 points assigned to certain wetland units")
arcpy.SelectLayerByAttribute_management(WURoadRail, "CLEAR_SELECTION")

```

### 5.7.83 Water Quality Potential

```
#####  
#  
# File Name: WQPotential.py  
# Developer: Yibing Han  
# Date: 12/13/2017  
# Purpose:  
# This script handles the execution of all the Water Quality Potential metrics.  
#  
#####  
import datetime  
import logging  
import traceback  
import arcpy  
  
from Variables import Clay, IrrEdge, LandPos, LowSlope, Microtopo, Organic, SeasonPond,  
SLOPE, VegByLP, VegPerUng, VegWoody, WFlowPath  
from Factors import ChemTime, ClayOrganic, Depressions, Headwater, SWoutflow, VegWQ  
from Aspects import WQPotential  
  
def procWQPotential(WetlandPoly):  
    logger = logging.getLogger("WFA.WQuality.WQPotential")  
  
    #####  
    ## 1. Run Variables  
    #####  
  
    Clay.Clay(WetlandPoly)  
  
    IrrEdge.CalcIrrEdge(WetlandPoly)
```

WFlowPath.DetermineWFlowPath(WetlandPoly)

LandPos.DetermineLandPos(WetlandPoly)

SLOPE.CalcSLOPE(WetlandPoly)

LowSlope.CalcLowSlope(WetlandPoly)

Microtopo.MicroTopo(WetlandPoly)

Organic.OrganicFactor(WetlandPoly)

SeasonPond.CalcSeasonPond(WetlandPoly)

VegByLP.CalcVegByLP(WetlandPoly)

VegPerUng.CalcVegPerUng(WetlandPoly)

VegWoody.CalcVegWoody(WetlandPoly)

#####

## 2. Run Factors

#####

ChemTime.CalcChemTime(WetlandPoly)

ClayOrganic.DetermineClayOrganic(WetlandPoly)

Depressions.CalcDepressions(WetlandPoly)

Headwater.DetermineHW(WetlandPoly)

SWoutflow.DetermineSWoutflow(WetlandPoly)

VegWQ.CalcVegWQ(WetlandPoly)

#####

## 3. Run Aspect

#####

WQPotential.DetermineWQPotential(WetlandPoly)

### 5.7.84 Water Quality Potential Aspects

```
#####  
#  
# File Name: WQPotential.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 6/16/2016 (modified 11/02/2017)  
# Purpose:  
#   Water Quality Function  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import arcpy  
from utilities import actions  
import logging  
  
def DetermineWQPotential(WetlandPoly):  
    logger = logging.getLogger("WFA.WQuality.WQPotential.WQPotential")  
  
    # Clean up if needed  
    if arcpy.Exists("WU_WQPotential1"):  
        arcpy.Delete_management("WU_WQPotential1")  
    if arcpy.Exists("WU_WQPotential2"):  
        arcpy.Delete_management("WU_WQPotential2")  
    if arcpy.Exists("WU_WQPotential3"):  
        arcpy.Delete_management("WU_WQPotential3")  
    if arcpy.Exists("WU_WQPotential4"):
```



```

    arcpy.Delete_management("WU_WQPotential4")
if arcpy.Exists("WU_WQPotential"):
    arcpy.Delete_management("WU_WQPotential")

# Setting python variables
arcpy.MakeFeatureLayer_management(r"WU_ChemTime","fcChemTime")
arcpy.MakeFeatureLayer_management(r"WU_ClayOrganic","fcClayOrganic")
arcpy.MakeFeatureLayer_management(r"WU_Depressions","fcDepressions")
arcpy.MakeFeatureLayer_management(r"WU_Headwater","fcHeadwater")
arcpy.MakeFeatureLayer_management(r"WU_SWOutflow","fcSWOutflow")
arcpy.MakeFeatureLayer_management(r"WU_VegWQ","fcVegWQ")
logger.info("feature layers ready")

# Spatial join to bring together the factor values

#####
#####

# SJ: ChemTime & ClayOrganic

#####
#####

fmSJCC = arcpy.FieldMappings()
fmSJCC.addTable("fcChemTime")
fmSJCC.addTable("fcClayOrganic")

keepers = []
keepers = ["WUKey","Shape_Length","Shape_Area","ChemTime","ClayOrganic"]

for field in fmSJCC.fields:
    if field.name not in keepers:
        fmSJCC.removeFieldMap(fmSJCC.findFieldMapIndex(field.name))

```

```

arcpy.SpatialJoin_analysis("fcChemTime","fcClayOrganic","WU_WQPotential1","JOIN_ONE
_TO_ONE","KEEP_ALL",fmSJCC,"CONTAINS")
arcpy.MakeFeatureLayer_management("WU_WQPotential1","fcWQPotential1")
logger.info("Spatial Join completed to add variables ChemTime and ClayOrganic")

```

```

#####
#####

```

```

# SJ: Depression

```

```

#####
#####

```

```

fmSJD = arcpy.FieldMappings()
fmSJD.addTable("fcWQPotential1")
fmSJD.addTable("fcDepressions")

```

```

keepers = []
keepers =
["WUKey","Shape_Length","Shape_Area","ChemTime","ClayOrganic","Depressions"]

```

```

for field in fmSJD.fields:
    if field.name not in keepers:
        fmSJD.removeFieldMap(fmSJD.findFieldMapIndex(field.name))

```

```

arcpy.SpatialJoin_analysis("fcWQPotential1","fcDepressions","WU_WQPotential2","JOIN_O
NE_TO_ONE","KEEP_ALL",fmSJD,"CONTAINS")
arcpy.MakeFeatureLayer_management("WU_WQPotential2","fcWQPotential2")
logger.info("Spatial Join completed to add variable Depression")

```

```
#####  
#####
```

```
# SJ: Headwater
```

```
#####  
#####
```

```
fmSJH = arcpy.FieldMappings()  
fmSJH.addTable("fcWQPotential2")  
fmSJH.addTable("fcHeadwater")
```

```
keepers = []  
keepers =  
["WUKey", "Shape_Length", "Shape_Area", "ChemTime", "ClayOrganic", "Depressions", "Headw  
ater"]
```

```
for field in fmSJH.fields:  
    if field.name not in keepers:  
        fmSJH.removeFieldMap(fmSJH.findFieldMapIndex(field.name))
```

```
arcpy.SpatialJoin_analysis("fcWQPotential2", "fcHeadwater", "WU_WQPotential3", "JOIN_ON  
E_TO_ONE", "KEEP_ALL", fmSJH, "CONTAINS")  
arcpy.MakeFeatureLayer_management("WU_WQPotential3", "fcWQPotential3")  
logger.info("Spatial Join completed to add variable Depression")
```

```
#####  
#####
```

```
# SJ: SWOutFlow
```

```
#####  
#####
```

```

fmSJSW = arcpy.FieldMappings()
fmSJSW.addTable("fcWQPotential3")
fmSJSW.addTable("fcSWOutflow")

keepers = []
keepers =
["WUKey","Shape_Length","Shape_Area","ChemTime","ClayOrganic","Depressions","Headw
ater","SWOutflow"]

for field in fmSJSW.fields:
    if field.name not in keepers:
        fmSJSW.removeFieldMap(fmSJSW.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis("fcWQPotential3","fcSWOutflow","WU_WQPotential4","JOIN_O
NE_TO_ONE","KEEP_ALL",fmSJSW,"CONTAINS")
arcpy.MakeFeatureLayer_management("WU_WQPotential4","fcWQPotential4")
logger.info("Spatial Join completed to add variable SWOutflow")

#####
#####

# SJ: VegWQ

#####
#####

fmSJV = arcpy.FieldMappings()
fmSJV.addTable("fcWQPotential4")
fmSJV.addTable("fcVegWQ")

keepers = []

```

```
keepers =  
["WUKey","Shape_Length","Shape_Area","ChemTime","ClayOrganic","Depressions","Headw  
ater","SWOutflow","VegWQ"]
```

```
for field in fmSJV.fields:
```

```
    if field.name not in keepers:
```

```
        fmSJV.removeFieldMap(fmSJV.findFieldMapIndex(field.name))
```

```
arcpy.SpatialJoin_analysis("fcWQPotential4","fcVegWQ","WU_WQPotential","JOIN_ONE_T  
O_ONE","KEEP_ALL",fmSJV,"CONTAINS")
```

```
arcpy.MakeFeatureLayer_management("WU_WQPotential","fcWQPotential")
```

```
logger.info("Spatial Join completed to add variable VegWQ")
```

```
# Add WQPotential field to Wetland Units and set the initial point value to zero
```

```
actions.DeleteField("fcWQPotential","WQPotential")
```

```
arcpy.AddField_management("fcWQPotential", "WQPotential", "SHORT")
```

```
arcpy.CalculateField_management("fcWQPotential","WQPotential","0","VB")
```

```
logger.info("WQPotential field added to Wetland Units and initial point values set to zero")
```

```
# Sum the factor points
```

```
arcpy.CalculateField_management("fcWQPotential","WQPotential","[ChemTime] +  
[ClayOrganic] + [Depressions] + [Headwater] + [SWOutflow] + [VegWQ]","VB","#")
```

```
logger.info("points summed for WQPotential")
```

```
# Clean up
```

```
if arcpy.Exists("WU_WQPotential1"):
```

```
    arcpy.Delete_management("WU_WQPotential1")
```

```
if arcpy.Exists("WU_WQPotential2"):
```

```
    arcpy.Delete_management("WU_WQPotential2")
```

```
if arcpy.Exists("WU_WQPotential3"):
```

```
arcpy.Delete_management("WU_WQPotential3")
if arcpy.Exists("WU_WQPotential4"):
    arcpy.Delete_management("WU_WQPotential4")
```

### 5.7.85 ChemTime: Water Quality Potential

```
#####  
#  
# File Name: ChemTime.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 3/21/2016 (modified 12/05/2017)  
# Purpose:  
#   Input to Water Quality  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcChemTime(WetlandPoly):  
    logger = logging.getLogger("WFA.WQuality.WQPotential.ChemTime")  
  
    # Clean up if needed  
    if arcpy.Exists("WU_ChemTime"):  
        arcpy.Delete_management("WU_ChemTime")  
    if arcpy.Exists("WU_ChemTime0"):  
        arcpy.Delete_management("WU_ChemTime0")  
    if arcpy.Exists("WU_ChemTime1"):  
        arcpy.Delete_management("WU_ChemTime1")
```

```

if arcpy.Exists("WU_ChemTime2"):
    arcpy.Delete_management("WU_ChemTime2")
if arcpy.Exists("WU_ChemTime3"):
    arcpy.Delete_management("WU_ChemTime3")

arcpy.MakeFeatureLayer_management(r"WU_FloodArea","fcFloodplain")
arcpy.MakeFeatureLayer_management(r"WU_SeasonPond","fcSeasonPond")
arcpy.MakeFeatureLayer_management(r"WU_SLOPE","fcSLOPE")
arcpy.MakeFeatureLayer_management(r"WU_IrrEdge","fcIrrEdge")

# Create feature class to store ChemTime variable
arcpy.CopyFeatures_management(WetlandPoly, "WU_ChemTime0")
arcpy.MakeFeatureLayer_management(r"WU_ChemTime0","fcWUChemTime0")
logger.info("feature layers ready")

#####
#####

# SJ: Floodplain

#####
#####

fmSJFP = arcpy.FieldMappings()
fmSJFP.addTable("fcWUChemTime0")
fmSJFP.addTable("fcFloodplain")

keepers = []
keepers = ["WUKey","Shape_Length","Shape_Area","Floodplain"]

for field in fmSJFP.fields:
    if field.name not in keepers:

```



```

fmSJFP.removeFieldMap(fmSJFP.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis("fcWUChemTime0","fcFloodplain","WU_ChemTime1","JOIN_ON
E_TO_ONE","KEEP_ALL",fmSJFP,"CONTAINS")
arcpy.MakeFeatureLayer_management("WU_ChemTime1","fcWUChemTime1")
logger.info("spatial join completed to add field Floodplain")

#####
#####

# SJ: SeasonPond

#####
#####

fmSJSP = arcpy.FieldMappings()
fmSJSP.addTable("fcWUChemTime1")
fmSJSP.addTable("fcSeasonPond")

keepers = []
keepers = ["WUKey","Shape_Length","Shape_Area","Floodplain","SeasonPond"]

for field in fmSJSP.fields:
    if field.name not in keepers:
        fmSJSP.removeFieldMap(fmSJSP.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis("fcWUChemTime1","fcSeasonPond","WU_ChemTime2","JOIN_O
NE_TO_ONE","KEEP_ALL",fmSJSP,"CONTAINS")
arcpy.MakeFeatureLayer_management("WU_ChemTime2","fcWUChemTime2")
logger.info("spatial join completed to add field SeasonPond")

```

```
#####  
#####
```

```
# SJ: SLOPE
```

```
#####  
#####
```

```
fmSJS� = arcpy.FieldMappings()  
fmSJS�.addTable("fcWUChemTime2")  
fmSJS�.addTable("fcSLOPE")
```

```
keepers = []
```

```
keepers = ["WUKey", "Shape_Length", "Shape_Area", "Floodplain", "SeasonPond", "SLOPE"]
```

```
for field in fmSJS�.fields:
```

```
    if field.name not in keepers:
```

```
        fmSJS�.removeFieldMap(fmSJS�.findFieldMapIndex(field.name))
```

```
arcpy.SpatialJoin_analysis("fcWUChemTime2", "fcSLOPE", "WU_ChemTime3", "JOIN_ONE_  
TO_ONE", "KEEP_ALL", fmSJS�, "CONTAINS")
```

```
arcpy.MakeFeatureLayer_management("WU_ChemTime3", "fcWUChemTime3")
```

```
logger.info("spatial join completed to add field SLOPE")
```

```
#####  
#####
```

```
# SJ: IrrEdge
```

```
#####  
#####
```

```
fmSJIR = arcpy.FieldMappings()
```

```

fmSJIR.addTable("fcWUChemTime3")
fmSJIR.addTable("fcIrrEdge")

keepers = []
keepers =
["WUKey","Shape_Length","Shape_Area","Floodplain","SeasonPond","SLOPE","IrrEdge"]

for field in fmSJIR.fields:
    if field.name not in keepers:
        fmSJIR.removeFieldMap(fmSJIR.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis("fcWUChemTime3","fcIrrEdge","WU_ChemTime","JOIN_ONE_TO_ONE","KEEP_ALL",fmSJIR,"CONTAINS")
arcpy.MakeFeatureLayer_management("WU_ChemTime","fcWUChemTime")
logger.info("spatial join completed to add field IrrEdge")

# Add field to Wetland Units and set initial point value to SeasonPond
actions.DeleteField("fcWUChemTime","ChemTime")
arcpy.AddField_management("fcWUChemTime", "ChemTime", "SHORT")

arcpy.CalculateField_management("fcWUChemTime","ChemTime","[SeasonPond]","VB","#")
logger.info("field ChemTime added and initial value set to SeasonPond")

# Filter Seasonal Ponding (SeasonPond) points based on Slope and Floodplain
strWHERE = """"SLOPE" > 5 OR "Floodplain" = 'Y'""""
arcpy.SelectLayerByAttribute_management("fcWUChemTime", "NEW_SELECTION", strWHERE)
arcpy.CalculateField_management("fcWUChemTime","ChemTime","0","VB","#")

strWHERE = """"SLOPE" > 2 AND "SLOPE" < 6 AND "ChemTime" > 2""""

```

```

    arcpy.SelectLayerByAttribute_management("fcWUChemTime", "NEW_SELECTION",
strWHERE)

    arcpy.CalculateField_management("fcWUChemTime","ChemTime","2","VB","#")
    logger.info("points assigned to ChemTime")

# Add point for irregular edge (IrrEdge)
strWHERE = """"IrrEdge" = 1 AND "Floodplain" = 'N' AND "ChemTime" < 3""""
    arcpy.SelectLayerByAttribute_management("fcWUChemTime", "NEW_SELECTION",
strWHERE)

arcpy.CalculateField_management("fcWUChemTime","ChemTime","[ChemTime]+1","VB","#
")
    logger.info("point added for irregular edge")

arcpy.SelectLayerByAttribute_management("fcWUChemTime", "CLEAR_SELECTION")

# Clean up
if arcpy.Exists("WU_ChemTime0"):
    arcpy.Delete_management("WU_ChemTime0")
if arcpy.Exists("WU_ChemTime1"):
    arcpy.Delete_management("WU_ChemTime1")
if arcpy.Exists("WU_ChemTime2"):
    arcpy.Delete_management("WU_ChemTime2")
if arcpy.Exists("WU_ChemTime3"):
    arcpy.Delete_management("WU_ChemTime3")

```

### 5.7.86 ClayOrganic: Water Quality Potential

```
#####  
#  
# File Name: ClayOrganic.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date 4/5/2016 (modified 12/08/2017)  
# Purpose:  
#   Input to Water Quality  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def DetermineClayOrganic(WetlandPoly):  
    logger = logging.getLogger("WFA.WQuality.WQPotential.ClayOrganics")  
  
    # Clean up if needed  
    if arcpy.Exists("WU_ClayOrganic"):  
        arcpy.Delete_management("WU_ClayOrganic")  
    if arcpy.Exists("WU_ClayOrganic0"):  
        arcpy.Delete_management("WU_ClayOrganic0")  
    if arcpy.Exists("WU_ClayOrganic1"):  
        arcpy.Delete_management("WU_ClayOrganic1")
```

```

if arcpy.Exists("WU_ClayOrganic2"):
    arcpy.Delete_management("WU_ClayOrganic2")
if arcpy.Exists("WU_ClayOrganic3"):
    arcpy.Delete_management("WU_ClayOrganic3")

# Setting environment variables
arcpy.MakeFeatureLayer_management(r"WU_Organic","fcOrganic")
arcpy.MakeFeatureLayer_management(r"WU_Clay","fcClay")
arcpy.MakeFeatureLayer_management(r"WU_FloodArea","fcWUFloodplain")
arcpy.MakeFeatureLayer_management(r"WU_SeasonPond","fcWUSeasonPond")

arcpy.CopyFeatures_management(WetlandPoly, "WU_ClayOrganic0")
arcpy.MakeFeatureLayer_management(r"WU_ClayOrganic0","fcWUClayOrganic0")
logger.info("feature layers ready")

# Join Clay and Organic to combine the two fields into one feature class called
WU_ClayOrganic

#####
#####

# SJ: Organic

#####
#####

fmSJORG = arcpy.FieldMappings()
fmSJORG.addTable("fcWUClayOrganic0")
fmSJORG.addTable("fcOrganic")

keepers = []
keepers = ["WUKey","Shape_Length","Shape_Area","Organic"]

```

```
for field in fmSJORG.fields:
```

```
    if field.name not in keepers:
```

```
        fmSJORG.removeFieldMap(fmSJORG.findFieldMapIndex(field.name))
```

```
arcpy.SpatialJoin_analysis("fcWUClayOrganic0","fcOrganic","WU_ClayOrganic1","JOIN_ON  
E_TO_ONE","KEEP_ALL",fmSJORG,"CONTAINS")
```

```
arcpy.MakeFeatureLayer_management("WU_ClayOrganic1","fcWUClayOrganic1")
```

```
logger.info("spatial join completed to add field Organic")
```

```
#####  
#####
```

```
# SJ: Clay
```

```
#####  
#####
```

```
fmSJClay = arcpy.FieldMappings()
```

```
fmSJClay.addTable("fcWUClayOrganic1")
```

```
fmSJClay.addTable("fcClay")
```

```
keepers = []
```

```
keepers = ["WUKey","Shape_Length","Shape_Area","Organic","Clay"]
```

```
for field in fmSJClay.fields:
```

```
    if field.name not in keepers:
```

```
        fmSJClay.removeFieldMap(fmSJClay.findFieldMapIndex(field.name))
```

```
arcpy.SpatialJoin_analysis("fcWUClayOrganic1","fcClay","WU_ClayOrganic2","JOIN_ONE_  
TO_ONE","KEEP_ALL",fmSJClay,"CONTAINS")
```

```
arcpy.MakeFeatureLayer_management("WU_ClayOrganic2","fcWUClayOrganic2")
```

```
logger.info("spatial join completed to add field Clay")
```

```
#####  
#####
```

```
# SJ: Floodplain
```

```
#####  
#####
```

```
fmSJFP = arcpy.FieldMappings()  
fmSJFP.addTable("fcWUClayOrganic2")  
fmSJFP.addTable("fcWUFloodplain")
```

```
keepers = []  
keepers = ["WUKey", "Shape_Length", "Shape_Area", "Organic", "Clay", "Floodplain"]
```

```
for field in fmSJClay.fields:
```

```
    if field.name not in keepers:
```

```
        fmSJClay.removeFieldMap(fmSJClay.findFieldMapIndex(field.name))
```

```
arcpy.SpatialJoin_analysis("fcWUClayOrganic2", "fcWUFloodplain", "WU_ClayOrganic3", "JO  
IN_ONE_TO_ONE", "KEEP_ALL", fmSJFP, "CONTAINS")
```

```
arcpy.MakeFeatureLayer_management("WU_ClayOrganic3", "fcWUClayOrganic3")
```

```
logger.info("spatial join completed to add field Floodplain")
```

```
#####  
#####
```

```
# SJ: SeasonPond
```



```
#####  
#####
```

```
fmSJSP = arcpy.FieldMappings()  
fmSJSP.addTable("fcWUClayOrganic3")  
fmSJSP.addTable("fcWUSeasonPond")
```

```
keepers = []  
keepers =  
["WUKey", "Shape_Length", "Shape_Area", "Organic", "Clay", "Floodplain", "SeaPondRatio", "SeasonPond"]
```

```
for field in fmSJSP.fields:
```

```
    if field.name not in keepers:
```

```
        fmSJSP.removeFieldMap(fmSJSP.findFieldMapIndex(field.name))
```

```
arcpy.SpatialJoin_analysis("fcWUClayOrganic3", "fcWUSeasonPond", "WU_ClayOrganic", "JOIN_ONE_TO_ONE", "KEEP_ALL", fmSJSP, "CONTAINS")
```

```
arcpy.MakeFeatureLayer_management("WU_ClayOrganic", "fcWUClayOrganic")
```

```
logger.info("spatial join completed to add field SeasonPond")
```

```
# Add ClayOrganic field to Wetland Units and set initial point value to zero
```

```
actions.DeleteField("fcWUClayOrganic", "ClayOrganic")
```

```
arcpy.AddField_management("fcWUClayOrganic", "ClayOrganic", "SHORT")
```

```
arcpy.CalculateField_management("fcWUClayOrganic", "ClayOrganic", "0", "VB", "#")
```

```
logger.info("field ClayOrganic added to Wetland Units and initial point value set to zero")
```

```
# Assign points to wetland units not in floodplain with clay or organic soils and seasonal ponding
```

```
strwhere = """"Floodplain" = 'N' and ( "Clay" = 'Y' or "Organic" = 'Y') and "SeaPondRatio" > 0.1""""
```

```
arcpy.SelectLayerByAttribute_management("fcWUClayOrganic","NEW_SELECTION",strwhere)
```

```
    arcpy.CalculateField_management("fcWUClayOrganic","ClayOrganic","1","python","#")
```

```
    strwhere = """"Floodplain" = 'N' and ( "Clay" = 'Y' or "Organic" = 'Y') and "SeaPondRatio" > 0.5""""
```

```
arcpy.SelectLayerByAttribute_management("fcWUClayOrganic","NEW_SELECTION",strwhere)
```

```
    arcpy.CalculateField_management("fcWUClayOrganic","ClayOrganic","2","python","#")
```

```
    strwhere = """"Floodplain" = 'N' and ( "Clay" = 'Y' or "Organic" = 'Y') and "SeaPondRatio" > 0.9""""
```

```
arcpy.SelectLayerByAttribute_management("fcWUClayOrganic","NEW_SELECTION",strwhere)
```

```
    arcpy.CalculateField_management("fcWUClayOrganic","ClayOrganic","3","python","#")
```

```
    logger.info("points 1, 2, or 3 assigned to wetland units not in floodplain with clay or organic soils and seasonal ponding")
```

```
arcpy.SelectLayerByAttribute_management("fcWUClayOrganic", "CLEAR_SELECTION")
```

```
# Clean up
```

```
if arcpy.Exists("WU_ClayOrganic0"):
```

```
    arcpy.Delete_management("WU_ClayOrganic0")
```

```
if arcpy.Exists("WU_ClayOrganic1"):
```

```
    arcpy.Delete_management("WU_ClayOrganic1")
```

```
if arcpy.Exists("WU_ClayOrganic2"):
```

```
    arcpy.Delete_management("WU_ClayOrganic2")
```

```
if arcpy.Exists("WU_ClayOrganic3"):
```

```
    arcpy.Delete_management("WU_ClayOrganic3")
```

### 5.7.87 Depressions: Water Quality Potential

```
#####  
#  
# File Name: Depressions.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 3/21/2016 (modified 11/29/2017)  
# Purpose:  
#   Input to Water Quality; Max 5 points, floodplain wetlands only.  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcDepressions(WetlandPoly):  
    logger = logging.getLogger("WFA.WQuality.WQPotential.Dpressions")  
  
    # Clean up if needed  
    if arcpy.Exists("WU_Depressions"):  
        arcpy.Delete_management("WU_Depressions")  
    if arcpy.Exists("WU_Depressions0"):  
        arcpy.Delete_management("WU_Depressions0")  
    if arcpy.Exists("WU_Depressions1"):  
        arcpy.Delete_management("WU_Depressions1")
```

```

if arcpy.Exists("WU_Depressions2"):
    arcpy.Delete_management("WU_Depressions2")
if arcpy.Exists("WU_Depressions3"):
    arcpy.Delete_management("WU_Depressions3")

# Setting python variables
arcpy.MakeFeatureLayer_management(r"WU_FloodArea","fcFloodplain")
arcpy.MakeFeatureLayer_management(r"WU_Microtopo","fcMicrotopo")
arcpy.MakeFeatureLayer_management(r"WU_LowSlope","fcLowSlope")
arcpy.MakeFeatureLayer_management(r"WU_IrrEdge","fcIrrEdge")
logger.info("feature layers ready")

# Create feature class to store Depressions variable
arcpy.CopyFeatures_management(WetlandPoly, "WU_Depressions0")
arcpy.MakeFeatureLayer_management(r"WU_Depressions0","fcWUDepressions0")
logger.info("feature copied to store Depressions variable")

# Spatial join to add input variables to attribute table

#####
#####
# SJ: Floodplain

#####
#####
fmSJWPO0 = arcpy.FieldMappings()
fmSJWPO0.addTable("fcWUDepressions0")
fmSJWPO0.addTable("fcFloodplain")

keepers = []
keepers = ["WUKey","Shape_Length","Shape_Area","Floodplain"]

```

```
for field in fmSJWPO0.fields:
```

```
    if field.name not in keepers:
```

```
        fmSJWPO0.removeFieldMap(fmSJWPO0.findFieldMapIndex(field.name))
```

```
arcpy.SpatialJoin_analysis("fcWUDEpressions0","fcFloodplain","WU_Depressions1","JOIN_O  
NE_TO_ONE","KEEP_ALL",fmSJWPO0,"CONTAINS")
```

```
arcpy.MakeFeatureLayer_management("WU_Depressions1","fcWUDEpressions1")
```

```
logger.info("Spatial join to add input Floodplain to attribute table completed")
```

```
#####  
#####
```

```
# SJ: Microtopo
```

```
#####  
#####
```

```
fmSJWPO1 = arcpy.FieldMappings()
```

```
fmSJWPO1.addTable("fcWUDEpressions1")
```

```
fmSJWPO1.addTable("fcMicrotopo")
```

```
keepers = []
```

```
keepers = ["WUKey","Shape_Length","Shape_Area","Floodplain","Microtopo"]
```

```
for field in fmSJWPO1.fields:
```

```
    if field.name not in keepers:
```

```
        fmSJWPO1.removeFieldMap(fmSJWPO1.findFieldMapIndex(field.name))
```

```
arcpy.SpatialJoin_analysis("fcWUDEpressions1","fcMicrotopo","WU_Depressions2","JOIN_O  
NE_TO_ONE","KEEP_ALL",fmSJWPO1,"CONTAINS")
```

```
arcpy.MakeFeatureLayer_management("WU_Depressions2","fcWUDepressions2")
logger.info("Spatial join to add input Microtopo to attribute table completed")
```

```
#####
#####
```

```
# SJ: LowSlope
```

```
#####
#####
```

```
fmSJWPO2 = arcpy.FieldMappings()
fmSJWPO2.addTable("fcWUDepressions2")
fmSJWPO2.addTable("fcLowSlope")
```

```
keepers = []
```

```
keepers = ["WUKey","Shape_Length","Shape_Area","Floodplain","Microtopo","LowSlope"]
```

```
for field in fmSJWPO2.fields:
```

```
    if field.name not in keepers:
```

```
        arcpy.RemoveFieldMap(fmSJWPO2.findFieldMapIndex(field.name))
```

```
arcpy.SpatialJoin_analysis("fcWUDepressions2","fcLowSlope","WU_Depressions3","JOIN_O
NE_TO_ONE","KEEP_ALL",fmSJWPO2,"CONTAINS")
```

```
arcpy.MakeFeatureLayer_management("WU_Depressions3","fcWUDepressions3")
```

```
logger.info("Spatial join to add input LowSlope to attribute table completed")
```

```
#####
#####
```

```
# SJ: IrrEdge
```

```

#####
#####

fmSJWPO3 = arcpy.FieldMappings()
fmSJWPO3.addTable("fcWUDepressions3")
fmSJWPO3.addTable("fcIrrEdge")

keepers = []
keepers =
["WUKey","Shape_Length","Shape_Area","Floodplain","Microtopo","LowSlope","IrrEdge"]

for field in fmSJWPO3.fields:
    if field.name not in keepers:
        fmSJWPO3.removeFieldMap(fmSJWPO3.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis("fcWUDepressions3","fcIrrEdge","WU_Depressions","JOIN_ONE_
TO_ONE","KEEP_ALL",fmSJWPO3,"CONTAINS")
arcpy.MakeFeatureLayer_management("WU_Depressions","fcWUDepressions")
logger.info("Spatial join to add input IrrEdge to attribute table completed")

# Add field to Wetland Units and set initial point value to zero
actions.DeleteField("fcWUDepressions","Depressions")
arcpy.AddField_management("fcWUDepressions", "Depressions", "SHORT")
arcpy.CalculateField_management("fcWUDepressions","Depressions","0","VB","#")
logger.info("field Depressions added and initial value set to 0")

# Sum points for surface depression (Depressions) in floodplain Wetland Units

arcpy.SelectLayerByAttribute_management("fcWUDepressions","NEW_SELECTION","""Floodplain" = 'Y'""")

```

```
arcpy.CalculateField_management("fcWUDepressions","Depressions","[Microtopo]+[LowSlope]+[IrrEdge]","VB","#")
logger.info("field Depressions calculated")
arcpy.SelectLayerByAttribute_management("fcWUDepressions", "CLEAR_SELECTION")

## Clean up
if arcpy.Exists("WU_Depressions0"):
    arcpy.Delete_management("WU_Depressions0")
if arcpy.Exists("WU_Depressions1"):
    arcpy.Delete_management("WU_Depressions1")
if arcpy.Exists("WU_Depressions2"):
    arcpy.Delete_management("WU_Depressions2")
if arcpy.Exists("WU_Depressions3"):
    arcpy.Delete_management("WU_Depressions3")
```



### 5.7.89 Headwater: Water Quality Potential

```
#####  
#  
# File Name: Headwater.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 6/15/2016 (modified 11/28/2017)  
# Purpose:  
#   Input to Water Quality (Potential) and Flood Attenuation (Potential) functions  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def DetermineHW(WetlandPoly):  
    logger = logging.getLogger("WFA.WQuality.WQPotential.Headwater")  
  
    # Clean up if needed  
    if arcpy.Exists("WU_Headwater"):  
        arcpy.Delete_management("WU_Headwater")  
  
    # Setting python variables  
    arcpy.MakeFeatureLayer_management(WetlandPoly,"fcWU")  
    arcpy.MakeFeatureLayer_management(r"WU_LandPos","fcWULandPos")
```

```

logger.info("feature layers ready")

# Spatial join to add input variable to attribute table
fmSJ = arcpy.FieldMappings()
fmSJ.addTable("fcWU")
fmSJ.addTable("fcWULandPos")

keepers = []
keepers = ["WUKey","Shape_Length","Shape_Area","LandPos"]

for field in fmSJ.fields:
    if field.name not in keepers:
        fmSJ.removeFieldMap(fmSJ.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis("fcWU","fcWULandPos","WU_Headwater","JOIN_ONE_TO_ONE",
"KEEP_ALL",fmSJ,"CONTAINS")

logger.info("spatial join completed to add input variable to attribute table")
fcWUHeadwater = arcpy.mapping.Layer(r"WU_Headwater")

# Add Headwater field to Wetland Units and set the initial point value to zero
actions.DeleteField(fcWUHeadwater,"Headwater")
arcpy.AddField_management(fcWUHeadwater, "Headwater", "SHORT")
arcpy.CalculateField_management(fcWUHeadwater, "Headwater", "0", "PYTHON")
logger.info("field Headwater added and initial point value set to 0")

# Assin 1 point to Wetland Units with Landscape Position headwater modifier

arcpy.SelectLayerByAttribute_management(fcWUHeadwater,"NEW_SELECTION","""LandP
os" LIKE "%h""")

arcpy.CalculateField_management(fcWUHeadwater,"Headwater","1","PYTHON","#")

```

```
logger.info("point assigned to Wetland Units with Landscape Position headwater modifier")  
arcpy.SelectLayerByAttribute_management(fcWUHeadwater, "CLEAR_SELECTION")
```

### 5.7.90 SWoutflow: Water Quality Potential

```
#####  
#  
# File Name: SWoutflow.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date 6/14/2016 (modified 12/05/2017)  
# Purpose:  
# SWOutflow: Input to Water Quality. / SWOutflow2: Input to Flood Attenuation.  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def DetermineSWoutflow(WetlandPoly):  
    logger = logging.getLogger("WFA.WQuality.WQPotential.SWoutflow")  
  
    # Clean up if needed  
    if arcpy.Exists("WU_SWOutflow"):  
        arcpy.Delete_management("WU_SWOutflow")  
  
    # Setting python variables  
    arcpy.MakeFeatureLayer_management(r"WU_WFlowPath","fcWFlowPath")  
    arcpy.MakeFeatureLayer_management(r"WU_FloodArea","fcWUFloodplain")
```

```
logger.info("feature layers ready")
```

```
#####  
#####
```

```
# Spatial join to add input variables to attribute table
```

```
#####  
#####
```

```
fmSJ2 = arcpy.FieldMappings()  
fmSJ2.addTable("fcWFlowPath")  
fmSJ2.addTable("fcWUFloodplain")
```

```
keepers = []  
keepers = ["WUKey", "Shape_Length", "Shape_Area", "WFlowPath", "Floodplain"]
```

```
for field in fmSJ2.fields:  
    if field.name not in keepers:  
        fmSJ2.removeFieldMap(fmSJ2.findFieldMapIndex(field.name))
```

```
arcpy.SpatialJoin_analysis("fcWFlowPath", "fcWUFloodplain", "WU_SWOutflow", "JOIN_ON  
E_TO_ONE", "KEEP_ALL", fmSJ2, "CONTAINS")  
arcpy.MakeFeatureLayer_management("WU_SWOutflow", "fcWUSWoutflow")  
logger.info("spatial join to add WFlowPath and Floodplain completed")
```

```
#####  
#####
```

```
# Add SWOutflow fields to Wetland Units and set initial value to zero
```

```
#####  
#####
```

```
actions.DeleteField("fcWUSWoutflow", "SWOutflow")  
arcpy.AddField_management("fcWUSWoutflow", "SWOutflow", "SHORT")  
arcpy.CalculateField_management("fcWUSWoutflow", "SWOutflow", "0", "PYTHON_9.3")  
logger.info("field SWOutflow added and initial value set to 0")
```

```
actions.DeleteField("fcWUSWoutflow", "SWOutflow2")  
arcpy.AddField_management("fcWUSWoutflow", "SWOutflow2", "SHORT")  
arcpy.CalculateField_management("fcWUSWoutflow", "SWOutflow2", "0", "PYTHON_9.3")  
logger.info("field SWOutflow2 added and initial value set to 0")
```

```
#####  
#####
```

```
# Assign points for to SWoutflow
```

```
#####  
#####
```

```
arcpy.SelectLayerByAttribute_management("fcWUSWoutflow", "NEW_SELECTION", """"Flo  
odplain" = 'N'""")
```

```
arcpy.CalculateField_management("fcWUSWoutflow", "SWOutflow", "1", "VB", "#")
```

```
arcpy.SelectLayerByAttribute_management("fcWUSWoutflow", "NEW_SELECTION", """"Flo  
odplain" = 'N' AND "WFlowPath" IN ('OI','TI','BI','IB')""")
```

```
arcpy.CalculateField_management("fcWUSWoutflow", "SWOutflow", "3", "VB", "#")
```

```
arcpy.CalculateField_management("fcWUSWoutflow", "SWOutflow2", "1", "VB", "#")
```

```
arcpy.SelectLayerByAttribute_management("fcWUSWoutflow","NEW_SELECTION","""Flo  
odplain" = 'N' AND "WFlowPath" IN ('IS')""")  
    arcpy.CalculateField_management("fcWUSWoutflow","SWOutflow","4","VB","#")  
    arcpy.CalculateField_management("fcWUSWoutflow","SWOutflow2","2","VB","#")  
    logger.info("points assigned to SWOutflow and SWOutflow2")
```

### 5.7.91 VegWQ: Water Quality Potential

```
#####  
#  
# File Name: VegWQ.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 3/23/2016 (modified 11/02/2017)  
# Purpose:  
#   Input to Water Quality  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcVegWQ(WetlandPoly):  
    logger = logging.getLogger("WFA.WQuality.WQPotential.VegWQ")  
  
    #clean up if needed  
    if arcpy.Exists("WU_VegWQ0"):  
        arcpy.Delete_management("WU_VegWQ0")  
    if arcpy.Exists("WU_VegWQ1"):  
        arcpy.Delete_management("WU_VegWQ1")  
    if arcpy.Exists("WU_VegWQ2"):  
        arcpy.Delete_management("WU_VegWQ2")
```



```

if arcpy.Exists("WU_VegWQ3"):
    arcpy.Delete_management("WU_VegWQ3")
if arcpy.Exists("WU_VegWQ"):
    arcpy.Delete_management("WU_VegWQ")

arcpy.MakeFeatureLayer_management(r"WU_VegPerUng","fcVegPerUng")
arcpy.MakeFeatureLayer_management(r"WU_VegWoody","fcVegWoody")
arcpy.MakeFeatureLayer_management(r"WU_VegByLP","fcVegByLP")
arcpy.MakeFeatureLayer_management(r"WU_FloodArea","fcFloodplain")
logger.info("feature layers ready")

# Create feature class to store VegWQ variable
arcpy.CopyFeatures_management(WetlandPoly, "WU_VegWQ0")
arcpy.MakeFeatureLayer_management(r"WU_VegWQ0","WUVegWQ0")
logger.info("feature class WU_VegWQ0 created")

# Add VegWQ field to Wetland Units and set initial point value to zero
actions.DeleteField("WUVegWQ0","VegWQ")
arcpy.AddField_management("WUVegWQ0", "VegWQ", "SHORT")
arcpy.CalculateField_management("WUVegWQ0","VegWQ","0","VB","#")
logger.info("field VegWQ added to Wetland Units and initial point value set to zero")

```

```

#####
#####

```

```

# SJ: VegPerUng

```

```

#####
#####

```

```

fmSJVPU = arcpy.FieldMappings()
fmSJVPU.addTable("WUVegWQ0")

```

```

fmSJVPU.addTable("fcVegPerUng")

keepers = []
keepers = ["WUKey", "Shape_Length", "Shape_Area", "VegWQ", "VegPerUng"]

for field in fmSJVPU.fields:
    if field.name not in keepers:
        fmSJVPU.removeFieldMap(fmSJVPU.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis("WUVegWQ0", "fcVegPerUng", "WU_VegWQ1", "JOIN_ONE_TO_ONE", "KEEP_ALL", fmSJVPU, "CONTAINS")
arcpy.MakeFeatureLayer_management(r"WU_VegWQ1", "WUVegWQ1")
logger.info("spatial join for VegPerUng completed")

## Spatial join to add input variables to attribute table

#####
#####

# SJ: VegWoody (3 NULL Records)

#####
#####

fmSJVW = arcpy.FieldMappings()
fmSJVW.addTable("WUVegWQ1")
fmSJVW.addTable("fcVegWoody")

keepers = []
keepers = ["WUKey", "Shape_Length", "Shape_Area", "VegWQ", "VegPerUng", "VegWoody"]

for field in fmSJVW.fields:

```

```

if field.name not in keepers:
    fmSJVW.removeFieldMap(fmSJVW.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis("WUVegWQ1","fcVegWoody","WU_VegWQ2","JOIN_ONE_TO_
ONE","KEEP_ALL",fmSJVW,"CONTAINS")
    arcpy.MakeFeatureLayer_management(r"WU_VegWQ2","WUVegWQ2")
    logger.info("spatial join for VegWoody completed")

#####
#####

# SJ: VegByLP (10776 NULL Records)

#####
#####

fmSJVLP = arcpy.FieldMappings()
fmSJVLP.addTable("WUVegWQ2")
fmSJVLP.addTable("fcVegByLP")

keepers = []
keepers =
["WUKey","Shape_Length","Shape_Area","VegWQ","VegPerUng","VegWoody","VegByLP"]

for field in fmSJVLP.fields:
    if field.name not in keepers:
        fmSJVLP.removeFieldMap(fmSJVLP.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis("WUVegWQ2","fcVegByLP","WU_VegWQ3","JOIN_ONE_TO_
ONE","KEEP_ALL",fmSJVLP,"CONTAINS")
    arcpy.MakeFeatureLayer_management(r"WU_VegWQ3","WUVegWQ3")

```

```
logger.info("spatial join for VegByLP completed")
```

```
#####  
#####
```

```
# SJ: Floodplain
```

```
#####  
#####
```

```
fmSJFP = arcpy.FieldMappings()  
fmSJFP.addTable("WUVegWQ3")  
fmSJFP.addTable("fcFloodplain")
```

```
keepers = []  
keepers =  
["WUKey", "Shape_Length", "Shape_Area", "VegWQ", "VegPerUng", "VegWoody", "VegByLP",  
"Floodplain"]
```

```
for field in fmSJFP.fields:
```

```
    if field.name not in keepers:
```

```
        fmSJFP.removeFieldMap(fmSJFP.findFieldMapIndex(field.name))
```

```
arcpy.SpatialJoin_analysis("WUVegWQ3", "fcFloodplain", "WU_VegWQ", "JOIN_ONE_TO_O  
NE", "KEEP_ALL", fmSJFP, "CONTAINS")
```

```
arcpy.MakeFeatureLayer_management(r"WU_VegWQ", "WUVegWQ")
```

```
logger.info("spatial join for Floodplain completed")
```

```
# Sum the point for VegPerUng, VegWoody, and VegByLP
```

```
arcpy.CalculateField_management("WUVegWQ", "VegWQ", "[VegPerUng] + [VegWoody]  
+ [VegByLP]", "VB", "#")
```

```
logger.info("the point summed for VegPerUng, VegWoody, and VegByLP")
```

```

# Reduce any excess point scores to the maximum allowed
arcpy.SelectLayerByAttribute_management("WUVegWQ", "CLEAR_SELECTION")

arcpy.SelectLayerByAttribute_management("WUVegWQ", "NEW_SELECTION", """"VegWQ
"> 10""")
arcpy.CalculateField_management("WUVegWQ", "VegWQ", "10", "VB", "#")

arcpy.SelectLayerByAttribute_management("WUVegWQ", "CLEAR_SELECTION")

arcpy.SelectLayerByAttribute_management("WUVegWQ", "NEW_SELECTION", """"VegWQ
"> 5 AND "Floodplain" = 'N'""")
arcpy.CalculateField_management("WUVegWQ", "VegWQ", "5", "VB", "#")
logger.info("excess point scores reduced to the maximum allowed")

arcpy.SelectLayerByAttribute_management("WUVegWQ", "CLEAR_SELECTION")

# Clean up
if arcpy.Exists("WU_VegWQ0"):
    arcpy.Delete_management("WU_VegWQ0")
if arcpy.Exists("WU_VegWQ1"):
    arcpy.Delete_management("WU_VegWQ1")
if arcpy.Exists("WU_VegWQ2"):
    arcpy.Delete_management("WU_VegWQ2")
if arcpy.Exists("WU_VegWQ3"):
    arcpy.Delete_management("WU_VegWQ3")

```

### 5.7.92 Clay: Water Quality Potential

```
#####  
#  
# File Name: Clay.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 3/2/2016 (modified 11/16/2017)  
# Purpose:  
#   Input to Water Quality / Clay and Organic Soils Factor  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def Clay(WetlandPoly):  
    logger = logging.getLogger("WFA.WQuality.WQPotential.Clay")  
  
    # Clean up if needed  
    if arcpy.Exists("WU_Clay"):  
        arcpy.Delete_management("WU_Clay")  
  
    PalustringPlots = arcpy.mapping.Layer(globalvars.srcPalustringPlots)  
    SSURGO = arcpy.mapping.Layer(globalvars.srcSSURGO)  
    logger.info("feature layers ready")
```

```
#####  
#####
```

```
# Part 1: Palustrine Plots
```

```
#####  
#####
```

```
#Create feature class to store Clay value
```

```
arcpy.CopyFeatures_management(WetlandPoly,"WU_Clay","#","0","0","0")
```

```
fcWUClay = arcpy.mapping.Layer("WU_Clay")
```

```
logger.info("WU_Clay created to store Clay value")
```

```
# add Clay field to Wetland Poly
```

```
actions.DeleteField(fcWUClay,"Clay")
```

```
arcpy.AddField_management(fcWUClay, "Clay", "TEXT", "", "", "2")
```

```
arcpy.CalculateField_management(fcWUClay, "Clay", "N", "PYTHON_9.3")
```

```
logger.info("field Clay added to Wetland units and initial value set to 'N'")
```

```
# Select Wetland Units that intersect palustrine plots selection
```

```
strWHERE = """"("Soil_Textu" LIKE '%clay%' OR "Profile_1" LIKE '%clay%') AND  
"Depth_of_o" IN ( ' ', '0', '1', '2', '3', '4') """
```

```
arcpy.SelectLayerByAttribute_management(PalustrinePlots, "NEW_SELECTION",  
strWHERE)
```

```
logger.info("Wetland Units that intersect palustrine plots selection selected")
```

```
# Update the value for Clay based on Palustrine plots
```

```
arcpy.SelectLayerByLocation_management(fcWUClay, "INTERSECT", PalustrinePlots, "",  
"NEW_SELECTION")
```

```
arcpy.CalculateField_management(fcWUClay, "Clay", "Y", "PYTHON_9.3")
```

```
arcpy.SelectLayerByAttribute_management(fcWUClay, "CLEAR_SELECTION")
```

```
arcpy.SelectLayerByAttribute_management(PalustrinePlots, "CLEAR_SELECTION")
logger.info("the value for Clay based on Palustrine plots updated")
```

```
#####
#####
```

```
# Part 2: SSURGO
```

```
#####
#####
```

```
# Select Wetland Units that intersect with the SSURGO selection.
```

```
arcpy.SelectLayerByLocation_management(fcWUClay, "INTERSECT", SSURGO, "",
"NEW_SELECTION")
```

```
logger.info("Wetland Units that intersect with the SSURGO selection selected")
```

```
# Update the value for Clay based on SSURGO
```

```
arcpy.CalculateField_management(fcWUClay, "Clay", "Y", "PYTHON_9.3")
```

```
arcpy.SelectLayerByAttribute_management(fcWUClay, "CLEAR_SELECTION")
```

```
logger.info("the value for Clay based on SSURGO updated")
```

```
# Clean up
```



### 5.7.93 IrrEdge: Water Quality Potential

```
#####  
#  
# File Name: IrrEdge.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 3/7/2016 (modified 11/16/2017)  
# Purpose:  
#   Input to Water Quality/Surface Depressions  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcIrrEdge(WetlandPoly):  
    logger = logging.getLogger("WFA.WQuality.WQPotential.IrrEdge")  
  
    # Clean up if needed  
    if arcpy.Exists("RiversLakes"):  
        arcpy.Delete_management("RiversLakes")  
    if arcpy.Exists("WU_RiversLakes"):  
        arcpy.Delete_management("WU_RiversLakes")  
    if arcpy.Exists("Intersecting_lines"):  
        arcpy.Delete_management("Intersecting_lines")
```

```

if arcpy.Exists("DryEdges"):
    arcpy.Delete_management("DryEdges")
if arcpy.Exists("WU_IrrEdge"):
    arcpy.Delete_management("WU_IrrEdge")
if arcpy.Exists("WU_IrrEdge1"):
    arcpy.Delete_management("WU_IrrEdge1")

# Setting python variables
arcpy.MakeFeatureLayer_management(globalvars.srcRiversLakes,"fcRiversLakes")
logger.info("feature layers ready")

#Create feature class to store intermediate value
arcpy.CopyFeatures_management(WetlandPoly,"WU_IrrEdge1","#","0","0","0")
arcpy.MakeFeatureLayer_management("WU_IrrEdge1", "fcWUIrrEdge1")
logger.info("WU_IrrEdge1 created to store intermediate value")

# deleting then adding the IrrEdgeRat
actions.DeleteField("fcWUIrrEdge1","IrrEdgeRat")
arcpy.AddField_management("fcWUIrrEdge1", "IrrEdgeRat", "FLOAT")

# Calculate initial value of IrrEdgeRat for Wetland Units
arcpy.CalculateField_management("fcWUIrrEdge1","IrrEdgeRat","[Shape_Length]/([Shape_Area]^0.5)","VB","#")
logger.info("field IrrEdgeRat added and calculated")

# Select the Wetland Units that border a river or lake

arcpy.SelectLayerByLocation_management("fcWUIrrEdge1","INTERSECT","fcRiversLakes",
"#","NEW_SELECTION")
arcpy.CopyFeatures_management("fcWUIrrEdge1", "WU_RiversLakes")

```

```

logger.info("Wetland Units that border a river or lake selected and exported")

# Convert Wetland polygons to lines

arcpy.PolygonToLine_management("WU_RiversLakes","Intersecting_lines","IGNORE_NEIG
HBORS")

arcpy.MakeFeatureLayer_management("Intersecting_lines", "fcIntersectingLines")
logger.info("wetland polygons converted to lines")

# Erase the wet perimeter lines
arcpy.Erase_analysis("fcIntersectingLines","fcRiversLakes","DryEdges","#")
arcpy.MakeFeatureLayer_management(r"DryEdges","fcDryEdges")
logger.info("wet perimeter lines erased")

# deleting then adding the DryPerim
actions.DeleteField("fcDryEdges","DryPerim")
arcpy.AddField_management("fcDryEdges", "DryPerim", "FLOAT")
arcpy.CalculateField_management("fcDryEdges","DryPerim","[Shape_Length]","VB","#")
logger.info("field DryPerim added and value calculated")

# Reset to NULL records from DryEdges with length < 26. These are mapping or
computational errors
strWHERE = """"DryPerim" < 26""""
arcpy.SelectLayerByAttribute_management("fcDryEdges", "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management("fcDryEdges","DryPerim","NULL","VB","#")
logger.info("NULL records from DryEdges with length < 26 reseted to NULL")

#####
#####

```

```
# SJ: Wetland Units & DryEdges
```

```
#####  
#####
```

```
arcpy.SelectLayerByAttribute_management("fcDryEdges", "CLEAR_SELECTION")  
arcpy.SelectLayerByAttribute_management("fcWUIrrEdge1", "CLEAR_SELECTION")
```

```
fmSJWUD = arcpy.FieldMappings()  
fmSJWUD.addTable("fcWUIrrEdge1")  
fmSJWUD.addTable("fcDryEdges")
```

```
keepers = []  
keepers = ["WUKey", "Shape_Length", "Shape_Area", "IrrEdgeRat", "DryPerim"]
```

```
for field in fmSJWUD.fields:  
    if field.name not in keepers:  
        fmSJWUD.removeFieldMap(fmSJWUD.findFieldMapIndex(field.name))
```

```
arcpy.SpatialJoin_analysis("fcWUIrrEdge1", "fcDryEdges", "WU_IrrEdge", "JOIN_ONE_TO_ONE", "KEEP_ALL", fmSJWUD, "CONTAINS")  
arcpy.MakeFeatureLayer_management("WU_IrrEdge", "fcWUIrrEdge")  
logger.info("spatial join of WU_IrrEdge1 and DryEdges completed")
```

```
#####  
#####
```

```
strWHERE = """"DryPerim" > 0"""  
arcpy.SelectLayerByAttribute_management("fcWUIrrEdge", "NEW_SELECTION",  
strWHERE)
```

```

# Update the value of IrrEdgeRar for the selected records

arcpy.CalculateField_management("fcWUIrrEdge","IrrEdgeRat","[DryPerim]/([Shape_Area]^0.5)","VB","#")

arcpy.SelectLayerByAttribute_management("fcWUIrrEdge", "CLEAR_SELECTION")

logger.info("the value of IrrEdgeRar updated for the selected records")

# Add IrrEdge point field and set the initial value to zero
actions.DeleteField("fcWUIrrEdge","IrrEdge")

arcpy.AddField_management("fcWUIrrEdge", "IrrEdge", "SHORT")

arcpy.CalculateField_management("fcWUIrrEdge","IrrEdge","0","VB","#")

logger.info("field IrrEdge added and initial value set to 0")

# Assign 1 point if IrrEdgeRat > 6
strWHERE = """"IrrEdgeRat" > 6""""

arcpy.SelectLayerByAttribute_management("fcWUIrrEdge", "NEW_SELECTION",
strWHERE)

arcpy.CalculateField_management("fcWUIrrEdge","IrrEdge","1","VB","#")

logger.info("1 point assigned for IrrEdge if IrrEdgeRat > 6 for wetland units")

arcpy.SelectLayerByAttribute_management("fcWUIrrEdge", "CLEAR_SELECTION")

# Clean up
if arcpy.Exists("RiversLakes"):
    arcpy.Delete_management("RiversLakes")
if arcpy.Exists("WU_RiversLakes"):
    arcpy.Delete_management("WU_RiversLakes")
if arcpy.Exists("Intersecting_lines"):
    arcpy.Delete_management("Intersecting_lines")
if arcpy.Exists("DryEdges"):
    arcpy.Delete_management("DryEdges")

```

```
if arcpy.Exists("WU_IrrEdge1"):
    arcpy.Delete_management("WU_IrrEdge1")
```

### 5.7.94 LandPos: Water Quality Potential

```
#####  
#  
# File Name: LandPos.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 6/14/2016 (modified 11/28/2017)  
# Purpose:  
# Basic functional variable, used in several functional equations  
# Input to Water Quality/Headwater Location  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def DetermineLandPos(WetlandPoly):  
    logger = logging.getLogger("WFA.WQuality.WQPotential.LandPos")  
  
    # Clean up if needed  
    if arcpy.Exists("WU_LandPos"):  
        arcpy.Delete_management("WU_LandPos")  
    if arcpy.Exists("WU_LandPos1"):  
        arcpy.Delete_management("WU_LandPos1")
```

```

# Setting python variables
arcpy.MakeFeatureLayer_management(r"WU_FloodArea","fcWUFloodplain")
arcpy.MakeFeatureLayer_management(r"WU_WflowPath","fcWFlowPath")
arcpy.MakeFeatureLayer_management(globalvars.srcDrainageArea,"fcDA27m")
arcpy.MakeFeatureLayer_management(globalvars.srcWBRivers,"fcWBRivers")
arcpy.MakeFeatureLayer_management(globalvars.srcFSOFlow,"fcFSOFlow")
arcpy.MakeFeatureLayer_management(globalvars.srcEnhWetland,"fcENWI")
logger.info("feature layers ready")

#####
#####

# SJ: Joins to add variables to new Landscape Position feature class

#####
#####

fmSJFP = arcpy.FieldMappings()
fmSJFP.addTable("fcWFlowPath")
fmSJFP.addTable("fcWUFloodplain")

keepers = []
keepers = ["WUKey","Shape_Length","Shape_Area","WFlowPath","Floodplain"]

for field in fmSJFP.fields:
    if field.name not in keepers:
        fmSJFP.removeFieldMap(fmSJFP.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis("fcWFlowPath","fcWUFloodplain","WU_LandPos1","JOIN_ONE_
TO_ONE","KEEP_ALL",fmSJFP,"CONTAINS")
arcpy.MakeFeatureLayer_management(r"WU_LandPos1","fcWULandPos1")

```



```

logger.info("spatial join WFlowPath and Floodplain completed")

arcpy.JoinField_management("fcWULandPos1","OBJECTID","fcDA27m","WUKey","WUKey;CntrWshd")
logger.info("join field completed")

# Export join to feature class
arcpy.CopyFeatures_management("fcWULandPos1","WU_LandPos","#","0","0","0")
arcpy.MakeFeatureLayer_management(r"WU_LandPos","fcWULandPos")
logger.info("joined data exported")

# Add text field to the Wetland Units feature class
actions.DeleteField("fcWULandPos","LandPos")
arcpy.AddField_management("fcWULandPos", "LandPos", "TEXT", 5)
logger.info("field LandPos added to wetland units")

# Assign Lotic Stream Lanscape Position
arcpy.SelectLayerByAttribute_management("fcWULandPos", "CLEAR_SELECTION")

arcpy.SelectLayerByAttribute_management("fcWULandPos","NEW_SELECTION","""Flood plain" = 'Y'""")
arcpy.CalculateField_management("fcWULandPos","LandPos","LS","PYTHON_9.3","#")
arcpy.SelectLayerByAttribute_management("fcWULandPos", "CLEAR_SELECTION")
logger.info("Lotic stream landscape position assigned")

# Assign Lotic River Landscape Position
actions.DeleteField("fcWULandPos","River")
arcpy.AddField_management("fcWULandPos", "River", "TEXT", 2)

```

```
arcpy.SelectLayerByLocation_management("fcWULandPos","WITHIN_A_DISTANCE","fcWB  
BRivers","200 Meters","NEW_SELECTION")
```

```
arcpy.CalculateField_management("fcWULandPos","River","Y","PYTHON_9.3")
```

```
arcpy.SelectLayerByAttribute_management("fcWULandPos","NEW_SELECTION","""LandP  
os" = 'LS' AND "River" = 'Y'""")
```

```
arcpy.CalculateField_management("fcWULandPos","LandPos","LR","PYTHON_9.3","#")
```

```
arcpy.SelectLayerByAttribute_management("fcWULandPos", "CLEAR_SELECTION")
```

```
logger.info("Lotic river landscape position assigned")
```

```
# Assign headwater modifier to Lotic Landscape Position for wetlands intersecting first and  
second order streams, outflow wetlands, and wetlands with intermittent flow.
```

```
# Include isolated wetlands for now since almost all of these are actually outflow wetlands,  
but the streams flowing from them are too small to show up on the NHD.
```

```
actions.DeleteField("fcWULandPos","FSOStream")
```

```
arcpy.AddField_management("fcWULandPos", "FSOStream", "TEXT", 2)
```

```
arcpy.SelectLayerByLocation_management("fcWULandPos","INTERSECT","fcFSOFlow","#  
","NEW_SELECTION")
```

```
arcpy.CalculateField_management("fcWULandPos","FSOStream","Y","PYTHON_9.3","#")
```

```
#arcpy.SelectLayerByAttribute_management(fcWULandPos,"NEW_SELECTION","""LandP  
os" = 'LS' AND ("FSOStream" = 'Y' OR "WFlowPath" LIKE '%O%' OR "WFlowPath" LIKE  
'%I%')""")
```

```
arcpy.SelectLayerByAttribute_management("fcWULandPos","NEW_SELECTION","LandPos  
= 'LS' AND ((POSITION('O' IN WFlowPath) > 0) OR (POSITION('I' IN WFlowPath) > 0) OR  
(FSOStream = 'Y'))")
```

```
arcpy.CalculateField_management("fcWULandPos","LandPos","LSh","PYTHON_9.3","#")
```

```
logger.info("headwater modifier assigned to Lotic Landscape position for certain wetlands")
```

```

# Assign Lentic Landscape Position
arcpy.SelectLayerByAttribute_management("fcWULandPos", "CLEAR_SELECTION")

arcpy.SelectLayerByAttribute_management("fcENWI", "NEW_SELECTION", """"WETLAND
_TYPE" = 'Lake'""")

arcpy.SelectLayerByLocation_management("fcWULandPos", "WITHIN_A_DISTANCE", "fcE
NWI", "25 Meters", "NEW_SELECTION")
    arcpy.CalculateField_management("fcWULandPos", "LandPos", "LE", "PYTHON_9.3", "#")
    logger.info("Lentic Landscape position assigned")

# Assign Terrene Landscape Position
arcpy.SelectLayerByAttribute_management("fcWULandPos", "CLEAR_SELECTION")
arcpy.SelectLayerByAttribute_management("fcENWI", "CLEAR_SELECTION")

arcpy.SelectLayerByAttribute_management("fcWULandPos", "NEW_SELECTION", """"LandP
os" IS NULL""")
    arcpy.CalculateField_management("fcWULandPos", "LandPos", "TE", "PYTHON_9.3", "#")
    logger.info("Terrene Landscape position assigned")

# Assign headwater modifier to Terrene Landscape Position for wetlands intersecting first
and second order streams, outflow wetlands, and wetlands with intermittent flow.

# Include isolated wetlands for now since almost all of these are actually outflow wetlands,
but the streams flowing from them are too small to show up on the NHD.

arcpy.SelectLayerByAttribute_management("fcWULandPos", "NEW_SELECTION", """"LandPo
s = 'TE' AND ((POSITION('O' IN WFlowPath) > 0) OR (POSITION('I' IN WFlowPath) > 0)
OR (FSOStream = 'Y'))""")
    arcpy.CalculateField_management("fcWULandPos", "LandPos", "TEh", "PYTHON_9.3", "#")
    logger.info("headwater modifier assigned to Terrene Landscape position for certain
wetlands")

```

```
# Assign headwater modifier to Terrene Landscape Position for wetlands with small
contributing watershed
```

```
arcpy.SelectLayerByAttribute_management("fcWULandPos","NEW_SELECTION", """"LandP
os" = 'TE' AND "CntrWshd" < 161874""")
```

```
    arcpy.CalculateField_management("fcWULandPos","LandPos","TEh","PYTHON_9.3","#")
```

```
    arcpy.SelectLayerByAttribute_management("fcWULandPos", "CLEAR_SELECTION")
```

```
    logger.info("headwater modifier assigned to Terrene Landscape Position for wetlands with
small contributing watershed")
```

```
# Assign headwater modifier to Terrene Landscape Position for wetlands that occupy a large
percentage of their contributing watershed
```

```
    actions.DeleteField("fcWULandPos","PropWshd")
```

```
    arcpy.AddField_management("fcWULandPos", "PropWshd", "DOUBLE")
```

```
    arcpy.CalculateField_management("fcWULandPos","PropWshd","[Shape_Area]/
[CntrWshd]","VB","#")
```

```
arcpy.SelectLayerByAttribute_management("fcWULandPos","NEW_SELECTION", """"LandP
os" = 'TE' AND "PropWshd" > 0.05""")
```

```
    arcpy.CalculateField_management("fcWULandPos","LandPos","TEh","PYTHON_9.3","#")
```

```
    arcpy.SelectLayerByAttribute_management("fcWULandPos", "CLEAR_SELECTION")
```

```
    logger.info("headwater modifier assigned to Terrene Landscape for wetlands that occupy a
large percentage of their contributing watershed")
```

```
# Clean Up
```

```
if arcpy.Exists("WU_LandPos1"):
```

```
    arcpy.Delete_management("WU_LandPos1")
```

### 5.7.95 Lowslope: Water Quality Potential

```
#####  
#  
# File Name: LowSlope.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 3/3/2016 (modified 11/28/2017)  
# Purpose:  
#   Water Quality Function / Potential / Surface Depressions Factor (Max 2 points)  
#   Flood Attenuation Function / Potential  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcLowSlope(WetlandPoly):  
    logger = logging.getLogger("WFA.WQuality.WQPotential.LowSlope")  
  
    # Clean up if needed  
    if arcpy.Exists("WU_LowSlope"):  
        arcpy.Delete_management("WU_LowSlope")  
  
    #Setting Python variables  
    arcpy.MakeFeatureLayer_management(WetlandPoly, "fcWU")
```

```

arcpy.MakeFeatureLayer_management(r"WU_SLOPE", "fcWUSLOPE")
logger.info("feature layers ready")

## Create feature class to store LowSlope
fmSJLS = arcpy.FieldMappings()
fmSJLS.addTable('fcWU')
fmSJLS.addTable('fcWUSLOPE')
keepers = []
keepers = ['WUKey','Shape_Length','Shape_Area','SLOPE']
for field in fmSJLS.fields:
    if field.name not in keepers:
        fmSJLS.removeFieldMap(fmSJLS.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis('fcWU', 'fcWUSLOPE', 'WU_LowSlope', 'JOIN_ONE_TO_ONE',
'KEEP_ALL', fmSJLS, 'CONTAINS')
fcWULowSlope = arcpy.mapping.Layer(r"WU_LowSlope")
logger.info("feature class WU_LowSlope created to store LowSlope")

# deleting then add the LowSlope field and setting the value to 0
actions.DeleteField(fcWULowSlope,"LowSlope")
arcpy.AddField_management(fcWULowSlope, "LowSlope", "SHORT")
arcpy.CalculateField_management(fcWULowSlope, "LowSlope", "0", "PYTHON_9.3")
logger.info("field LowSlope added and initial value set to 0")

#####

# LowSlope field

#####

# assigning 2 points to wetlands with a slope < 2

```

```

strWHERE = """"SLOPE" < 2""""
arcpy.SelectLayerByAttribute_management(fcWULowSlope, "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management(fcWULowSlope, "LowSlope", "2", "PYTHON_9.3")
arcpy.SelectLayerByAttribute_management(fcWULowSlope, "CLEAR_SELECTION")

# assigning 1 points to wetlands with a slope > 1 and < 6
strWHERE = """"SLOPE" > 1 AND "SLOPE" < 6 """"
arcpy.SelectLayerByAttribute_management(fcWULowSlope, "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management(fcWULowSlope, "LowSlope", "1", "PYTHON_9.3")
arcpy.SelectLayerByAttribute_management(fcWULowSlope, "CLEAR_SELECTION")
logger.info("points assigned to wetland units")

```

## 5.7.96 Microtopo: Water Quality Potential

```
#####  
#  
# File Name: Microtopo.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 3/3/2016 (modified 11/09/2017)  
# Purpose:  
#   Input to Water Quality/Surface Depressions  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def MicroTopo(WetlandPoly):  
    logger = logging.getLogger("WFA.WQuality.WQPotential.Microtopo")  
  
    # Clean up if needed  
    if arcpy.Exists("NWIpalustrine"):  
        arcpy.Delete_management("NWIpalustrine")  
    if arcpy.Exists("WU_Microtopo"):  
        arcpy.Delete_management("WU_Microtopo")  
  
    # Setting python variables
```



```

arcpy.MakeFeatureLayer_management(WetlandPoly,"fcWU")
arcpy.MakeFeatureLayer_management(globalvars.srcInput, "fcEnhWVWetland")
logger.info("feature layers ready")

# Create a new layer form the palustrine polygons in the NWI
strWHERE = """"ATTRIBUTE" LIKE 'P%""""
arcpy.SelectLayerByAttribute_management("fcEnhWVWetland", "NEW_SELECTION",
strWHERE)
arcpy.CopyFeatures_management("fcEnhWVWetland", "NWIpalustrine")
arcpy.MakeFeatureLayer_management("NWIpalustrine","fcNWIpalustrine")
arcpy.SelectLayerByAttribute_management("fcEnhWVWetland", "CLEAR_SELECTION")

#####
#####

# SJ: NWIpalustrine

#####
#####

# Sum the perimeters of the palustrine polygons that make up each Wetland Unit

arcpy.SpatialJoin_analysis("fcWU","fcNWIpalustrine","WU_Microtopo","JOIN_ONE_TO_ONE",
"KEEP_ALL",
""""WUKey "WUKey" true true false 4 Long 0 0 ,First,#,fcWU,WUKey,-1,-1;
Shape_Length "Shape_Length" false true true 8 Double 0 0
,First,#,fcWU,Shape_Length,-1,-1;
Shape_Area "Shape_Area" false true true 8 Double 0 0 ,First,#,fcWU,Shape_Area,-1,-1;
SHAPE_Length_1 "SHAPE_Length" false true true 8 Double 0 0
,Sum,#,fcNWIpalustrine,SHAPE_Length,-1,-1;
SHAPE_Area_1 "SHAPE_Area" false true true 8 Double 0 0
,First,#,fcNWIpalustrine,SHAPE_Area,-1,-1""",
"INTERSECT", "#", "#")

```

```

fcWUMicrotopo = arcpy.mapping.Layer(r"WU_Microtopo")

logger.info("Spatial Join completed to sum the perimeters of the palustrine polygons that
make up each Wetland Unit")

#####
#####

# deleting then adding the MicroRatio, and Microtopo fields
actions.DeleteField(fcWUMicrotopo,"MicroRatio")
arcpy.AddField_management(fcWUMicrotopo, "MicroRatio", "FLOAT")
actions.DeleteField(fcWUMicrotopo,"Microtopo")
arcpy.AddField_management(fcWUMicrotopo, "Microtopo", "SHORT")

# Divide the perimeter of summed palustrine polygons by the square roof of the Wetland Unit
Area
arcpy.CalculateField_management(fcWUMicrotopo,"MicroRatio","[SHAPE_Length_1]/(
[Shape_Area]^0.5)","VB","#")

# Assign points to Wetland Units
arcpy.CalculateField_management(fcWUMicrotopo, "Microtopo", "0", "PYTHON")

strWHERE = """"MicroRatio" > 8""""
arcpy.SelectLayerByAttribute_management(fcWUMicrotopo, "NEW_SELECTION",
strWHERE)
arcpy.CalculateField_management(fcWUMicrotopo, "Microtopo", "1", "PYTHON")
arcpy.SelectLayerByAttribute_management(fcWUMicrotopo, "CLEAR_SELECTION")

strWHERE = """"MicroRatio" > 15""""
arcpy.SelectLayerByAttribute_management(fcWUMicrotopo, "NEW_SELECTION",
strWHERE)

```

```
arcpy.CalculateField_management(fcWUMicrotopo, "Microtopo", "2", "PYTHON")
arcpy.SelectLayerByAttribute_management(fcWUMicrotopo, "CLEAR_SELECTION")
```

```
if arcpy.Exists("NWIpalustrine"):
    arcpy.Delete_management("NWIpalustrine")
```

### 5.7.97 Organic: Water Quality Potential

```
#####
```

```
#
```

```
# File Name: Organic.py
```

```
# Developer: Chad Ashworth (modified by Yibing Han)
```

```
# Date: 3/18/2016 (modified 11/29/2017)
```

```
# Purpose:
```

```
# Input to Water Quality / Clay and Organic Soils Factor
```

```
#
```

```
#####
```

```
#!/usr/bin/python
```

```
import sys
```

```
sys.path.append("../..")
```

```
import logging
```

```
import arcpy
```

```
from globalvars import globalvars
```

```
from utilities import actions
```

```
def OrganicFactor(WetlandPoly):
```

```
    logger = logging.getLogger("WFA.WQuality.WQPotential.Organic")
```

```
    # Clean up if needed
```

```
    if arcpy.Exists("WU_Organic"):
```

```
        arcpy.Delete_management("WU_Organic")
```

```
    # Setting python variables
```

```
    fcSsurgoOrganic = arcpy.mapping.Layer(globalvars.srcSsurgoOrganic)
```

```
    fcEnhancedNWI = arcpy.mapping.Layer(globalvars.srcInput)
```

```

fcPeatlands = arcpy.mapping.Layer(globalvars.srcPeatlands)
fcPalustrinePlots = arcpy.mapping.Layer(globalvars.srcPalustrineplots)
fcSSURGO = arcpy.mapping.Layer(globalvars.srcSSURGOWV)

arcpy.CopyFeatures_management(WetlandPoly, "WU_Organic")
fcWUOrganic = arcpy.mapping.Layer(r"WU_Organic")
logger.info("feature layers ready")

# Add field Organic to Wetland Units and set initial point value to "no organic"
actions.DeleteField(fcWUOrganic,"Organic")
arcpy.AddField_management(fcWUOrganic, "Organic", "TEXT", 2)
arcpy.CalculateField_management(fcWUOrganic,"Organic","N","PYTHON","#")
logger.info("field Organic added and initial value set to N")

## PART 1: PEATLANDS
# Select Wetland Units that are peatlands

arcpy.SelectLayerByLocation_management(fcWUOrganic,"INTERSECT",fcPeatlands,"#","NE
W_SELECTION")
logger.info("wetland units that are peatlands selected")

# Update value for "Organic" based on peatlands
arcpy.CalculateField_management(fcWUOrganic,"Organic","Y","PYTHON","#")
arcpy.SelectLayerByAttribute_management(fcWUOrganic, "CLEAR_SELECTION")
logger.info("field Organic updated to wetland units that are peatlands")

## PART 2: NWI ORGANIC MATTER
# Select polygons that have an organic modifier in the National Wetland Inventory
strWHERE = """"ATTRIBUTE" LIKE '%g'""""

```

```
arcpy.SelectLayerByAttribute_management(fcEnhancedNWI, "NEW_SELECTION",
strWHERE)
```

```
# Select Wetland Units that intersect organic NWI polygons
```

```
arcpy.SelectLayerByLocation_management(fcWUOrganic,"INTERSECT",fcEnhancedNWI,"#",
,"NEW_SELECTION")
```

```
arcpy.SelectLayerByAttribute_management(fcEnhancedNWI, "CLEAR_SELECTION")
```

```
logger.info("wetland units that intersect organic NWI polygons selected")
```

```
# Update value for "Organic" based on NWI
```

```
arcpy.CalculateField_management(fcWUOrganic,"Organic","Y","PYTHON","#")
```

```
arcpy.SelectLayerByAttribute_management(fcWUOrganic, "CLEAR_SELECTION")
```

```
logger.info("field Organic updated to wetland units that intersect organic NWI polygons")
```

```
## PART 3: PALUSTRINE PLOTS
```

```
# Select Palustrine plots that have peat or much soils
```

```
strWHERE = """"Soil_Textu" LIKE '%peat%' OR "Soil_Textu" LIKE '%muck%' OR
"Profile_1" LIKE '%peat%' OR "Profile_1" LIKE '%muck%' OR "Depth_of_o" NOT IN
(",0',1')""""
```

```
arcpy.SelectLayerByAttribute_management(fcPalustrinePlots,"NEW_SELECTION",strWHER
E)
```

```
# Select Wetland Units that intersect palustrine plots with organic soils
```

```
arcpy.SelectLayerByLocation_management(fcWUOrganic,"INTERSECT",fcPalustrinePlots,"#
","NEW_SELECTION")
```

```
logger.info("wetland units that intersect palustrine plots with organic soils selected")
```

```
# Update value for "Organic" based on palustrine plots
```

```
arcpy.CalculateField_management(fcWUOrganic,"Organic","Y","PYTHON","#")
```

```
arcpy.SelectLayerByAttribute_management(fcWUOrganic, "CLEAR_SELECTION")
logger.info("field Organic updated to wetland units that intersect palustrine plots with organic soils")
```

```
## PART 4: SSURGO SELECTION
```

```
# Select Wetland Units that intersect with SSURGO selection
```

```
arcpy.SelectLayerByLocation_management(fcWUOrganic,"INTERSECT",fcSsurgoOrganic,"#", "NEW_SELECTION")
```

```
logger.info("wetland units that intersect with SSURGO selection selected")
```

```
# Update value for "Organic" based on SSURGO
```

```
arcpy.CalculateField_management(fcWUOrganic,"Organic","Y","PYTHON","#")
```

```
arcpy.SelectLayerByAttribute_management(fcWUOrganic, "CLEAR_SELECTION")
```

```
logger.info("field Organic updated to wetland units that intersect with SSURGO selection")
```

### 5.7.98 SeasonPond: Water Quality Potential

```
#####
```

```
#
```

```
# File Name: SeasonPond.py
```

```
# Developer: Chad Ashworth (modified by Yibing Han)
```

```
# Date: 3/15/2016 (modified 12/01/2017; modified 2/3/2022 to expand selection to include  
vegetated lacustrine littoral and vegetated riverine polygons)
```

```
# Purpose:
```

```
# Input to Water Quality/Potential aspect/ChemTime Factor
```

```
#
```

```
#####
```

```
#!/usr/bin/python
```

```
import sys
```

```
sys.path.append("../..")
```

```
import logging
```

```
import arcpy
```

```
from globalvars import globalvars
```

```
from utilities import actions
```

```
def CalcSeasonPond(WetlandPoly):
```

```
    logger = logging.getLogger("WFA.WQuality.WQPotential.SeasonPond")
```

```
    # Clean up if needed
```

```
    if arcpy.Exists("WU_SeasonPond1"):
```

```
        arcpy.Delete_management("WU_SeasonPond1")
```

```
    if arcpy.Exists("WU_SeasonPond"):
```

```
        arcpy.Delete_management("WU_SeasonPond")
```

```
    # Setting python variables
```



```

arcpy.MakeFeatureLayer_management(globalvars.srcInput, "fcEnhWVWetland")
arcpy.MakeFeatureLayer_management(WetlandPoly,"fcWU")
logger.info("feature layers ready")

# Select all wetland polygons that are not permanently flooded
strWHERE = """"ATTRIBUTE" NOT LIKE '%H%' AND ("ATTRIBUTE" LIKE 'P%' OR
"ATTRIBUTE" LIKE 'L2AB%' OR "ATTRIBUTE" LIKE 'L2US5%' OR "ATTRIBUTE"
LIKE 'L2EM%' OR "ATTRIBUTE" LIKE 'R2AB%' OR "ATTRIBUTE" LIKE 'R3AB%' OR
"ATTRIBUTE" LIKE 'R2US5%' OR "ATTRIBUTE" LIKE 'R3US5%' OR "ATTRIBUTE"
LIKE 'R2EM%' OR "ATTRIBUTE" LIKE 'R3EM%' OR "ATTRIBUTE" LIKE 'R4SB7%')""""
arcpy.SelectLayerByAttribute_management("fcEnhWVWetland", "NEW_SELECTION",
strWHERE)
logger.info("all the aplustrine wetland that are not permanently flooded selected")

# Create layer of non-permanently flooded wetlands from selection
arcpy.CopyFeatures_management("fcEnhWVWetland", "WU_SeasonPond1")
arcpy.MakeFeatureLayer_management("WU_SeasonPond1", "fcSeasonPond1")
logger.info("layer of non-permanently flooded wetlands from selection created")
arcpy.SelectLayerByAttribute_management("fcEnhWVWetland", "CLEAR_SELECTION")

#Add field to store shape area
actions.DeleteField("fcSeasonPond1","SeaPondRatio")
arcpy.AddField_management("fcSeasonPond1", "SHAPE_Area_1", "FLOAT")

arcpy.CalculateField_management("fcSeasonPond1","SHAPE_Area_1","[SHAPE_Area]","VB
","#")
logger.info("field SHAPE_Area_1 added and value calculated")

#####
#####

# SJ: SeasonPond

```

```
#####  
#####
```

```
# Join non-permanently flooded wetlands to Wetland Units and sum the non-permanently  
flooded area
```

```
fmSJ = arcpy.FieldMappings()  
fmSJ.addTable("fcWU")  
fmSJ.addTable("fcSeasonPond1")
```

```
keepers = []
```

```
keepers = ["WUKey", "Shape_Length", "Shape_Area", "SHAPE_Area_1"]
```

```
for field in fmSJ.fields:
```

```
    if field.name not in keepers:
```

```
        fmSJ.removeFieldMap(fmSJ.findFieldMapIndex(field.name))
```

```
fldKeyIndex = fmSJ.findFieldMapIndex("SHAPE_Area_1")
```

```
fieldmap = fmSJ.getFieldMap(fldKeyIndex)
```

```
fieldmap.mergeRule = "Sum"
```

```
fmSJ.replaceFieldMap(fldKeyIndex, fieldmap)
```

```
arcpy.SpatialJoin_analysis("fcWU", "fcSeasonPond1", "WU_SeasonPond", "JOIN_ONE_TO_O  
NE", "KEEP_ALL", fmSJ, "INTERSECT")
```

```
fcSeasonPond = arcpy.mapping.Layer(r"WU_SeasonPond")
```

```
logger.info("Spatial join non-permanently flooded wetlands to Wetland Units and sum the  
non-permanently flooded area")
```

```
# Add field to store ration of non-permanently-flooded area to total area
```

```
actions.DeleteField(fcSeasonPond, "SeaPondRatio")
```

```
arcpy.AddField_management(fcSeasonPond, "SeaPondRatio", "FLOAT")
```

```
logger.info("field SeaPondRatio added to store ration of non-permanently-flooded area to total area")
```

```
# Calculate raio o fnon-permanently flooded to Wetland Unit area
```

```
arcpy.CalculateField_management(fcSeasonPond,"SeaPondRatio","[SHAPE_Area_1]/[Shape_Area]","VB","#")
```

```
logger.info("raio o fnon-permanently flooded calculated to Wetland Unit area")
```

```
# Add field to store points for fnon-permanently flooded area and set initial value to zero
```

```
actions.DeleteField(fcSeasonPond,"SeasonPond")
```

```
arcpy.AddField_management(fcSeasonPond, "SeasonPond", "SHORT")
```

```
arcpy.CalculateField_management(fcSeasonPond,"SeasonPond","0","VB","#")
```

```
logger.info("field SeasonPond added and initial value set to 0")
```

```
# Assign points to Wetland Units for seasonal ponding
```

```
strWHERE = """"SeaPondRatio" > 0.1"""
```

```
arcpy.SelectLayerByAttribute_management(fcSeasonPond, "NEW_SELECTION", strWHERE)
```

```
arcpy.CalculateField_management(fcSeasonPond,"SeasonPond","1","VB","#")
```

```
strWHERE = """"SeaPondRatio" > 0.4"""
```

```
arcpy.SelectLayerByAttribute_management(fcSeasonPond, "NEW_SELECTION", strWHERE)
```

```
arcpy.CalculateField_management(fcSeasonPond,"SeasonPond","2","VB","#")
```

```
strWHERE = """"SeaPondRatio" > 0.7"""
```

```
arcpy.SelectLayerByAttribute_management(fcSeasonPond, "NEW_SELECTION", strWHERE)
```

```
arcpy.CalculateField_management(fcSeasonPond,"SeasonPond","3","VB","#")
```

```
logger.info("points assigned to Wetland Units for SeasonPond")
```

```
arcpy.SelectLayerByAttribute_management(fcSeasonPond, "CLEAR_SELECTION")
```

```
# Clean up
```

```
if arcpy.Exists("WU_SeasonPond1"):
```

```
    arcpy.Delete_management("WU_SeasonPond1")
```

### 5.7.99 Slope: Water Quality Potential

```
#####  
#  
# File Name: SLOPE.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 3/2/2016 (modified 11/28/2017)  
# Purpose:  
# Calculate slope as the median value of percent  
# slope pixels within a Wetland Unit  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
from arcpy.sa import *  
  
def CalcSLOPE(WetlandPoly):  
    arcpy.CheckOutExtension("Spatial")  
    logger = logging.getLogger("WFA.WQuality.WQPotential.SLOPE")  
  
    # Clean up if needed  
    if arcpy.Exists("ZonalSt_WU_SLOPE"):  
        arcpy.Delete_management("ZonalSt_WU_SLOPE")  
    if arcpy.Exists("WU_SLOPE"):
```

```

    arcpy.Delete_management("WU_SLOPE")
if arcpy.Exists("WU_SLOPE1"):
    arcpy.Delete_management("WU_SLOPE1")

# Copy Wetland Units feature class
arcpy.CopyFeatures_management(WetlandPoly,"WU_SLOPE1")
arcpy.MakeFeatureLayer_management("WU_SLOPE1", "fcWUSLOPE1")
logger.info("feature layer ready")

# Zonal statistics
#arcpy.CalculateStatistics_management(globalvars.srcSlopePCT)
#ZonalSt_WU_SLOPE = ZonalStatisticsAsTable(WetlandPoly, "WUKey",
globalvars.srcSlopePCT, "ZonalSt_WU_SLOPE", "NODATA", "MEDIAN")
    arcpy.gp.ZonalStatisticsAsTable("fcWUSLOPE1", "WUKey", globalvars.srcSlopePCT,
"ZonalSt_WU_SLOPE", "NODATA", "MEDIAN")
    logger.info("zonal statistics completed")

# join table
    arcpy.AddJoin_management("fcWUSLOPE1", "WUKey", "ZonalSt_WU_SLOPE",
"WUKey")
    logger.info("zonal statistics table joined to wetland units")

# create feature class from the Wetland Poly data joined with the Zonal Statistics Output
Table
    arcpy.FeatureClassToFeatureClass_conversion("fcWUSLOPE1", arcpy.env.workspace,
"WU_SLOPE")
    WUSlope = arcpy.mapping.Layer(r"WU_SLOPE")
    logger.info("feature class WU_SLOPE created")

actions.DeleteField(WUSlope,"SLOPE")
arcpy.AddField_management(WUSlope, "SLOPE", "SHORT")

```

```
arcpy.CalculateField_management(WUSlope,"SLOPE","[ZonalSt_WU_SLOPE_MEDIAN]","VB","#")
```

```
logger.info("field SLOPE added and calculated")
```

```
# remove join
```

```
arcpy.RemoveJoin_management("fcWUSLOPE1")
```

```
if arcpy.Exists("ZonalSt_WU_SLOPE"):
```

```
    arcpy.Delete_management("ZonalSt_WU_SLOPE")
```

```
if arcpy.Exists("WU_SLOPE1"):
```

```
    arcpy.Delete_management("WU_SLOPE1")
```

### 5.7.100 VegByLP: Water Quality Potential

```
#####  
#  
# File Name: VegByLP.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 3/22/2016 (modified 12/06/2017)  
# Purpose:  
# Used in Water Quality Function / Potential aspect / Vegetation Factor  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcVegByLP(WetlandPoly):  
    logger = logging.getLogger("WFA.WQuality.WQPotential.VegByLP")  
  
    # Clean up if needed  
    if arcpy.Exists("WU_VegByLP1"):  
        arcpy.Delete_management("WU_VegByLP1")  
    if arcpy.Exists("WU_VegByLP"):  
        arcpy.Delete_management("WU_VegByLP")  
    if arcpy.Exists("VegAll"):  
        arcpy.Delete_management("VegAll")
```



```

if arcpy.Exists("Lakes"):
    arcpy.Delete_management("Lakes")
if arcpy.Exists("WUbyLake"):
    arcpy.Delete_management("WUbyLake")
if arcpy.Exists("WUbyLakeVegAll"):
    arcpy.Delete_management("WUbyLakeVegAll")
if arcpy.Exists("Ponds"):
    arcpy.Delete_management("Ponds")
if arcpy.Exists("WUwithPond"):
    arcpy.Delete_management("WUwithPond")
if arcpy.Exists("WUwithPondVegAll"):
    arcpy.Delete_management("WUwithPondVegAll")
if arcpy.Exists("WUwithPondVegAll_join"):
    arcpy.Delete_management("WUwithPondVegAll_join")
if arcpy.Exists("WU_VegByLake"):
    arcpy.Delete_management("WU_VegByLake")

# Setting Python variables
arcpy.MakeFeatureLayer_management(WetlandPoly,"fcWU")
arcpy.MakeFeatureLayer_management(globalvars.srcInput,"fcInput")
arcpy.MakeFeatureLayer_management(globalvars.srcRiversLakes,"fcRiversLakes")
arcpy.MakeFeatureLayer_management(r"WU_WflowPath","fcWUflowPath")
logger.info("feature layers ready")

# Add fields to Wetland Units and set initial point value to zero
actions.DeleteField("fcWU","VegByLP")
arcpy.AddField_management("fcWU","VegByLP","SHORT")
arcpy.CalculateField_management("fcWU","VegByLP","0","VB","#")
logger.info("field VegByLP added and initial value set to 0")

```

```
actions.DeleteField("fcWU","VegStream")
arcpy.AddField_management("fcWU", "VegStream", "SHORT")
logger.info("field VegStream added")
```

```
actions.DeleteField("fcWU","PondRatio")
arcpy.AddField_management("fcWU", "PondRatio", "FLOAT")
logger.info("field PondRatio added")
```

```
#####
#####
```

# PART 1: CREATE VEGETATION LAYER

```
#####
#####
```

# Select the forest, shrubland, emergent, moss, and aquatic bed vegetation

```
arcpy.SelectLayerByAttribute_management("fcInput","NEW_SELECTION","""ATTRIBUTE
LIKE 'PEM%' OR "ATTRIBUTE" LIKE 'PFO%' OR "ATTRIBUTE" LIKE 'PSS%' OR
"ATTRIBUTE" LIKE 'PAB%' OR "ATTRIBUTE" LIKE 'PML%""")
```

```
arcpy.CopyFeatures_management("fcInput", "VegAll")
```

```
arcpy.MakeFeatureLayer_management(r"VegAll","fcVegAll")
```

```
logger.info("forest, shrubland, emergent, moss, and aquatic bed vegetation selected and
exported")
```

```
#####
#####
```

# PART 2: CREATE RIVER AND LAKE SELECTIONS

```
#####
#####
```

```

# Select Wetland Units that share a boundary with rivers or lakes
arcpy.SelectLayerByAttribute_management("fcInput", "CLEAR_SELECTION")

arcpy.SelectLayerByLocation_management("fcWU", "INTERSECT", "fcRiversLakes", "#", "NEW_SELECTION")
arcpy.CopyFeatures_management("fcWU", "WUbyLake", "#", "0", "0", "0")
arcpy.MakeFeatureLayer_management(r"WUbyLake", "fcWUbyLake")
logger.info("Wetland Units that share a boundary with lakes selected and exported")

# Select WUbyLake that are vegetated

arcpy.SelectLayerByLocation_management("fcWUbyLake", "CONTAINS", "fcVegAll", "#", "NEW_SELECTION")
arcpy.CopyFeatures_management("fcWUbyLake", "WUbyLakeVegAll", "#", "0", "0", "0")
arcpy.MakeFeatureLayer_management(r"WUbyLakeVegAll", "fcWUbyLakeVegAll")
logger.info("Wetland Units that share a boundary with lakes selected and exported")

# Assign 1 point to VegByLP for the selected Wetland Units
arcpy.CalculateField_management("fcWUbyLakeVegAll", "VegByLP", "1", "VB", "#")
logger.info("1 point assignd to VegByLP for the selected Wetland Units")

#####
#####

# PART 3: CREATE POND SELECTIONS

#####
#####

# Select ponds.

arcpy.SelectLayerByAttribute_management("fcInput", "NEW_SELECTION", """"ATTRIBUTE
" LIKE 'PA%' OR "ATTRIBUTE" LIKE 'PU%""")

```

```

arcpy.CopyFeatures_management("fcInput","Ponds","#","0","0","0")
arcpy.MakeFeatureLayer_management(r"Ponds","fcPonds")
logger.info("ponds selected and exported")

# Select Wetland Units that contain ponds

arcpy.SelectLayerByLocation_management("fcWU","CONTAINS","fcPonds","#","NEW_SELECTION")
arcpy.CopyFeatures_management("fcWU","WUwithPond","#","0","0","0")
arcpy.MakeFeatureLayer_management(r"WUwithPond","fcWUwithPond")
logger.info("Wetland Units that contain ponds selected and exported")

# Select WUwithPond that are vegetated

arcpy.SelectLayerByLocation_management("fcWUwithPond","CONTAINS","fcVegAll","#","NEW_SELECTION")
arcpy.CopyFeatures_management("fcWUwithPond","WUwithPondVegAll","#","0","0","0")
arcpy.MakeFeatureLayer_management(r"WUwithPondVegAll","fcWUwithPondVegAll")
logger.info("WUwithPond that are vegetated selected and exported")

# Add Area fields and calculate geometry
actions.DeleteField("fcPonds","PondArea")
arcpy.AddField_management("fcPonds", "PondArea", "FLOAT")
arcpy.CalculateField_management("fcPonds","PondArea","[SHAPE_Area]","VB","#")
logger.info("field PondArea added and calculated")

actions.DeleteField("WUwithPondVegAll","WUArea")
arcpy.AddField_management("WUwithPondVegAll", "WUArea", "FLOAT")

arcpy.CalculateField_management("WUwithPondVegAll","WUArea","[SHAPE_Area]","VB","#")

```

```

logger.info("field WUArea added and calculated")

# Spatial join vegetated WU with ponds
fmSJPonds = arcpy.FieldMappings()
fmSJPonds.addTable("fcWUwithPondVegAll")
fmSJPonds.addTable("fcPonds")

keepers = []
keepers =
["WUKey", "Shape_Length", "Shape_Area", "VegByLP", "PondRatio", "VegStream", "PondArea",
"WUArea"]

for field in fmSJPonds.fields:
    if field.name not in keepers:
        fmSJPonds.removeFieldMap(fmSJPonds.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis("fcWUwithPondVegAll", "fcPonds", "WUwithPondVegAll_join", "J
OIN_ONE_TO_ONE", "KEEP_ALL", fmSJPonds, "CONTAINS")

arcpy.MakeFeatureLayer_management(r"WUwithPondVegAll_join", "fcWUwithPondVegAllJo
in")

logger.info("spatial join WUwithPondVegAll and Ponds completed")

# Calculate ratio of pond area (Ponds) to vegetated Wetland Unit (WUwithPondVegAll_join)

arcpy.CalculateField_management("fcWUwithPondVegAllJoin", "PondRatio", "[PondArea]/[W
UArea]", "VB", "#")

logger.info("field PondRatio calculated")

# Assign 1 point to VegByLP if pond area is < 100% of Wetland Unit area

```

```

arcpy.SelectLayerByAttribute_management("fcWUwithPondVegAllJoin","NEW_SELECTION",
"''''''PondRatio" < 1''''')

    arcpy.CalculateField_management("fcWUwithPondVegAllJoin","VegByLP","1","VB","#")
    logger.info("1 point assigned to VegByLP if pond area is < 100% of Wetland Unit area")

# PART 4: COMBINE RESULTS
# Spatial Join lake results to Wetland Units
arcpy.SelectLayerByAttribute_management("fcWU", "CLEAR_SELECTION")
arcpy.SelectLayerByAttribute_management("fcWUwithPondVegAllJoin",
"CLEAR_SELECTION")

actions.DeleteField("fcWUbyLakeVegAll","VegByLP_1")
arcpy.AddField_management("fcWUbyLakeVegAll", "VegByLP_1", "SHORT")

arcpy.CalculateField_management("fcWUbyLakeVegAll","VegByLP_1","[VegByLP]","VB",
"#")

fmSJKLakes = arcpy.FieldMappings()
fmSJKLakes.addTable("fcWU")
fmSJKLakes.addTable("fcWUbyLakeVegAll")

keepers = []
keepers =
["WUKey","Shape_Length","Shape_Area","VegByLP","VegByLP_1","PondRatio"]

for field in fmSJKLakes.fields:
    if field.name not in keepers:
        fmSJKLakes.removeFieldMap(fmSJKLakes.findFieldMapIndex(field.name))

```

```

arcpy.SpatialJoin_analysis("fcWU","fcWUbyLakeVegAll","WU_VegByLake","JOIN_ONE_T
O_ONE","KEEP_ALL",fmSJLakes,"INTERSECT")
    arcpy.MakeFeatureLayer_management(r"WU_VegByLake","fcWUVegByLake")
    logger.info("spatial join of lake results completed")

# Select lake results and write to Wetland Units
strWHERE = """"VegByLP_1" = 1""""
    arcpy.SelectLayerByAttribute_management("fcWUVegByLake", "NEW_SELECTION",
strWHERE)
    arcpy.CalculateField_management("fcWUVegByLake","VegByLP","1","VB","#")
    logger.info("lake results selected and written to Wetland Units")

    arcpy.SelectLayerByAttribute_management("fcWUVegByLake", "CLEAR_SELECTION")

## Spatial Join pond results to Wetland Units
    arcpy.SelectLayerByAttribute_management("fcWU", "CLEAR_SELECTION")
    arcpy.SelectLayerByAttribute_management("fcWUwithPondVegAllJoin",
"CLEAR_SELECTION")

    actions.DeleteField("fcWUwithPondVegAllJoin","VegByLP_12")
    arcpy.AddField_management("fcWUwithPondVegAllJoin", "VegByLP_12", "SHORT")

arcpy.CalculateField_management("fcWUwithPondVegAllJoin","VegByLP_12","[VegByLP]",
"VB","#")

fmSJWU = arcpy.FieldMappings()
fmSJWU.addTable("fcWUVegByLake")
fmSJWU.addTable("fcWUwithPondVegAllJoin")

keepers = []

```

```
keepers =
["WUKey","Shape_Length","Shape_Area","VegByLP","VegByLP_1","VegByLP_12","PondR
atio"]
```

```
for field in fmSJWU.fields:
```

```
    if field.name not in keepers:
```

```
        fmSJWU.removeFieldMap(fmSJWU.findFieldMapIndex(field.name))
```

```
arcpy.SpatialJoin_analysis("fcWUVegByLake","fcWUwithPondVegAllJoin","WU_VegByLP1
","JOIN_ONE_TO_ONE","KEEP_ALL",fmSJWU,"INTERSECT")
```

```
    arcpy.MakeFeatureLayer_management(r"WU_VegByLP1","fcWUVegByLP1")
```

```
    logger.info("spatial join of pond results completed")
```

```
# Select pond results and write to Wetland Units
```

```
strWHERE = """"VegByLP_12" = 1"""
```

```
arcpy.SelectLayerByAttribute_management("fcWUVegByLP1", "NEW_SELECTION",
strWHERE)
```

```
arcpy.CalculateField_management("fcWUVegByLP1","VegByLP","1","VB","#")
```

```
arcpy.SelectLayerByAttribute_management("fcWUVegByLP1", "CLEAR_SELECTION")
```

```
logger.info("pond results selected and written to Wetland Units")
```

```
# Delete unnecessary fields from WU_VegByLP1
```

```
arcpy.DeleteField_management("fcWUVegByLP1","VegByLP_1;VegByLP_12")
```

```
#####
#####
```

```
# PART 5: Add vegetated wetlands that contain a through-flowing perennial stream.
```

```
#####
#####
```



```

## Spatial Join WU_VegByLP1 to WU_WFlowPath
fmSJPerennial = arcpy.FieldMappings()
fmSJPerennial.addTable("fcWUVegByLP1")
fmSJPerennial.addTable("fcWUflowPath")

keepers = []
keepers =
["WUKey", "Shape_Length", "Shape_Area", "VegByLP", "PondRatio", "VegStream", "WFlowPath"]

for field in fmSJPerennial.fields:
    if field.name not in keepers:
        fmSJPerennial.removeFieldMap(fmSJPerennial.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis("fcWUVegByLP1", "fcWUflowPath", "WU_VegByLP", "JOIN_ONE_TO_ONE", "KEEP_ALL", fmSJPerennial, "CONTAINS")
arcpy.MakeFeatureLayer_management(r"WU_VegByLP", "fcWUVegByLP")
logger.info("spatial join WU_VegByLP1 to WU_WFlowPath completed")

# Select vegetated wetlands

arcpy.SelectLayerByLocation_management("fcWUVegByLP", "INTERSECT", "fcVegAll", "#", "NEW_SELECTION")

# Select vegetated wetlands that contain a through-flowing perennial stream
strWHERE = """"WFlowPath" = 'TP'"""
arcpy.SelectLayerByAttribute_management("fcWUVegByLP", "SUBSET_SELECTION", strWHERE)
arcpy.CalculateField_management("fcWUVegByLP", "VegByLP", "1", "VB", "#")
arcpy.SelectLayerByAttribute_management("fcWUVegByLP", "CLEAR_SELECTION")

```

```
logger.info("perennial stream results selected and written to Wetland Units")
```

```
# Clean up
```

```
arcpy.DeleteField_management("fcWU", "VegByLP;PondRatio;VegStream")
```

```
if arcpy.Exists("WU_VegByLP1"):
```

```
    arcpy.Delete_management("WU_VegByLP1")
```

```
if arcpy.Exists("WUbyLake"):
```

```
    arcpy.Delete_management("WUbyLake")
```

```
if arcpy.Exists("WUbyLakeVegAll"):
```

```
    arcpy.Delete_management("WUbyLakeVegAll")
```

```
if arcpy.Exists("Ponds"):
```

```
    arcpy.Delete_management("Ponds")
```

```
if arcpy.Exists("WUwithPond"):
```

```
    arcpy.Delete_management("WUwithPond")
```

```
if arcpy.Exists("WUwithPondVegAll"):
```

```
    arcpy.Delete_management("WUwithPondVegAll")
```

```
if arcpy.Exists("WUwithPondVegAll_join"):
```

```
    arcpy.Delete_management("WUwithPondVegAll_join")
```

```
if arcpy.Exists("WU_VegByLake"):
```

```
    arcpy.Delete_management("WU_VegByLake")
```

### 5.7.101 VegPerUng: Water Quality Potential

```
#####  
#  
# File Name: VegPerUng.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 7/17/2015 (modified 11/08/2017)  
# Purpose:  
#   VegPerUng: Used in Water Quality Function / Potential / Vegetation. Max 5 points.  
#   VegPerUng4: Used in Flood Attenuation Function / Potential / Vegetation. Max 4 points.  
#   VegPerUng1: Used in Habitat and Ecological Integrity Function / Potential / Vegetation.  
#   Max 1 point.  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcVegPerUng(WetlandPoly):  
    logger = logging.getLogger("WFA.WQuality.WQPotential.VegPerUng")  
  
    # Clean up if needed  
    if arcpy.Exists("VegPFOPSSPEM"):  
        arcpy.Delete_management("VegPFOPSSPEM")  
    if arcpy.Exists("VegPerUng"):  
        arcpy.Delete_management("VegPerUng")
```

```

if arcpy.Exists("WUVegPerUngIntersect"):
    arcpy.Delete_management("WUVegPerUngIntersect")
if arcpy.Exists("WUVegPerUngIntersect_SUM_STAT"):
    arcpy.Delete_management("WUVegPerUngIntersect_SUM_STAT")
if arcpy.Exists("WU_VegPerUng"):
    arcpy.Delete_management("WU_VegPerUng")
if arcpy.Exists("WU_VegPerUng1"):
    arcpy.Delete_management("WU_VegPerUng1")

# setting the variables
arcpy.MakeFeatureLayer_management(globalvars.srcPasturesNotHayfields,
"fcPasturesNotHayfields")
arcpy.MakeFeatureLayer_management(globalvars.srcInput, "fcEnhWVWetland")
logger.info("feature layers ready")

# Create feature class to store VegPerUng variables
arcpy.CopyFeatures_management(WetlandPoly, "WU_VegPerUng1")
arcpy.MakeFeatureLayer_management("WU_VegPerUng1", "fcWUVegPerUng1")
logger.info("feature layer WU_VegPerUng1 created")

# selecting and creating a feature class of forests, shrublands, and persistent emergent
vegetation sites within EnhWVWetland
strWHERE = """"ATTRIBUTE" NOT LIKE 'PEM2%' AND ("ATTRIBUTE" LIKE
'PEM%' OR "ATTRIBUTE" LIKE 'PFO%' OR "ATTRIBUTE" LIKE 'PSS%')""""
arcpy.SelectLayerByAttribute_management("fcEnhWVWetland", "NEW_SELECTION",
strWHERE)
arcpy.CopyFeatures_management("fcEnhWVWetland", "VegPFOPSSPEM")
arcpy.MakeFeatureLayer_management("VegPFOPSSPEM", "fcVegPFOPSSPEM")
arcpy.SelectLayerByAttribute_management("fcEnhWVWetland", "CLEAR_SELECTION")
logger.info("feature class of forests, shrublands, and persistent emergent vegetation sites
within EnhWVWetland created")

```

```

# Erase the known grazed pastures from the intermediate vegetation layer
arcpy.Erase_analysis("fcVegPFOPSSPEM","fcPasturesNotHayfields","VegPerUng","#")
arcpy.MakeFeatureLayer_management("VegPerUng", "fcVegPerUng")
logger.info("known grazed pastures from the intermediate vegetation layer erased")

# Calculate the percentage of each Wetland Unit that is persistent ungrazed vegetation
(VegPerUng)
# Attribute each Wetland Unit with the percentage of VerPerUng
actions.DeleteField("fcWUVegPerUng1","OrigArea")
arcpy.AddField_management("fcWUVegPerUng1", "OrigArea", "DOUBLE")
arcpy.CalculateField_management("fcWUVegPerUng1", "OrigArea", "!SHAPE_Area!",
"PYTHON")
logger.info("field OrigArea created and calculated")

# intersect "fcWUVegPerUng1" with VegPerUng
arInputData = ["fcWUVegPerUng1","fcVegPerUng"]
arcpy.Intersect_analysis(arInputData, "WUVegPerUngIntersect","ALL","#","INPUT")
arcpy.MakeFeatureLayer_management("WUVegPerUngIntersect",
"fcWUVegPerUngIntersect")
logger.info("Wetland units intersected with VegPerUng")

# add and calculate PctIntersect field
actions.DeleteField("fcWUVegPerUngIntersect","PctIntersect")
arcpy.AddField_management("fcWUVegPerUngIntersect", "PctIntersect", "FLOAT")
arcpy.CalculateField_management("fcWUVegPerUngIntersect", "PctIntersect",
"!SHAPE_Area!/!OrigArea!*100", "PYTHON")
logger.info("field PctIntersect added and calculated")

# Execute the Summary Statistics function

```

```

    arcpy.Statistics_analysis("fcWUVegPerUngIntersect",
"WUVegPerUngIntersect_SUM_STAT", [{"PctIntersect", "SUM"}],
["FID_WU_VegPerUng1"])

    arcpy.MakeTableView_management(r"WUVegPerUngIntersect_SUM_STAT",
"tvWUVegPerUngIntersectSumm")

    logger.info("summary table WUVegPerUngIntersect_SUM_STAT created")

    ""# Add new field (VegPerUngPct) to attribute table to store the percentage of persistent
ungrazed vegetation
actions.DeleteField("fcWUVegPerUng1","VegPerUngPct")
arcpy.AddField_management("fcWUVegPerUng1", "VegPerUngPct", "FLOAT")
arcpy.CalculateField_management("fcWUVegPerUng1", "VegPerUngPct", "0", "VB")
logger.info("field VegPerUngPct added and initial value set to 0")

    # Add new field (VegPerUng) to attribute table to store the score in relation to the percentage
of persistent ungrazed vegetation
actions.DeleteField("fcWUVegPerUng1","VegPerUng")
arcpy.AddField_management("fcWUVegPerUng1", "VegPerUng", "SHORT")
arcpy.CalculateField_management("fcWUVegPerUng1", "VegPerUng", "0", "VB")
logger.info("field VegPerUng added and initial value set to 0)""

    # Join Wetland Units to the WUVegPerUngIntersect_SUM_STAT table
arcpy.AddJoin_management( "fcWUVegPerUng1", "WUKey",
"tvWUVegPerUngIntersectSumm", "FID_WU_VegPerUng1")
logger.info("join added to the WUVegPerUngIntersect_SUM_STAT table")
arcpy.FeatureClassToFeatureClass_conversion("fcWUVegPerUng1", arcpy.env.workspace,
"WU_VegPerUng")
arcpy.MakeFeatureLayer_management(r"WU_VegPerUng", "fcWUVegPerUng")

    # Add new field (VegPerUngPct) to attribute table to store the percentage of persistent
ungrazed vegetation
actions.DeleteField("fcWUVegPerUng","VegPerUngPct")

```

```

arcpy.AddField_management("fcWUVegPerUng", "VegPerUngPct", "FLOAT")
arcpy.CalculateField_management("fcWUVegPerUng", "VegPerUngPct", "0", "PYTHON")
logger.info("field VegPerUngPct added and initial value set to 0")

# Add new field (VegPerUng) to attribute table to store the score in relation to the percentage
of persistent ungrazed vegetation
actions.DeleteField("fcWUVegPerUng","VegPerUng")
arcpy.AddField_management("fcWUVegPerUng", "VegPerUng", "SHORT")
arcpy.CalculateField_management("fcWUVegPerUng", "VegPerUng", "0", "PYTHON")
logger.info("field VegPerUng added and initial value set to 0")

arcpy.CalculateField_management("fcWUVegPerUng", "VegPerUngPct",
"!WUVegPerUngIntersect_SUM_STAT_SUM_PctIntersect!", "PYTHON")
logger.info("field VegPerUngPct calculated")

# Remove Join
arcpy.RemoveJoin_management("fcWUVegPerUng1")
logger.info("join removed")

# Replace null values with 0
strWHERE = """"VegPerUngPct" IS NULL""""

arcpy.SelectLayerByAttribute_management("fcWUVegPerUng","NEW_SELECTION",strWH
ERE)
arcpy.CalculateField_management("fcWUVegPerUng", "VegPerUngPct", "0", "VB")

# Assign points to Wetland Units for VegPerUng
strWHERE = """"VegPerUngPct" > 66.7""""

arcpy.SelectLayerByAttribute_management("fcWUVegPerUng","NEW_SELECTION",strWH
ERE)

```

```

arcpy.CalculateField_management("fcWUVegPerUng", "VegPerUng", "5", "VB")

strWHERE = """"VegPerUngPct" < 66.701 AND "VegPerUngPct" > 33.3""""

arcpy.SelectLayerByAttribute_management("fcWUVegPerUng", "NEW_SELECTION", strWHERE)

arcpy.CalculateField_management("fcWUVegPerUng", "VegPerUng", "3", "VB")

strWHERE = """"VegPerUngPct" < 33.301 AND "VegPerUngPct" > 10""""

arcpy.SelectLayerByAttribute_management("fcWUVegPerUng", "NEW_SELECTION", strWHERE)

arcpy.CalculateField_management("fcWUVegPerUng", "VegPerUng", "1", "VB")

strWHERE = """"VegPerUngPct" < 10.001""""

arcpy.SelectLayerByAttribute_management("fcWUVegPerUng", "NEW_SELECTION", strWHERE)

arcpy.CalculateField_management("fcWUVegPerUng", "VegPerUng", "0", "VB")
logger.info("points assigned to field VegPerUng")
arcpy.SelectLayerByAttribute_management("fcWUVegPerUng", "CLEAR_SELECTION")

# add VegPerUng4 field
actions.DeleteField("fcWUVegPerUng", "VegPerUng4")
arcpy.AddField_management("fcWUVegPerUng", "VegPerUng4", "SHORT")
arcpy.CalculateField_management("fcWUVegPerUng", "VegPerUng4", "0", "VB")
logger.info("field VegPerUng4 added and initial value set to 0")

# add VegPerUng1 field
actions.DeleteField("fcWUVegPerUng", "VegPerUng1")
arcpy.AddField_management("fcWUVegPerUng", "VegPerUng1", "SHORT")

```



```

arcpy.CalculateField_management("fcWUVegPerUng", "VegPerUng1", "0", "VB")
logger.info("field VegPerUng1 added and initial value set to 0")

# Assign points to Wetland Units for VegPerUng4 and VegPerUng1
strWHERE = """"VegPerUngPct" > 10""""

arcpy.SelectLayerByAttribute_management("fcWUVegPerUng", "NEW_SELECTION", strWHERE)

arcpy.CalculateField_management("fcWUVegPerUng", "VegPerUng4", "1", "VB")

strWHERE = """"VegPerUngPct" > 33.3""""

arcpy.SelectLayerByAttribute_management("fcWUVegPerUng", "NEW_SELECTION", strWHERE)

arcpy.CalculateField_management("fcWUVegPerUng", "VegPerUng4", "2", "VB")

strWHERE = """"VegPerUngPct" > 50""""

arcpy.SelectLayerByAttribute_management("fcWUVegPerUng", "NEW_SELECTION", strWHERE)

arcpy.CalculateField_management("fcWUVegPerUng", "VegPerUng4", "3", "VB")
arcpy.CalculateField_management("fcWUVegPerUng", "VegPerUng1", "1", "VB")

strWHERE = """"VegPerUngPct" > 66.7""""

arcpy.SelectLayerByAttribute_management("fcWUVegPerUng", "NEW_SELECTION", strWHERE)

arcpy.CalculateField_management("fcWUVegPerUng", "VegPerUng4", "4", "VB")
logger.info("points assigned to fields VegPerUng1 and VegPerUng4")
arcpy.SelectLayerByAttribute_management("fcWUVegPerUng", "CLEAR_SELECTION")

# Clean up

```

```
if arcpy.Exists("VegPFOPSSPEM"):
    arcpy.Delete_management("VegPFOPSSPEM")
if arcpy.Exists("VegPerUng"):
    arcpy.Delete_management("VegPerUng")
if arcpy.Exists("WUVegPerUngIntersect"):
    arcpy.Delete_management("WUVegPerUngIntersect")
if arcpy.Exists("WUVegPerUngIntersect_SUM_STAT"):
    arcpy.Delete_management("WUVegPerUngIntersect_SUM_STAT")
if arcpy.Exists("WU_VegPerUng1"):
    arcpy.Delete_management("WU_VegPerUng1")
```

### 5.7.102 VegWoody: Water Quality Potential

```
#####  
#  
# File Name: VegWoody.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 3/15/2016 (modified 11/03/2017)  
# Purpose:  
#   Input to Water Quality / Potential / Vegetation Factor  
#  
#####  
#!/usr/: Input to Water Quality / Potential / Vegetation Factor.bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcVegWoody(WetlandPoly):  
    logger = logging.getLogger("WFA.WQuality.WQPotential.VegWoody")  
  
    # Clean up if needed  
    if arcpy.Exists("VegPFOPSS"):  
        arcpy.Delete_management("VegPFOPSS")  
    if arcpy.Exists("VegPFO"):  
        arcpy.Delete_management("VegPFO")  
    if arcpy.Exists("WUPFOJoin"):  
        arcpy.Delete_management("WUPFOJoin")
```

```

if arcpy.Exists("WU_VegWoody"):
    arcpy.Delete_management("WU_VegWoody")

# Setting python variables
arcpy.MakeFeatureLayer_management(WetlandPoly, "fcWU")
arcpy.MakeFeatureLayer_management(globalvars.srcInput, "fcENWI")
logger.info("feature layers ready")

# Select all woody vegetation, both forest and shrubland
strWHERE = """"ATTRIBUTE" LIKE 'PFO%' OR "ATTRIBUTE" LIKE 'PSS%""""
arcpy.SelectLayerByAttribute_management("fcENWI", "NEW_SELECTION", strWHERE)
logger.info("all woody vegetation, both forest and shrubland selected")

# Create layer of woody vegetation from selection
arcpy.CopyFeatures_management("fcENWI", "VegPFOPSS")
arcpy.MakeFeatureLayer_management(r"VegPFOPSS", "fcVegPFOPSS")
logger.info("layer VegPFOPSS created of woody vegetation from selection")
arcpy.SelectLayerByAttribute_management("fcENWI", "CLEAR_SELECTION")

# Add field to store woody area
actions.DeleteField("fcVegPFOPSS","PFOPSSarea")
arcpy.AddField_management("fcVegPFOPSS", "PFOPSSarea", "FLOAT")

arcpy.CalculateField_management("fcVegPFOPSS","PFOPSSarea","[SHAPE_Area]","VB","#")
)
logger.info("field PFOPSSarea to store woody area")

# Select just the forest vegetation, not including the shrubs
strWHERE = """"ATTRIBUTE" LIKE 'PFO%""""
arcpy.SelectLayerByAttribute_management("fcENWI", "NEW_SELECTION", strWHERE)

```

```

logger.info("the forest vegetation, not including the shrubs selected")

# Create layer of forest vegetation from selection
arcpy.CopyFeatures_management("fcENWI", "VegPFO")
arcpy.MakeFeatureLayer_management(r"VegPFO", "fcVegPFO")
logger.info("layer VegPFO created of forest vegetation from selection")
arcpy.SelectLayerByAttribute_management("fcENWI", "CLEAR_SELECTION")

# Add field to store forest area
actions.DeleteField("fcVegPFO","PFOarea")
arcpy.AddField_management("fcVegPFO", "PFOarea", "FLOAT")
arcpy.CalculateField_management("fcVegPFO","PFOarea","[SHAPE_Area]","VB","#")
logger.info("field PFOarea added to store forest area")

# Join forests to Wetland Units and sum the forest area

#####
#####

# SJ: VegPFO

#####
#####

fmSJPFO = arcpy.FieldMappings()
fmSJPFO.addTable("fcWU")
fmSJPFO.addTable("fcVegPFO")

fldKeyIndex1 = fmSJPFO.findFieldMapIndex("PFOarea")
fieldmap1 = fmSJPFO.getFieldMap(fldKeyIndex1)
fieldmap1.mergeRule = "Sum"
fmSJPFO.replaceFieldMap(fldKeyIndex1, fieldmap1)

```

```
arcpy.SpatialJoin_analysis("fcWU","fcVegPFO","WUPFOjoin","JOIN_ONE_TO_ONE","KEEP_ALL",fmSJPFO,"INTERSECT")
```

```
arcpy.MakeFeatureLayer_management("WUPFOjoin","fcWUPFOjoin")
```

```
logger.info("forests joined to wetland units and the forest area summed up")
```

```
#####  
#####
```

```
# SJ: VegPFOPSS
```

```
#####  
#####
```

```
fmSJPSS = arcpy.FieldMappings()
```

```
fmSJPSS.addTable("fcWUPFOjoin")
```

```
fmSJPSS.addTable("fcVegPFOPSS")
```

```
fldKeyIndex2 = fmSJPSS.findFieldMapIndex("PFOPSSarea")
```

```
fieldmap2 = fmSJPSS.getFieldMap(fldKeyIndex2)
```

```
fieldmap2.mergeRule = "Sum"
```

```
fmSJPSS.replaceFieldMap(fldKeyIndex2, fieldmap2)
```

```
arcpy.SpatialJoin_analysis("fcWUPFOjoin","fcVegPFOPSS","WU_VegWoody","JOIN_ONE_TO_ONE","KEEP_ALL",fmSJPSS,"INTERSECT")
```

```
fcWUVegWoody = arcpy.mapping.Layer(r"WU_VegWoody")
```

```
logger.info("woody vegetation joined to wetland units and the woody area summed up")
```

```
# Add fields to store rations of forest and woody area to total area
```

```
actions.DeleteField(fcWUVegWoody,"PForatio")
```

```
arcpy.AddField_management(fcWUVegWoody, "PForatio", "FLOAT")
```

```
actions.DeleteField(fcWUVegWoody,"PFOPSSratio")
```

```

arcpy.AddField_management(fcWUVegWoody, "PFOPSSratio", "FLOAT")
logger.info("fields PFOratio and PFOPSSratio added to store rations of forest and woody area
to total area")

# Calculate ratio of woody vegetation to Wetland Unit area

arcpy.CalculateField_management(fcWUVegWoody,"PFOPSSratio", "[PFOPSSarea]/[Shape_A
rea]", "VB", "#")
logger.info("ratio of woody vegetation calculated to Wetland Unit area")

# Calculate ratio of forest vegetation to Wetland Unit area

arcpy.CalculateField_management(fcWUVegWoody,"PFOratio", "[PFOarea]/[Shape_Area]", "V
B", "#")
logger.info("ratio of forest vegetation calculated to Wetland Unit area")

#####
#####

# Add new attribute field to store points for VegWoody and set initial value to zero

#####
#####

actions.DeleteField(fcWUVegWoody,"VegWoody")
arcpy.AddField_management(fcWUVegWoody, "VegWoody", "SHORT")
arcpy.CalculateField_management(fcWUVegWoody,"VegWoody", "0", "VB", "#")
logger.info("field VegWoody added to store points for VegWoody and initial value set to
zero")

actions.DeleteField(fcWUVegWoody,"VegWoody4")
arcpy.AddField_management(fcWUVegWoody, "VegWoody4", "SHORT")
arcpy.CalculateField_management(fcWUVegWoody,"VegWoody4", "0", "VB", "#")

```

```
logger.info("field VegWoody4 added to store points for VegWoody and initial value set to zero")
```

```
actions.DeleteField(fcWUVegWoody,"VegWoody2")
```

```
arcpy.AddField_management(fcWUVegWoody, "VegWoody2", "SHORT")
```

```
arcpy.CalculateField_management(fcWUVegWoody,"VegWoody2","0","VB","#")
```

```
logger.info("field VegWoody2 added to store points for VegWoody and initial value set to zero")
```

```
actions.DeleteField(fcWUVegWoody,"VegWoodyFor")
```

```
arcpy.AddField_management(fcWUVegWoody, "VegWoodyFor", "SHORT")
```

```
arcpy.CalculateField_management(fcWUVegWoody,"VegWoodyFor","0","VB","#")
```

```
logger.info("field VegWoodyFor added to store points for VegWoody and initial value set to zero")
```

```
# Assign points to Wetland Units for woody vegetation
```

```
strWHERE = """"PFOPSSratio" > 0.1"""
```

```
arcpy.SelectLayerByAttribute_management(fcWUVegWoody, "NEW_SELECTION", strWHERE)
```

```
arcpy.CalculateField_management(fcWUVegWoody,"VegWoody","1","VB","#")
```

```
arcpy.CalculateField_management(fcWUVegWoody,"VegWoody4","1","VB","#")
```

```
arcpy.CalculateField_management(fcWUVegWoody,"VegWoody2","1","VB","#")
```

```
strWHERE = """"PFOPSSratio" > 0.5"""
```

```
arcpy.SelectLayerByAttribute_management(fcWUVegWoody, "NEW_SELECTION", strWHERE)
```

```
arcpy.CalculateField_management(fcWUVegWoody,"VegWoody4","2","VB","#")
```

```
strWHERE = """"PFOPSSratio" > 0.333"""
```

```
arcpy.SelectLayerByAttribute_management(fcWUVegWoody, "NEW_SELECTION", strWHERE)
```



```

arcpy.CalculateField_management(fcWUVegWoody,"VegWoody","2","VB","#")

strWHERE = """"PFOPSSratio" > 0.667""""

arcpy.SelectLayerByAttribute_management(fcWUVegWoody, "NEW_SELECTION",
strWHERE)

arcpy.CalculateField_management(fcWUVegWoody,"VegWoody","3","VB","#")

strWHERE = """"PFOPSSratio" > 0.667 AND "PFOratio" > 0.333""""

arcpy.SelectLayerByAttribute_management(fcWUVegWoody, "NEW_SELECTION",
strWHERE)

arcpy.CalculateField_management(fcWUVegWoody,"VegWoody","4","VB","#")
arcpy.CalculateField_management(fcWUVegWoody,"VegWoody4","3","VB","#")

strWHERE = """"PFOratio" > 0.667""""

arcpy.SelectLayerByAttribute_management(fcWUVegWoody, "NEW_SELECTION",
strWHERE)

arcpy.CalculateField_management(fcWUVegWoody,"VegWoody","5","VB","#")
arcpy.CalculateField_management(fcWUVegWoody,"VegWoody4","4","VB","#")
arcpy.CalculateField_management(fcWUVegWoody,"VegWoody2","2","VB","#")

strWHERE = """"PFOratio" > 0.1 OR "PFOarea" > 10000""""

arcpy.SelectLayerByAttribute_management(fcWUVegWoody, "NEW_SELECTION",
strWHERE)

arcpy.CalculateField_management(fcWUVegWoody,"VegWoodyFor","1","VB","#")

strWHERE = """"("PFOratio" > 0.33 AND "PFOarea" > 2000) OR "PFOarea" > 20000""""

arcpy.SelectLayerByAttribute_management(fcWUVegWoody, "NEW_SELECTION",
strWHERE)

arcpy.CalculateField_management(fcWUVegWoody,"VegWoodyFor","2","VB","#")

strWHERE = """"("PFOratio" > 0.667 AND "PFOarea" > 5000) OR "PFOarea" > 50000""""

```

```
arcpy.SelectLayerByAttribute_management(fcWUVegWoody, "NEW_SELECTION",
strWHERE)

arcpy.CalculateField_management(fcWUVegWoody,"VegWoodyFor","3","VB","#")
logger.info("points assigned to Wetland Units for woody vegetation")
arcpy.SelectLayerByAttribute_management(fcWUVegWoody, "CLEAR_SELECTION")

# Clean up
if arcpy.Exists("VegPFOPSS"):
    arcpy.Delete_management("VegPFOPSS")
if arcpy.Exists("VegPFO"):
    arcpy.Delete_management("VegPFO")
if arcpy.Exists("WUPFOJoin"):
    arcpy.Delete_management("WUPFOJoin")
```

### 5.7.103 WFlowPath: Water Quality Potential

```
#####  
#  
# File Name: WFlowPath.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 4/5/2016 (modified 11/28/2017)  
# Purpose:  
#   Water Quality Function  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def DetermineWFlowPath(WetlandPoly):  
    logger = logging.getLogger("WFA.WQuality.WQPotential.WFlowPath")  
  
    # Clean up if needed  
    if arcpy.Exists("WU_WflowPath1"):  
        arcpy.Delete_management("WU_WflowPath1")  
    if arcpy.Exists("NHDflowline_Intersect"):  
        arcpy.Delete_management("NHDflowline_Intersect")  
    if arcpy.Exists("NHDflowline_IntMult"):  
        arcpy.Delete_management("NHDflowline_IntMult")
```

```

if arcpy.Exists("NHDflowline_IntMultDiss"):
    arcpy.Delete_management("NHDflowline_IntMultDiss")
if arcpy.Exists("WU_WflowPath2"):
    arcpy.Delete_management("WU_WflowPath2")
if arcpy.Exists("WU_WflowPath"):
    arcpy.Delete_management("WU_WflowPath")

# Setting python variables
arcpy.MakeFeatureLayer_management(globalvars.srcInput,"fcENWI")
arcpy.MakeFeatureLayer_management(globalvars.srcNHDWB24kRivers,
"fcNHDWB24kRivers")
arcpy.MakeFeatureLayer_management(globalvars.srcNHDFlowline,"fcNHDFlowline")
arcpy.MakeFeatureLayer_management(globalvars.srcDrainageArea,"fcDA27m")
arcpy.MakeFeatureLayer_management(globalvars.srcLakes,"fcLakes")
arcpy.MakeFeatureLayer_management(globalvars.srcRivers,"fcRivers")

arcpy.CopyFeatures_management(WetlandPoly, "WU_WflowPath1")
arcpy.MakeFeatureLayer_management(r"WU_WflowPath1","fcWUflowPath1")
logger.info("feature layers ready")

# Add text fields to the Wetland Units feature class, to allow computation of Water Flow Path
(WFlowPath)
actions.DeleteField("fcWUflowPath1","FlowPath")
arcpy.AddField_management("fcWUflowPath1", "FlowPath", "TEXT", 4)

actions.DeleteField("fcWUflowPath1","PerInt")
arcpy.AddField_management("fcWUflowPath1", "PerInt", "TEXT", 4)

actions.DeleteField("fcWUflowPath1","WFlowPath")
arcpy.AddField_management("fcWUflowPath1", "WFlowPath", "TEXT", 4)

```

```

logger.info("text fields added to the Wetland Units")

#####
####
# PART 1: Intersect NHDFlowlines and wetlands

#####
####
arInputData = ["fcWUflowPath1","fcNHDFlowline"]
arcpy.Intersect_analysis(arInputData,"NHDflowline_Intersect","ONLY_FID","#","POINT")
fcNHDflowline_Intersect = arcpy.mapping.Layer(r"NHDflowline_Intersect")
logger.info("intersect NHDFlowlines and wetlands completed")

# Create multiple points for single line segments

arcpy.MultipartToSinglepart_management(fcNHDflowline_Intersect,"NHDflowline_IntMult")
fcNHDflowline_IntMult = arcpy.mapping.Layer(r"NHDflowline_IntMult")
logger.info("multiple points feature created")

# Remove doubles

arcpy.Dissolve_management(fcNHDflowline_IntMult,"NHDflowline_IntMultDiss","#","#","SINGLE_PART","DISSOLVE_LINES")
fcNHDflowline_IntMultDiss = arcpy.mapping.Layer(r"NHDflowline_IntMultDiss")
logger.info("dissolve completed to remove doubles")

# Clear all selections
arcpy.SelectLayerByAttribute_management("fcWUflowPath1", "CLEAR_SELECTION")
arcpy.SelectLayerByAttribute_management("fcNHDFlowline", "CLEAR_SELECTION")
arcpy.SelectLayerByAttribute_management(fcNHDflowline_IntMult,
"CLEAR_SELECTION")

```

```
arcpy.SelectLayerByAttribute_management(fcNHDFlowline_IntMultDiss,
"CLEAR_SELECTION")
```

```
# Select by attribute, within attribute table of NHDFlowline
```

```
strWhere = """"FCode" IN (46003,46007,33600,33601, 33603)""""
```

```
arcpy.SelectLayerByAttribute_management("fcNHDFlowline","NEW_SELECTION",strWhere
)
```

```
logger.info("certain NHDFlowline selected")
```

```
# Select the wetland units that intersect intermittent or ephemeral stream(s)
```

```
arcpy.SelectLayerByLocation_management("fcWUflowPath1","INTERSECT","fcNHDFlowline",
"#","NEW_SELECTION")
```

```
logger.info("wetland units that intersect intermittent or ephemeral stream(s) selected")
```

```
# Attribute the Wetland Units that intersect intermittent or ephemeral stream(s)
```

```
arcpy.CalculateField_management("fcWUflowPath1","PerInt","I","PYTHON")
```

```
logger.info("value assigned to wetland units that intersect intermittent or ephemeral
stream(s)")
```

```
# Select by attribute, within attribute table of NHDFlowline
```

```
arcpy.SelectLayerByAttribute_management("fcWUflowPath1", "CLEAR_SELECTION")
```

```
arcpy.SelectLayerByAttribute_management("fcNHDFlowline", "CLEAR_SELECTION")
```

```
strWhere = """"FCode" IN (33400,46000,46006,55800)""""
```

```
arcpy.SelectLayerByAttribute_management("fcNHDFlowline","NEW_SELECTION",strWhere
)
```

```
logger.info("certain NHDFlowline selected")
```

```
# Select the Wetland Units that intersect perennial stream(s)
```

```

arcpy.SelectLayerByLocation_management("fcWUflowPath1","INTERSECT","fcNHDFlowline","#","NEW_SELECTION")

logger.info("wetland units that intersect perennial stream(s) selected")

# Attribute the Wetland Units that intersect perennial stream(s)
arcpy.CalculateField_management("fcWUflowPath1","PerInt","P","PYTHON")
arcpy.SelectLayerByAttribute_management("fcWUflowPath1", "CLEAR_SELECTION")
arcpy.SelectLayerByAttribute_management("fcNHDFlowline", "CLEAR_SELECTION")
logger.info("value assigned to wetland units that intersect perennial stream(s)")

# Join Wetland Units to stream intersection points
arcpy.MakeFeatureLayer_management(r"WU_WflowPath1","fcWUflowPath1")

arcpy.MakeFeatureLayer_management(r"NHDflowline_IntMultDiss","fcNHDflowline_IntMultDiss")

fmSJFP = arcpy.FieldMappings()
fmSJFP.addTable("fcWUflowPath1")
fmSJFP.addTable("fcNHDflowline_IntMultDiss")

arcpy.SpatialJoin_analysis("fcWUflowPath1","fcNHDflowline_IntMultDiss","WU_WflowPath2","JOIN_ONE_TO_ONE","KEEP_ALL",fmSJFP,"INTERSECT")

logger.info("spatial join Wetland Units to stream intersection points completed")

fcWUflowPath2 = arcpy.mapping.Layer(r"WU_WflowPath2")

# Attribute FlowPath (Throughflow, Outflow, Isolated)

arcpy.SelectLayerByAttribute_management(fcWUflowPath2,"NEW_SELECTION","""Join_Count" > 1""")

arcpy.CalculateField_management(fcWUflowPath2,"FlowPath","TH","PYTHON")

```

```
arcpy.SelectLayerByAttribute_management(fcWUflowPath2,"NEW_SELECTION", """"Join_Count" = 1""")
```

```
arcpy.CalculateField_management(fcWUflowPath2,"FlowPath","OU","PYTHON")
```

```
arcpy.SelectLayerByAttribute_management(fcWUflowPath2,"NEW_SELECTION", """"Join_Count" = 0""")
```

```
arcpy.CalculateField_management(fcWUflowPath2,"FlowPath","IS","PYTHON")
```

```
logger.info("FlowPath attribute values assigned to Wetland Units")
```

```
arcpy.SelectLayerByAttribute_management(fcWUflowPath2, "CLEAR_SELECTION")
```

```
arcpy.SelectLayerByAttribute_management("fcNHDFlowline", "CLEAR_SELECTION")
```

```
#####  
####
```

```
# PART 2: Update FlowPath based on adjcent streams, rivers, and impoundments
```

```
#####  
####
```

```
# Update FlowPath from isolated to outflow for wetlands within 30m of a mapped stream
```

```
arcpy.SelectLayerByLocation_management(fcWUflowPath2,"WITHIN_A_DISTANCE","fcNHDFlowline","30 Meters","NEW_SELECTION")
```

```
strWhere = """"FlowPath" = 'IS'"""
```

```
arcpy.SelectLayerByAttribute_management(fcWUflowPath2,"SUBSET_SELECTION",strWhere)
```

```
arcpy.CalculateField_management(fcWUflowPath2,"FlowPath","OU","PYTHON","#")
```

```
arcpy.CalculateField_management(fcWUflowPath2,"PerInt","I","PYTHON","#")
```



```
logger.info("values of FlowPath from isolated to outflow for wetlands within 30m of a mapped stream updated")
```

```
# Update FlowPath from isolate to outflow wetlands that contain an impoundment (NWI)
arcpy.SelectLayerByAttribute_management(fcWUflowPath2, "CLEAR_SELECTION")
```

```
strWhere = """"ATTRIBUTE" LIKE 'P%h%""""
```

```
arcpy.SelectLayerByAttribute_management("fcENWI", "NEW_SELECTION", strWhere)
```

```
arcpy.SelectLayerByLocation_management(fcWUflowPath2, "CONTAINS", "fcENWI", "#", "NEW_SELECTION")
```

```
strWhere = """"FlowPath" = 'IS""""
```

```
arcpy.SelectLayerByAttribute_management(fcWUflowPath2, "SUBSET_SELECTION", strWhere)
```

```
arcpy.CalculateField_management(fcWUflowPath2, "FlowPath", "OU", "PYTHON", "#")
```

```
arcpy.CalculateField_management(fcWUflowPath2, "PerInt", "I", "PYTHON", "#")
```

```
logger.info("values of FlowPath from isolate to outflow wetlands that contain an impoundment (NWI) updated")
```

```
# Join to add area of contributing watershed (CntrWshd)
```

```
arcpy.SelectLayerByAttribute_management(fcWUflowPath2, "CLEAR_SELECTION")
```

```
arcpy.SelectLayerByAttribute_management("fcENWI", "CLEAR_SELECTION")
```

```
arcpy.JoinField_management(fcWUflowPath2, "OBJECTID", "fcDA27m", "WUKey", "WUKey; CntrWshd")
```

```
logger.info("area of contributing watershed joined")
```

```
# Export join to feature class
```

```
arcpy.CopyFeatures_management(fcWUflowPath2, "WU_WflowPath")
```

```

arcpy.MakeFeatureLayer_management(r"WU_WflowPath", "fcWUflowPath")
logger.info("joined feature exported")

# Update isolated wetland to outflow intermittent if contributing watershed > 40 acres

arcpy.SelectLayerByAttribute_management("fcWUflowPath","NEW_SELECTION","""Flow
Path" = 'IS' AND "CntrWshd" > 161874""")

arcpy.CalculateField_management("fcWUflowPath","FlowPath","OU","PYTHON","#")
arcpy.CalculateField_management("fcWUflowPath","PerInt","I","PYTHON","#")
logger.info("values of isolated wetland to outflow intermittent if contributing watershed > 40
acres updated")
arcpy.SelectLayerByAttribute_management("fcWUflowPath", "CLEAR_SELECTION")
arcpy.SelectLayerByAttribute_management("fcENWI", "CLEAR_SELECTION")

# Set Flow Path to throughflow perennial for wetlands adjacent to NWI rivers
# Select NWI rivers
#
arcpy.SelectLayerByAttribute_management("fcENWI","NEW_SELECTION","""WETLAND
_TYPE" = 'Riverine""")

arcpy.SelectLayerByLocation_management("fcWUflowPath","INTERSECT","fcRivers","#","
NEW_SELECTION")
logger.info("NWI rivers selected")

# Attribute Water Flow Path for Wetland Units Adjacent to NWI rivers
arcpy.CalculateField_management("fcWUflowPath","FlowPath","TH","PYTHON","#")
arcpy.CalculateField_management("fcWUflowPath","PerInt","P","PYTHON","#")
logger.info("values assigned to Flow Path for Wetland Units intersecting NHD 24K rivers")
arcpy.SelectLayerByAttribute_management("fcWUflowPath", "CLEAR_SELECTION")
arcpy.SelectLayerByAttribute_management("fcENWI", "CLEAR_SELECTION")

```

```

# Select the NHD 24K Rivers and set intersecting wetland to throughflow perennial

arcpy.SelectLayerByLocation_management("fcWUflowPath","INTERSECT","fcNHDWB24k
Rivers","#","NEW_SELECTION")

# Attribute Flow Path for Wetland Units intersecting NHD 24K rivers
arcpy.CalculateField_management("fcWUflowPath","FlowPath","TH","PYTHON","#")
arcpy.CalculateField_management("fcWUflowPath","PerInt","P","PYTHON","#")
logger.info("values assigned to Flow Path for Wetland Units intersecting NHD 24K rivers")

#####
#####

# PART 3: Attribute Water Flow Path for Outflow, Throughflow and Isolated Wetland Units

#####
#####

arcpy.SelectLayerByAttribute_management("fcWUflowPath","NEW_SELECTION","""Flow
Path" = 'TH' AND "PerInt" = 'I'""")

arcpy.CalculateField_management("fcWUflowPath","WFlowPath","TI","PYTHON","#")

arcpy.SelectLayerByAttribute_management("fcWUflowPath","NEW_SELECTION","""Flow
Path" = 'TH' AND "PerInt" = 'P'""")

arcpy.CalculateField_management("fcWUflowPath","WFlowPath","TP","PYTHON","#")

arcpy.SelectLayerByAttribute_management("fcWUflowPath","NEW_SELECTION","""Flow
Path" = 'OU' AND "PerInt" = 'I'""")

arcpy.CalculateField_management("fcWUflowPath","WFlowPath","OI","PYTHON","#")

```

```
arcpy.SelectLayerByAttribute_management("fcWUflowPath","NEW_SELECTION","""Flow Path" = 'OU' AND "PerInt" = 'P'""")
```

```
arcpy.CalculateField_management("fcWUflowPath","WFlowPath","OP","PYTHON","#")
```

```
arcpy.SelectLayerByAttribute_management("fcWUflowPath","NEW_SELECTION","""Flow Path" = 'IS'""")
```

```
arcpy.CalculateField_management("fcWUflowPath","WFlowPath","IS","PYTHON","#")
```

```
logger.info("values assigned to Flow Path for Outflow, Throughflow and Isolated Wetland Units")
```

```
#####  
#####
```

```
# PART 4: Update Water Flow Path Based on adjacent lakes
```

```
#####  
#####
```

```
arcpy.SelectLayerByAttribute_management("fcWUflowPath", "CLEAR_SELECTION")
```

```
#arcpy.SelectLayerByAttribute_management("fcENWI","NEW_SELECTION","""WETLAND_TYPE" = 'Lake'""")
```

```
arcpy.SelectLayerByLocation_management("fcWUflowPath","INTERSECT","fcLakes","#","NEW_SELECTION")
```

```
# Attribute Flow Path for Wetland Units adjacent to lakes
```

```
arcpy.CalculateField_management("fcWUflowPath","FlowPath","BI","PYTHON","#")
```

```
logger.info("values assigned to Flow Path for Wetland Units adjacent to lakes")
```

```
# Attribute Water Flow Path for Wetland Units adjacent to lakes
```

```
arcpy.SelectLayerByAttribute_management("fcWUflowPath", "CLEAR_SELECTION")
```

```

arcpy.SelectLayerByAttribute_management("fcENWI", "CLEAR_SELECTION")

arcpy.SelectLayerByAttribute_management("fcWUflowPath", "NEW_SELECTION", """"Flow
Path" = 'BI' AND "WFlowPath" IN ( 'OP', 'OI')""")
    arcpy.CalculateField_management("fcWUflowPath", "WFlowPath", "BO", "PYTHON", "#")

arcpy.SelectLayerByAttribute_management("fcWUflowPath", "NEW_SELECTION", """"Flow
Path" = 'BI' AND "WFlowPath" IN ( 'TP', 'TI')""")
    arcpy.CalculateField_management("fcWUflowPath", "WFlowPath", "TB", "PYTHON", "#")

arcpy.SelectLayerByAttribute_management("fcWUflowPath", "NEW_SELECTION", """"Flow
Path" = 'BI' AND "WFlowPath" = 'IS'""")
    arcpy.CalculateField_management("fcWUflowPath", "WFlowPath", "IB", "PYTHON", "#")
    logger.info("values assigned to WFlowPath field")
    arcpy.SelectLayerByAttribute_management("fcWUflowPath", "CLEAR_SELECTION")

# Clean up
if arcpy.Exists("WU_WflowPath1"):
    arcpy.Delete_management("WU_WflowPath1")
if arcpy.Exists("NHDflowline_Intersect"):
    arcpy.Delete_management("NHDflowline_Intersect")
if arcpy.Exists("NHDflowline_IntMult"):
    arcpy.Delete_management("NHDflowline_IntMult")
if arcpy.Exists("NHDflowline_IntMultDiss"):
    arcpy.Delete_management("NHDflowline_IntMultDiss")
if arcpy.Exists("WU_WflowPath2"):
    arcpy.Delete_management("WU_WflowPath2")

```

### 5.7.104 Water Quality Society

```
#####  
#  
# File Name: WQSociety.py  
# Developer: Yibing Han  
# Date: 12/13/2017  
# Purpose:  
# This script handles the execution of all the Water Quality Value to Society metrics.  
#  
#####  
import datetime  
import logging  
import traceback  
import arcpy  
  
from Variables import Fisheries, WaterSupply  
from Factors import HUC12WQ, ImpairedOut, WQPlan, WQUse  
from Aspects import WQSociety  
  
def procWQSociety(WetlandPoly):  
    logger = logging.getLogger("WFA.WQuality.WQSociety")  
  
    #####  
    ## 1. Run Variables  
    #####  
  
    Fisheries.CalcFisheries(WetlandPoly)  
  
    WaterSupply.DetermineWaterSupply(WetlandPoly)
```

#####

## 2. Run Factors

#####

HUC12WQ.DetermineHUC12WQ(WetlandPoly)

ImpairedOut.CalcImpairedOut(WetlandPoly)

WQPlan.CalcWQPlan(WetlandPoly)

WQUse.CalcWQUse(WetlandPoly)

#####

## 3. Run Aspect

#####

WQSociety.DetermineWQSociety(WetlandPoly)

### 5.7.105 Water Quality Society Aspects

```
#####  
#  
# File Name: WQSociety.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 5/26/2016 (modified 11/02/2017)  
# Purpose:  
#   Water Quality Function  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import arcpy  
from utilities import actions  
import logging  
  
def DetermineWQSociety(WetlandPoly):  
    logger = logging.getLogger("WFA.WQuality.WQSociety.WQSociety")  
  
    # Setting python variables  
    arcpy.MakeFeatureLayer_management(r"WU_HUC12WQ","fcHUC12WQ")  
    arcpy.MakeFeatureLayer_management(r"WU_ImpairedOut","fcImpairedOut")  
    arcpy.MakeFeatureLayer_management(r"WU_WQPlan","fcWQPlan")  
    arcpy.MakeFeatureLayer_management(r"WU_WQUse","fcWQUse")  
    logger.info("feature layers ready")
```



```

# Clean up if needed
if arcpy.Exists("WU_WQSociety1"):
    arcpy.Delete_management("WU_WQSociety1")
if arcpy.Exists("WU_WQSociety2"):
    arcpy.Delete_management("WU_WQSociety2")
if arcpy.Exists("WU_WQSociety3"):
    arcpy.Delete_management("WU_WQSociety3")
if arcpy.Exists("WU_WQSociety4"):
    arcpy.Delete_management("WU_WQSociety4")
if arcpy.Exists("WU_WQSociety"):
    arcpy.Delete_management("WU_WQSociety")

# Create feature class to store WQSociety
arcpy.CopyFeatures_management(WetlandPoly, "WU_WQSociety1")
arcpy.MakeFeatureLayer_management(r"WU_WQSociety1", "fcWUSociety1")
logger.info("feature class WU_WQSociety1 created")

# Add WQSociety field to Wetland Units and set initial point value to zero
actions.DeleteField("fcWUSociety1", "WQSociety")
arcpy.AddField_management("fcWUSociety1", "WQSociety", "SHORT")
arcpy.CalculateField_management("fcWUSociety1", "WQSociety", "0", "VB", "#")
logger.info("WQSociety field added to Wetland Units and initial point values set to zero")

# Spatial joins to bring in factor values

#####
#####

# SJ: HUC12WQ

```

```
#####  
#####
```

```
fmSJHUC = arcpy.FieldMappings()  
fmSJHUC.addTable("fcWUSociety1")  
fmSJHUC.addTable("fcHUC12WQ")
```

```
keepers = []  
keepers = ["WUKey","Shape_Length","Shape_Area","WQSociety","HUC12WQ"]
```

```
for field in fmSJHUC.fields:
```

```
    if field.name not in keepers:
```

```
        fmSJHUC.removeFieldMap(fmSJHUC.findFieldMapIndex(field.name))
```

```
arcpy.SpatialJoin_analysis("fcWUSociety1","fcHUC12WQ","WU_WQSociety2","JOIN_ONE_  
TO_ONE","KEEP_ALL",fmSJHUC,"CONTAINS")
```

```
arcpy.MakeFeatureLayer_management("WU_WQSociety2","fcWUSociety2")
```

```
logger.info("Spatial Join completed to add variable HUC12WQ")
```

```
#####  
#####
```

```
# SJ: ImpairedOut
```

```
#####  
#####
```

```
fmSJIO = arcpy.FieldMappings()  
fmSJIO.addTable("WU_WQSociety2")  
fmSJIO.addTable("fcImpairedOut")
```

```

keepers = []
keepers =
["WUKey","Shape_Length","Shape_Area","WQSociety","HUC12WQ","ImpairedOut"]

for field in fmSJIO.fields:
    if field.name not in keepers:
        fmSJIO.removeFieldMap(fmSJIO.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis("WU_WQSociety2","fcImpairedOut","WU_WQSociety3","JOIN_O
NE_TO_ONE","KEEP_ALL",fmSJIO,"CONTAINS")
arcpy.MakeFeatureLayer_management("WU_WQSociety3","fcWUSociety3")
logger.info("Spatial Join completed to add variable ImpairedOut")

#####
#####

# SJ: WQPlan

#####
#####

fmSJWQP = arcpy.FieldMappings()
fmSJWQP.addTable("fcWUSociety3")
fmSJWQP.addTable("fcWQPlan")

keepers = []
keepers =
["WUKey","Shape_Length","Shape_Area","WQSociety","HUC12WQ","ImpairedOut","WQPla
n"]

for field in fmSJWQP.fields:

```

if field.name not in keepers:

```
fmSJWQP.removeFieldMap(fmSJWQP.findFieldMapIndex(field.name))
```

```
arcpy.SpatialJoin_analysis("fcWUSociety3","fcWQPlan","WU_WQSociety4","JOIN_ONE_TO_ONE","KEEP_ALL",fmSJWQP,"CONTAINS")
```

```
arcpy.MakeFeatureLayer_management("WU_WQSociety4","fcWUSociety4")
```

```
logger.info("Spatial Join completed to add variable WQPlan")
```

```
#####  
#####
```

```
# SJ: WQUse
```

```
#####  
#####
```

```
fmSJWQP = arcpy.FieldMappings()
```

```
fmSJWQP.addTable("fcWUSociety4")
```

```
fmSJWQP.addTable("fcWQUse")
```

```
keepers = []
```

```
keepers =
```

```
["WUKey","Shape_Length","Shape_Area","WQSociety","HUC12WQ","ImpairedOut","WQPlan","WQUse"]
```

```
for field in fmSJWQP.fields:
```

```
if field.name not in keepers:
```

```
fmSJWQP.removeFieldMap(fmSJWQP.findFieldMapIndex(field.name))
```

```
arcpy.SpatialJoin_analysis("fcWUSociety4","fcWQUse","WU_WQSociety","JOIN_ONE_TO_ONE","KEEP_ALL",fmSJWQP,"CONTAINS")
```

```

arcpy.MakeFeatureLayer_management("WU_WQSociety","fcWUSociety")
logger.info("Spatial Join completed to add variable WQUse")

# Sum the factor points

arcpy.CalculateField_management("fcWUSociety","WQSociety","[HUC12WQ] +
[ImpairedOut] + [WQPlan] + [WQUse]","VB","#")
logger.info("points summed for WQSociety")

# Reduce values that exceed the maximum allowable points

arcpy.SelectLayerByAttribute_management("fcWUSociety","NEW_SELECTION","""WQSo
ciety" > 4""")
arcpy.CalculateField_management("fcWUSociety","WQSociety","4","VB","#")
arcpy.SelectLayerByAttribute_management("fcWUSociety", "CLEAR_SELECTION")
logger.info("points reduced to maximum allowed for WQSociety")

# Clean up
if arcpy.Exists("WU_WQSociety1"):
    arcpy.Delete_management("WU_WQSociety1")
if arcpy.Exists("WU_WQSociety2"):
    arcpy.Delete_management("WU_WQSociety2")
if arcpy.Exists("WU_WQSociety3"):
    arcpy.Delete_management("WU_WQSociety3")
if arcpy.Exists("WU_WQSociety4"):
    arcpy.Delete_management("WU_WQSociety4")

```

### 5.7.106 Huc12WQ: Water Quality Society

```
#####  
#  
# File Name: HUC12WQ.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date 3/18/2016 (modified 12/05/2017)  
# Purpose:  
#   Water Quality Function, Value to Society  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def DetermineHUC12WQ(WetlandPoly):  
    logger = logging.getLogger("WFA.WQuality.WQSociety.HUC12WQ")  
  
    # Clean up if needed  
    if arcpy.Exists("WU_HUC12WQ"):  
        arcpy.Delete_management("WU_HUC12WQ")  
  
    # Setting python variables  
    shpHUC12s = arcpy.mapping.Layer(globalvars.srcHUC12s)  
    PublicFishingLakes = arcpy.mapping.Layer(globalvars.srcPublicFishingLakes)
```

```

fcAlgalStreams = arcpy.mapping.Layer(globalvars.srcAlgalStreams)
fcAlgalLakes = arcpy.mapping.Layer(globalvars.srcAlgalLakes)
shpImpairedStreams = arcpy.mapping.Layer(globalvars.srcImpairedStreams)
shpLimestone = arcpy.mapping.Layer(globalvars.srcLimeStone)
shpDolostone = arcpy.mapping.Layer(globalvars.srcDolostone)

# Create feature class to store ImpairedOut variable
arcpy.CopyFeatures_management(WetlandPoly, "WU_HUC12WQ")
WUHUC12WQ = arcpy.mapping.Layer(r"WU_HUC12WQ")
logger.info("feature layers ready")

# Add field to Wetland Units and set initial point value to zero
actions.DeleteField(WUHUC12WQ,"HUC12WQ")
arcpy.AddField_management(WUHUC12WQ, "HUC12WQ", "SHORT")
arcpy.CalculateField_management(WUHUC12WQ,"HUC12WQ","0","VB","#")
logger.info("field HUC12WQ added and initial value set to 0")

# Select lakes with power boat use
strWHERE = """"BoatType" NOT LIKE 'No%'""""
arcpy.SelectLayerByAttribute_management(PublicFishingLakes, "NEW_SELECTION",
strWHERE)
logger.info("lakes with power boat use selected")

# Select HUC12s that contain lakes with power boat use

arcpy.SelectLayerByLocation_management(shpHUC12s,"INTERSECT",PublicFishingLakes,"#
","NEW_SELECTION")
logger.info("HUC12s that contain lakes with power boat use selected")

# Select HUC12s that contain algal lakes

```

```
arcpy.SelectLayerByLocation_management(shpHUC12s,"INTERSECT",fcAlgalLakes,"#","ADD_TO_SELECTION")
```

```
logger.info("HUC12s that contain algal lakes selected")
```

```
# Select HUC12s that contain algal streams
```

```
arcpy.SelectLayerByLocation_management(shpHUC12s,"INTERSECT",fcAlgalStreams,"#","ADD_TO_SELECTION")
```

```
logger.info("HUC12s that contain algal streams selected")
```

```
# Select HUC12s that contain impaired stream reaches
```

```
arcpy.SelectLayerByLocation_management(shpHUC12s,"INTERSECT",shpImpairedStreams,"#","ADD_TO_SELECTION")
```

```
logger.info("HUC12s that contain impaired stream reaches selected")
```

```
# Select HUC12s that contain karst
```

```
arcpy.SelectLayerByLocation_management(shpHUC12s,"INTERSECT",shpLimestone,"#","ADD_TO_SELECTION")
```

```
arcpy.SelectLayerByLocation_management(shpHUC12s,"INTERSECT",shpDolostone,"#","ADD_TO_SELECTION")
```

```
logger.info("HUC12s that contain karst selected")
```

```
#Select Wetland Units with water quality issues
```

```
arcpy.SelectLayerByLocation_management(WUHUC12WQ,"INTERSECT",shpHUC12s,"#","NEW_SELECTION")
```

```
logger.info("Wetland Units with water quality issues selected")
```

```
# Assign 1 point to Wetland Units in HUC12s with water quality issues
```



```
arcpy.CalculateField_management(WUHUC12WQ,"HUC12WQ","1","VB","#")
logger.info("1 point assigned to Wetland Units in HUC12s with water quality issues")
```

```
arcpy.SelectLayerByAttribute_management(WUHUC12WQ, "CLEAR_SELECTION")
arcpy.SelectLayerByAttribute_management(shpHUC12s, "CLEAR_SELECTION")
```

### 5.7.107 ImpairedOut: Water Quality Society

```
#####  
#  
# File Name: ImpairedOut.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 3/16/2016 (modified 12/06/2017)  
# Purpose:  
#   Water Quality Function  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcImpairedOut(WetlandPoly):  
    logger = logging.getLogger("WFA.WQuality.WQSociety.ImpairedOut")  
  
    # Clean up if needed  
    if arcpy.Exists("WU_ImpairedOut"):  
        arcpy.Delete_management("WU_ImpairedOut")  
  
    PublicFishingLakes = arcpy.mapping.Layer(globalvars.srcPublicFishingLakes)  
    fcAlgalStreams = arcpy.mapping.Layer(globalvars.srcAlgalStreams)  
    fcAlgalLakes = arcpy.mapping.Layer(globalvars.srcAlgalLakes)
```

```

shpImpairedStreams = arcpy.mapping.Layer(globalvars.srcImpairedStreams)
#shpEPAOverlist24KNHD = arcpy.mapping.Layer(globalvars.srcEPAOverlist)
shpLimestone = arcpy.mapping.Layer(globalvars.srcLimeStone)
shpDolostone = arcpy.mapping.Layer(globalvars.srcDolostone)

# Create feature class to store ImpairedOut variable
arcpy.CopyFeatures_management(WetlandPoly, "WU_ImpairedOut")
WUImpairedOut = arcpy.mapping.Layer(r"WU_ImpairedOut")
logger.info("feature layers ready")

# Add field to Wetland Units and set initial point value to zero
actions.DeleteField(WUImpairedOut,"ImpairedOut")
arcpy.AddField_management(WUImpairedOut, "ImpairedOut", "SHORT")
arcpy.CalculateField_management(WUImpairedOut,"ImpairedOut","0","VB","#")
logger.info("field ImpairedOut added and initial value set to 0")

# Select lakes with power boat use
strWHERE = """"BoatType" NOT LIKE 'No%'""""
arcpy.SelectLayerByAttribute_management(PublicFishingLakes, "NEW_SELECTION",
strWHERE)
logger.info("lakes with power boat use selected")

# Select Wetland Units < 1km from lakes with power boat use

arcpy.SelectLayerByLocation_management(WUImpairedOut,"INTERSECT",PublicFishingLak
es,"1000 Meters","NEW_SELECTION")
logger.info("Wetland Units < 1km from lakes with power boat use selected")

# Select Wetland Units < 1km from algal lakes

```

```
arcpy.SelectLayerByLocation_management(WUImpairedOut,"INTERSECT",fcAlgalLakes,"1000 Meters","ADD_TO_SELECTION")
```

```
logger.info("Wetland Units < 1km from algal lakes selected")
```

```
# Select Wetland Units < 1km from algal streams
```

```
arcpy.SelectLayerByLocation_management(WUImpairedOut,"INTERSECT",fcAlgalStreams,"1000 Meters","ADD_TO_SELECTION")
```

```
logger.info("Wetland Units < 1km from algal streams selected")
```

```
# Select Wetland Units < 1km from impaired stream reaches
```

```
arcpy.SelectLayerByLocation_management(WUImpairedOut,"INTERSECT",shpImpairedStreams,"1000 Meters","ADD_TO_SELECTION")
```

```
#arcpy.SelectLayerByLocation_management(WUImpairedOut,"INTERSECT",shpEPAOverlist24KNHD,"1000 Meters","ADD_TO_SELECTION")
```

```
logger.info("Wetland Units < 1km from impaired stream reaches selected")
```

```
# Select Wetland Units on karst
```

```
arcpy.SelectLayerByLocation_management(WUImpairedOut,"INTERSECT",shpLimestone,"#", "ADD_TO_SELECTION")
```

```
arcpy.SelectLayerByLocation_management(WUImpairedOut,"INTERSECT",shpDolostone,"#", "ADD_TO_SELECTION")
```

```
logger.info("Wetland Units on karst selected")
```

```
# Assign 1 point to Wetland Units that discharge to impaired waters
```

```
arcpy.CalculateField_management(WUImpairedOut,"ImpairedOut","1","VB","#")
```

```
logger.info("1 point assigned to Wetland Units that discharge to impaired waters")
```

```
arcpy.SelectLayerByAttribute_management(PublicFishingLakes, "CLEAR_SELECTION")  
arcpy.SelectLayerByAttribute_management(WUImpairedOut, "CLEAR_SELECTION")
```

### 5.7.108 WQPlan: Water Quality Society

```
#####  
#  
# File Name: WQPlan.py  
# Developer: Chad Ashworth (modified and updated by Yibing Han)  
# Date: 3/18/2016, modified 11/02/2017, TMDL removed March 2023  
# Purpose:  
#   Water Quality Function  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcWQPlan(WetlandPoly):  
    logger = logging.getLogger("WFA.WQuality.WQSociety.WQPlan")  
  
    #clean up if needed  
    if arcpy.Exists("WU_WQPlan"):  
        arcpy.Delete_management("WU_WQPlan")  
  
    # Setting python variables  
    fcWatershedPlan = arcpy.mapping.Layer(globalvars.srcWatershedPlan)  
    fcTMDL = arcpy.mapping.Layer(globalvars.srcTMDL)
```

```

fcNatStrProAct_HUC10 = arcpy.mapping.Layer(globalvars.srcNatStrPreAct)
fcNF = arcpy.mapping.Layer(globalvars.srcNF)
fcNP = arcpy.mapping.Layer(globalvars.srcNP)
fcNWR = arcpy.mapping.Layer(globalvars.srcNWR)

# Create feature class to store WQPlan factor
arcpy.CopyFeatures_management(WetlandPoly, "WU_WQPlan")
WUWQPlan = arcpy.mapping.Layer(r"WU_WQPlan")
logger.info("feature layers ready")

# Add field to Wetland Units and set initial point value to zero
actions.DeleteField(WUWQPlan,"WQPlan")
arcpy.AddField_management(WUWQPlan, "WQPlan", "SHORT")
arcpy.CalculateField_management(WUWQPlan,"WQPlan","0","VB","#")
logger.info("WQPlan field added to Wetland Units and initial point values set to zero")

# Select Wetland Units with Watershed Plan

arcpy.SelectLayerByLocation_management(WUWQPlan,"INTERSECT",fcWatershedPlan,"#",
"NEW_SELECTION")

    logger.info("Wetland Units with Watershed Plan selected")

—# Select Wetland Units with TMDL Plan

arcpy.SelectLayerByLocation_management(WUWQPlan,"INTERSECT",fcTDML,"#","ADD_
TO_SELECTION")

—logger.info("Wetland Units with TMDL Plan selected")

# Select Wetland Units in watershed drained by National Streams Preservation Act streams

```

```
arcpy.SelectLayerByLocation_management(WUWQPlan,"INTERSECT",fcNatStrProAct_HUC
10,"#","ADD_TO_SELECTION")
```

```
logger.info("Wetland Units with TMDL Plan selected")
```

```
# Select National Forest owned by Forest Service
```

```
arcpy.SelectLayerByAttribute_management(fcNF,"NEW_SELECTION", """"Ownership" =
'Forest Service'""")
```

```
logger.info("National Forest owned by Forest Service selected")
```

```
# Select Wetland Units in Nation Parks, Forets, and Wildlife Refuges
```

```
arcpy.SelectLayerByLocation_management(WUWQPlan,"INTERSECT",fcNF,"#", "ADD_TO_
SELECTION")
```

```
arcpy.SelectLayerByLocation_management(WUWQPlan,"INTERSECT",fcNP,"#", "ADD_TO_
SELECTION")
```

```
arcpy.SelectLayerByLocation_management(WUWQPlan,"INTERSECT",fcNWR,"#", "ADD_T
O_SELECTION")
```

```
logger.info("Wetland Units in Nation Parks, Forets, and Wildlife Refuges selected")
```

```
# Assign 2 points to Wetland Units that are included in a watershed plan of some kind
```

```
arcpy.CalculateField_management(WUWQPlan,"WQPlan","2","VB","#")
```

```
logger.info("2 points assigned to Wetland Units that are included in a watershed plan of some
kind")
```

```
arcpy.SelectLayerByAttribute_management(WUWQPlan, "CLEAR_SELECTION")
```

```
arcpy.SelectLayerByAttribute_management(fcNF, "CLEAR_SELECTION")
```



### 5.7.109 WQuse: Water Quality Society

```
#####  
#  
# File Name: WQUse.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 3/18/2016 (modified 11/02/2017)  
# Purpose:  
#   Water Quality Function, Value to Society  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcWQUse(WetlandPoly):  
    logger = logging.getLogger("WFA.WQuality.WQSociety.WQUse")  
  
    # Clean up if needed  
    if arcpy.Exists("WU_WQUse1"):  
        arcpy.Delete_management("WU_WQUse1")  
    if arcpy.Exists("WU_WQUse2"):  
        arcpy.Delete_management("WU_WQUse2")  
    if arcpy.Exists("WU_WQUse"):  
        arcpy.Delete_management("WU_WQUse")
```

```

# Setting python variables
arcpy.MakeFeatureLayer_management(globalvars.srcSwimmingAreas,"fcSwimmingAreas")
arcpy.MakeFeatureLayer_management(r"WU_WaterSupply","fcWaterSupply")
arcpy.MakeFeatureLayer_management(r"WU_Fisheries","fcFisheries")
logger.info("feature layers ready")

# Create feature class to store WQPlan factor
arcpy.CopyFeatures_management(WetlandPoly, "WU_WQUse1")
arcpy.MakeFeatureLayer_management(r"WU_WQUse1","fcWUWQUse1")
logger.info("feature class WU_WQUse1 created")

# Add fields to Wetland Units and set initial point value to zero
actions.DeleteField("fcWUWQUse1","WQUse")
arcpy.AddField_management("fcWUWQUse1", "WQUse", "SHORT")
arcpy.CalculateField_management("fcWUWQUse1","WQUse","0","VB","#")

actions.DeleteField("fcWUWQUse1","Swim")
arcpy.AddField_management("fcWUWQUse1", "Swim", "SHORT")
arcpy.CalculateField_management("fcWUWQUse1","Swim","0","VB","#")
logger.info("WQUse and Swim fields added to Wetland Units and initial point values set to
zero")

# Select Wetland Units within 1km of Swimming Area

arcpy.SelectLayerByLocation_management("fcWUWQUse1","INTERSECT","fcSwimmingAr
eas","1000 Meters","NEW_SELECTION")

logger.info("Wetland Units within 1km of Swimming Area selected")

# Assign 1 point to selected Wetland Units

```

```

arcpy.CalculateField_management("fcWUWQUse1","Swim","1","VB","#")
logger.info("1 point assigned to selected Wetland Units")

# Select Wetland Units within 50m of Swimming Area

arcpy.SelectLayerByLocation_management("fcWUWQUse1","INTERSECT","fcSwimmingAr
eas","50 Meters","NEW_SELECTION")
logger.info("Wetland Units within 50m of Swimming Area selected")

# Assign 2 points to selected Wetland Units
arcpy.CalculateField_management("fcWUWQUse1","Swim","2","VB","#")
logger.info("2 points assigned to selected Wetland Units")

arcpy.SelectLayerByAttribute_management("fcWUWQUse1", "CLEAR_SELECTION")

# Spatial join to bring together the factor values

#####
#####

# SJ: WaterSupply

#####
#####

fmSJWS = arcpy.FieldMappings()
fmSJWS.addTable("fcWUWQUse1")
fmSJWS.addTable("fcWaterSupply")

keepers = []
keepers = ["WUKey","Shape_Length","Shape_Area","WQUse","Swim","WaterSupply"]

for field in fmSJWS.fields:

```

```

if field.name not in keepers:
    fmSJWS.removeFieldMap(fmSJWS.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis("fcWUWQUse1","fcWaterSupply","WU_WQUse2","JOIN_ONE_TO_ONE","KEEP_ALL",fmSJWS,"CONTAINS")
arcpy.MakeFeatureLayer_management("WU_WQUse2","fcWUWQUse2")
logger.info("Spatial Join completed to add variable WaterSupply")

#####
#####

# SJ: Fisheries

#####
#####

fmSJF = arcpy.FieldMappings()
fmSJF.addTable("fcWUWQUse2")
fmSJF.addTable("fcFisheries")

keepers = []
keepers =
["WUKey","Shape_Length","Shape_Area","WQUse","Swim","WaterSupply","Fisheries"]

for field in fmSJF.fields:
    if field.name not in keepers:
        fmSJF.removeFieldMap(fmSJF.findFieldMapIndex(field.name))

arcpy.SpatialJoin_analysis("fcWUWQUse2","fcFisheries","WU_WQUse","JOIN_ONE_TO_ONE","KEEP_ALL",fmSJF,"CONTAINS")
arcpy.MakeFeatureLayer_management("WU_WQUse","fcWUWQUse")

```

```

logger.info("Spatial Join completed to add variable Fisheries")

# Sum the points for water quality use
arcpy.CalculateField_management("fcWUWQUse","WQUse","[Swim] + [WaterSupply] +
[Fisheries]","VB","#")
logger.info("points summed for WQUse")

# Reduce points to maximum allowed for WQUse

arcpy.SelectLayerByAttribute_management("fcWUWQUse","NEW_SELECTION","""WQUs
e" > 2""")
arcpy.CalculateField_management("fcWUWQUse","WQUse","2","VB","#")
arcpy.SelectLayerByAttribute_management("fcWUWQUse","CLEAR_SELECTION")
logger.info("points reduced to maximum allowed for WQUse")

## Clean up
if arcpy.Exists("WU_WQUse1"):
    arcpy.Delete_management("WU_WQUse1")
if arcpy.Exists("WU_WQUse2"):
    arcpy.Delete_management("WU_WQUse2")

```

### 5.7.110 Fisheries: Water Quality Society

```
#####  
#  
# File Name: Fisheries.py  
# Developer: Chad Ashworth (modified by Yibing Han)  
# Date: 3/16/2016 (modified 12/04/2017)  
# Purpose:  
#   Water Quality Function  
#  
#####  
#!/usr/bin/python  
import sys  
sys.path.append("../..")  
  
import logging  
import arcpy  
from globalvars import globalvars  
from utilities import actions  
  
def CalcFisheries(WetlandPoly):  
    logger = logging.getLogger("WFA.WQuality.WQSociety.Fisheries")  
  
    # Clean up if needed  
    if arcpy.Exists("WU_Fisheries"):  
        arcpy.Delete_management("WU_Fisheries")  
  
    # Setting python variables  
    TroutUpdate = arcpy.mapping.Layer(globalvars.srcTrout)  
    HQSFisheries = arcpy.mapping.Layer(globalvars.srcHQSFisheries)
```

```

TroutStreams = arcpy.mapping.Layer(globalvars.srcTroutStreams)

# Create feature class to store Fisheries variable
arcpy.CopyFeatures_management(WetlandPoly, "WU_Fisheries")
WUFisheries = arcpy.mapping.Layer(r"WU_Fisheries")
logger.info("feature layers ready")

# Add field to Wetland Units and set initial point value to zero
actions.DeleteField(WUFisheries,"Fisheries")
arcpy.AddField_management(WUFisheries, "Fisheries", "SHORT")
arcpy.CalculateField_management(WUFisheries,"Fisheries","0","VB","#")
logger.info("field Fisheries added and initial value set to 0")

# Select Wetland Units within 1km of perennial trout stream

arcpy.SelectLayerByLocation_management(WUFisheries,"INTERSECT",TroutUpdate,"1000
Meters","NEW_SELECTION")

logger.info("Wetland Units within 1km of perennial trout stream selected")

# Select Wetland Units within 1km of high quality stream fisheries

arcpy.SelectLayerByLocation_management(WUFisheries,"INTERSECT",HQSFisheries,"1000
Meters","ADD_TO_SELECTION")

logger.info("Wetland Units within 1km of high quality stream fisheries selected")

# Select Wetland Units within 1km of stocked trout streams

arcpy.SelectLayerByLocation_management(WUFisheries,"INTERSECT",TroutStreams,"1000
Meters","ADD_TO_SELECTION")

logger.info("Wetland Units within 1km of stocked trout streams selected")

```

```

# Assign 1 point to Wetland Units that discharge to economic fisheries
arcpy.CalculateField_management(WUFisheries,"Fisheries","1","VB","#")
logger.info("1 point assigned to Wetland Units that discharge to economic fisheries")
arcpy.SelectLayerByAttribute_management(WUFisheries, "CLEAR_SELECTION")

# Select special fisheries
strWHERE = """"StockCode" NOT LIKE 'NS'"""

arcpy.SelectLayerByAttribute_management(TroutStreams, "NEW_SELECTION",
strWHERE)

strWHERE = """"RegType" = 'Catch-and-Release' OR "RegType" = 'Children and Class Q'
OR "RegType" = 'Fly-fishing-Only'"""

arcpy.SelectLayerByAttribute_management(TroutStreams,"ADD_TO_SELECTION",strWHE
RE)

logger.info("special fisheries selected")

# Select Wetland Units within 1 km of special fisheries

arcpy.SelectLayerByLocation_management(WUFisheries,"INTERSECT",TroutStreams,"1000
Meters","NEW_SELECTION")

logger.info("Wetland Units within 1 km of special fisheries selected")

# Assign 2 points to Wetland Units within 1km of special fisheries
arcpy.CalculateField_management(WUFisheries,"Fisheries","2","VB","#")
logger.info("2 points assigned to Wetland Units within 1km of special fisheries")
arcpy.SelectLayerByAttribute_management(WUFisheries, "CLEAR_SELECTION")
arcpy.SelectLayerByAttribute_management(TroutStreams, "CLEAR_SELECTION")

```



### 5.7.111 WaterSupply: Water Quality Society

```
#####  
#  
# File Name: WaterSupply.py  
# Developer: Chad Ashworth, Nate Gunn (modified by Yibing Han)  
# Date: 5/18/2016 (modified 12/08/2017)  
# Purpose:  
# This script contains functions which score wetlands based upon spatial  
# relationships to water supply #intakes. The "variable" (feature class)  
# output is referred to as WaterSupply in accompanying documentation  
#  
#####  
#!/usr/bin/python  
import sys, os  
sys.path.append("../..")  
  
import arcpy  
from globalvars import globalvars  
from datetime import datetime  
import collections  
from utilities import actions  
import logging  
  
logger = logging.getLogger("WFA.WQuality.WQSociety.WaterSupply")  
# Setting Python variables  
RATIO = "contribution"  
KEY = "wetland"  
PSWI = "intake"  
ITEMS_TO_REMOVE = ["WU_WaterSupply", "Surface_Intake_Drainage_Area_Intersect"]
```

```

#if __name__ == "__main__":
def DetermineWaterSupply(WetlandPoly):
    # Clean up if needed
    if arcpy.Exists("WU_WaterSupply"):
        arcpy.Delete_management("WU_WaterSupply")
    if arcpy.Exists("Surface_Intake_Drainage_Area_Intersect"):
        arcpy.Delete_management("Surface_Intake_Drainage_Area_Intersect")
    if arcpy.Exists("pswi_watersheds_with_out_of_state_drainage"):
        arcpy.Delete_management("pswi_watersheds_with_out_of_state_drainage")

    # Reading layers
    wetlands = WetlandPoly
    public_water_intakes_orig = globalvars.PSWI_WATERSHEDS
    arcpy.CopyFeatures_management(public_water_intakes_orig,
    "pswi_watersheds_with_out_of_state_drainage")
    public_water_intakes =
    arcpy.mapping.Layer("pswi_watersheds_with_out_of_state_drainage")
    zpc_5hr = arcpy.mapping.Layer(globalvars.ZPC_5HR)
    protection_areas = arcpy.mapping.Layer(globalvars.PROTECTION_AREAS)
    logger.info("layers ready")

    items = PublicWaterSupplyCheck(wetlands, public_water_intakes, zpc_5hr, protection_areas,
    public_water_intakes)
    #sanity_check(items, wetlands)

    # Clean up
    if arcpy.Exists("Surface_Intake_Drainage_Area_Intersect"):
        arcpy.Delete_management("Surface_Intake_Drainage_Area_Intersect")
    if arcpy.Exists("pswi_watersheds_with_out_of_state_drainage"):

```

```

    arcpy.Delete_management("pswi_watersheds_with_out_of_state_drainage")

#####
##### OPTIMIZED CODE STARTS HERE
#####
#Calculate each wetland's max contribution to a surface intake drainage area
def get_wetland_unit_contribution(wetland_unit, surface_intake_drainage_area, output):
    ## Create Original Area Field to the Surface Intake Drainage Area
    actions.DeleteField(surface_intake_drainage_area, "OrigArea")
    arcpy.AddField_management(surface_intake_drainage_area, "OrigArea", "DOUBLE")
    arcpy.CalculateField_management(surface_intake_drainage_area, "OrigArea",
"!SHAPE_Area!", "PYTHON_9.3")
    logger.info("field OrigArea created and calculated")

    ## Intersect the Supplied Wetland Layer and the Surface Intake Drainage Area
    lyrs = [wetland_unit, surface_intake_drainage_area]

arcpy.Intersect_analysis(lyrs,"Surface_Intake_Drainage_Area_Intersect","ALL","#","INPUT")
    logger.info("intersect complete for Supplied Wetland Layer and the Surface Intake Drainage
Area")

    #delete original area

    #arcpy.DeleteField_management(in_table=surface_intake_drainage_area,
drop_field="OrigArea")

## This will help keep things reliable if run in immediate mode. It also speeds testing.
def cleanup_workspace():
    # get the TOC by way of the map document and current frame
    if "ArcMap" in sys.executable:
        doc = arcpy.mapping.MapDocument("CURRENT")
        frame = doc.activeDataFrame

```

```

# clear the TOC or Delete attempts will fail
for lyr in arcpy.mapping.ListLayers(doc):
    if lyr.name in ITEMS_TO_REMOVE:
        arcpy.mapping.RemoveLayer(frame, lyr)

# clear the FCs used in intermediate steps and prior run results.
for item in ITEMS_TO_REMOVE:
    if arcpy.Exists(item):
        #print("Deleting {}".format(item,))
        arcpy.Delete_management(item)
    logger.info("workspace cleaned up")

#area ratio based scoring
#NOTE: the documentation uses percentage scoring. Be careful to use percentage
#in results if
def score(ratio):
    retval = 0
    if ratio:
        if ratio > 0.001:
            retval = 1
        if ratio > 0.01:
            retval = 2
    return retval

def classify_wetlands_by_intersection(wetlands, pswi_watersheds):
    #a range would be faster, but requires no gaps in OIDs for this class
    sc = arcpy.da.SearchCursor(wetlands, ["OID@"])
    items = {}
    for item in sc:
        items[item[0]] = {KEY: item[0], RATIO: 0.0}

```

```

del sc

sc = arcpy.da.SearchCursor("Surface_Intake_Drainage_Area_Intersect", ['FID_' +
wetlands.name, 'FID_' + pswi_watersheds.name, 'SHAPE@AREA' , 'OrigArea'])

#store the max contribution towards a drainage area for any wetland unit which intersects
for item in sc:
    #print("listing item {}".format(item,))
    wlu = item[0]
    #print("Already stored? {}".format(key in items))
    if wlu in items and items[wlu]:
        testval = {PSWI: item[1], RATIO: item[2] / item[3]} # new (key, ratio intersection area
to intake area)
        if testval[RATIO] > items[wlu][RATIO]:
            items[wlu] = testval
    else:
        items[wlu] = {PSWI:item[1], RATIO: item[2] / item[3]} # store dictionary of (pswi,
ratio intersection area to intake area)

zeroes = 0
ones = 0
twos = 0
for item in items:
    item_score = score(items[item][RATIO]) #score based on the stored ratio
    if item_score == 0:
        zeroes += 1
    if item_score ==1:
        ones += 1
    if item_score == 2:
        twos += 1
    items[item]['score'] = item_score
    #if item_score > 0:
        #print("wetland {} contains item: {}".format(item, items[item]))

```

```

#print "Classification results immediately after intersection scoring"
#print "zeroes: {}".format(zeroes,)
#print "ones : {}".format(ones,)
#print "twos : {}".format(twos,)
#print ""
return items

logger.info("the max contribution towards a drainage area for any wetland unit which
intersects stored")

#Perform the selections by attributes and intersections to generate scores of 1
def score_one_by_selection(wetlands, zpc_5hr, protection_areas, items):
    ## Select Secondary Protection Areas with surface water connections.
    strWhere1Pt = """"P_TYPE" in (NULL, 'Secondary Protection Area') AND "FAC_SRC" IN
('GU', 'SW')""""
    arcpy.SelectLayerByAttribute_management(protection_areas, "NEW_SELECTION",
strWhere1Pt)
    logger.info("Secondary Protection Areas with surface water connections selected")

    ## Select Wetland units within a Secondary Protection Area.
    arcpy.SelectLayerByLocation_management(wetlands, "INTERSECT", protection_areas, "",
"NEW_SELECTION")
    logger.info("Wetland units within a Secondary Protection Area selected")

    ## Select Wetland Units within the 5-hour travel distance in a Zone of Peripheral Concern.
    arcpy.SelectLayerByLocation_management(wetlands, "INTERSECT", zpc_5hr, "",
"ADD_TO_SELECTION")
    logger.info("Wetland Units within the 5-hour travel distance in a Zone of Peripheral Concern
added to selection")

with arcpy.da.SearchCursor(wetlands, ["OID@"]) as sc:
    for record in sc:

```

```

        oid = record[0]
        items[oid]['score'] = max(items[oid]['score'], 1)
del sc
logger.info("1 point scores generated for wetland units")

arcpy.SelectLayerByAttribute_management(protection_areas, "CLEAR_SELECTION")
arcpy.SelectLayerByAttribute_management(wetlands, "CLEAR_SELECTION")

#Perform the selections by attributes and intersections to generate scores of 2
def score_two_by_selection(wetlands, protection_areas, items):
    #print("Scoring twos by selection...")
    ## Select Protection Areas and Wellhead Critical Areas with surface water connections
    strWhere2Pt = """"P_TYPE" IN ('Protection Area', 'rotection Area', 'Wellhead Critical Area')
AND "FAC_SRC" IN ('GU', 'SW') """"
    arcpy.SelectLayerByAttribute_management(protection_areas, "NEW_SELECTION",
strWhere2Pt)
    logger.info("Protection Areas and Wellhead Critical Areas with surface water connections
selected")

    ## Select Wetland Units within Protection Areas or Wellhead Critical Areas with surface
connections.
    arcpy.SelectLayerByLocation_management(wetlands, "INTERSECT", protection_areas, "",
"NEW_SELECTION")
    logger.info("Wetland Units within Protection Areas or Wellhead Critical Areas with surface
connections selected")

    ## Select Wetland Units within Zone of Critical Concern.
    arcpy.SelectLayerByLocation_management(wetlands, "INTERSECT", globalvars.ZCC_WV,
"", "ADD_TO_SELECTION")
    logger.info("Wetland Units within Zone of Critical Concern added to selection")

```

```

with arcpy.da.SearchCursor(wetlands, ["OID@"]) as sc:
    for record in sc:
        oid = record[0]
        items[oid]['score'] = max(items[oid]['score'], 2)
del sc
logger.info("2 points scores generated for wetland units")

arcpy.SelectLayerByAttribute_management(protection_areas, "CLEAR_SELECTION")
arcpy.SelectLayerByAttribute_management(wetlands, "CLEAR_SELECTION")

#do a timed run of the wetland process
def PublicWaterSupplyCheck(wetlands, intakes, zpcs, protection_areas, pswi_watersheds):
    items = None

    fcPublicWaterIntakeIntersect = "Surface_Intake_Drainage_Area_Intersect"

    cleanup_workspace()

    #perform the intersection used for scoring
    get_wetland_unit_contribution(wetlands, intakes, "WU_WaterSupply")

    #score based on the wetland
    items = classify_wetlands_by_intersection(wetlands, pswi_watersheds)

    #1s
    score_one_by_selection(wetlands, zpcs, protection_areas, items)

    #2s
    score_two_by_selection(wetlands, protection_areas, items)

```



```

output_results(items, wetlands)

return items

logger.info("completed output WU_WaterSupply")
'''
def sanity_check(items, wetlands):
    #print("\nSanity check for results: ")
    check = len(items) == int(arcpy.GetCount_management("WU_WaterSupply").getOutput(0))
    #print "Number of Wetlands in FC is consistent with number of results: {}".format(check,)
    #print("Total wetland counts per score:\n")
    zeroes = 0
    ones = 0
    twos = 0
    for item in items:
        val = items[item]['score']
        if val == 2:
            twos += 1
        elif val == 1:
            ones += 1
        else:
            zeroes += 1
    #print("zeroes : {}".format(str(zeroes).rjust(8),))
    #print("ones   : {}".format(str(ones).rjust(8),))
    #print("twos   : {}".format(str(twos).rjust(8),))
    total = ones + twos + zeroes
    #print("-" * 17)
    #print("Total : {}".format(str(total).rjust(8),))
    logger.info("Completed sanity check for results")

```

```
'''
```

```
def output_results(items, wetlands):  
    ws = arcpy.env.workspace  
    template = globalvars.PSWI_TEMPLATE  
    target_path = os.path.join(ws, "WU_WaterSupply")  
    if arcpy.Exists(template):  
        if arcpy.Exists(target_path):  
            arcpy.Delete_management(target_path)  
  
        sr = arcpy.SpatialReference(26917)  
        arcpy.CreateFeatureclass_management(arcpy.env.workspace, "WU_WaterSupply",  
"POLYGON", template, "DISABLED", "DISABLED", sr)  
        logger.info("empty feature class created for WU_WaterSupply")  
        #  
        arcpy.SelectLayerByAttribute_management(wetlands, "CLEAR_SELECTION")  
        with arcpy.da.SearchCursor(wetlands, ["OID@", "Shape@", "WUKey"]) as sc,  
arcpy.da.InsertCursor(target_path, ["OID@", "Shape@", "WUKey", "PctInt", "WaterSupply"])  
as ic:  
            for record in sc:  
                # [oid, geometry, ratio, score]  
                wlu = record[0]  
                row = [wlu, record[1], record[2], items[wlu][RATIO] * 100, items[wlu]['score']]  
                ic.insertRow(row)  
            del sc  
            del ic  
        logger.info("stored records loaded into WU_WaterSupply")  
    else:  
        logger.warn("The supplied output feature class {} template is missing.".format(template,))
```

### 5.7.112 Wetland Functional Assessment Tool Launch Script

#####

#

# File Name: wfa.py

# Developer: Yibing Han @ West Virginia GIS Tech Center

# Methodology: Elizabeth Byers @ WV DEP

# Date: 02/2018

# Purpose:

# This is the main launching script that initiates the Wetland Functional Assessment.

# For questions or concerns, please contact:

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#

#####

#!/usr/bin/python

import sys, os

sys.path.append(os.path.abspath("."))

import gc

gc.enable()

import datetime

import time

```

import logging
import traceback
import arcpy

from globalvars import globalvars
from utilities import initRequest, actions, calcFunction, calcAllResults
from wquality import WQuality
from floodattn import FloodAttn
from habeco import HabEco

#scriptPath = os.path.abspath(__file__)
#thisFolder = os.path.dirname(scriptPath)

arcpy.env.overwriteOutput = True

#Set logger
logger = logging.getLogger("WFA")
logger.setLevel(logging.INFO)
#loggerFilePath = os.path.join(thisFolder, "logs")
loggerFile = os.path.join(globalvars.srcLogFolder, "WFA_" +
str(time.strftime("%Y%m%d_%H%M%S")) + ".txt")
fh = logging.FileHandler(loggerFile)
formatter = logging.Formatter('%(asctime)s - %(name)s - %(levelname)s - %(message)s')
fh.setFormatter(formatter)
logger.addHandler(fh)

ch = logging.StreamHandler()
ch.setLevel(logging.INFO)
ch.setFormatter(formatter)
logger.addHandler(ch)

```

```

logger.info("program started")

uid = "WetlandFunction"
strUploadFile = sys.argv[1]
globalvars.srcInput = strUploadFile
fcWetlandInput = arcpy.mapping.Layer(strUploadFile)

arcpy.AddMessage("Input Feature Class: " + str(strUploadFile))

# Geodatabase/Workspace
fcGeodbFCName = uid + "_" + str(time.strftime("%Y%m%d_%H%M%S"))
arcpy.CreateFileGDB_management(globalvars.srcGDBFolder, fcGeodbFCName)
strWorkspace = globalvars.srcGDBFolder + "\\\" + fcGeodbFCName + ".gdb"
arcpy.env.workspace = strWorkspace

arcpy.AddMessage("Target Geodatabase: " + str(fcGeodbFCName))

# initial run to create variables used across the sections
logger.info("Running initial functions to create variables used across the sections")
arcpy.AddMessage("Running initial functions to create variables used across the sections")
try:
fcWU = arcpy.mapping.Layer(initRequest.MainUtil(fcWetlandInput))
arcpy.AddMessage("Initial run completed to create variables used across the sections")
except arcpy.ExecuteError:
msgs = "EXECUTE ERRORS:\n" + arcpy.GetMessages(2) + "\n"
arcpy.AddError(msgs)
logger.error(msgs)
arcpy.AddMessage("Initial run to created variables failed")

```

```

sys.exit(1)
for handler in logger.handlers:
    logger.removeHandler(handler)
except:
tb = sys.exc_info()[2]
tbinfo = traceback.format_tb(tb)[0]
pymsg = "PYTHON ERRORS:\nTraceback info:\n" + tbinfo + "\nError Info:\n" +
str(sys.exc_info()[1])
msgs = "ArcPy ERRORS:\n" + arcpy.GetMessages(2) + "\n"

arcpy.AddError(pymsg)
arcpy.AddError(msgs)
logger.error(pymsg)
logger.error(msgs)
arcpy.AddMessage("Initial run to created variables failed")
sys.exit(1)
for handler in logger.handlers:
    logger.removeHandler(handler)

# run the Water Quality Assessment
logger.info("Running Water Quality Assessment")
arcpy.AddMessage("Running Water Quality Assessment")
try:
    WQuality.RunWaterQuality(fcWU)
    arcpy.AddMessage("Water Quality Assessment completed")
except arcpy.ExecuteError:
    msgs = "EXECUTE ERRORS:\n" + arcpy.GetMessages(2) + "\n"
    arcpy.AddError(msgs)
    logger.error(msgs)
    arcpy.AddMessage("Habitat and Ecological Integrity Assessment failed")

```

```

sys.exit(1)
for handler in logger.handlers:
    logger.removeHandler(handler)
except:
    tb = sys.exc_info()[2]
    tbinfo = traceback.format_tb(tb)[0]
    pymsg = "PYTHON ERRORS:\nTraceback info:\n" + tbinfo + "\nError Info:\n" +
str(sys.exc_info()[1])
    msgsg = "ArcPy ERRORS:\n" + arcpy.GetMessages(2) + "\n"

    arcpy.AddError(pymsg)
    arcpy.AddError(msgsg)
    logger.error(pymsg)
    logger.error(msgsg)
    arcpy.AddMessage("Water Quality Assessment failed")
    sys.exit(1)
for handler in logger.handlers:
    logger.removeHandler(handler)

# run Flood Attenuation Assessment
logger.info("Running Flood Attenuation Assessment")
arcpy.AddMessage("Running Flood Attenuation Assessment")
try:
    FloodAttn.RunFloodAttn(fcWU)
    arcpy.AddMessage("Flood Attenuation Assessment completed")
except arcpy.ExecuteError:
    msgsg = "EXECUTE ERRORS:\n" + arcpy.GetMessages(2) + "\n"
    arcpy.AddError(msgsg)
    logger.error(msgsg)
    arcpy.AddMessage("Flood Attenuation Assessment failed")

```

```

sys.exit(1)
for handler in logger.handlers:
    logger.removeHandler(handler)
except:
    tb = sys.exc_info()[2]
    tbinfo = traceback.format_tb(tb)[0]
    pymsg = "PYTHON ERRORS:\nTraceback info:\n" + tbinfo + "\nError Info:\n" +
str(sys.exc_info()[1])
    msgsg = "ArcPy ERRORS:\n" + arcpy.GetMessages(2) + "\n"

    arcpy.AddError(pymsg)
    arcpy.AddError(msgsg)
    logger.error(pymsg)
    logger.error(msgsg)
    arcpy.AddMessage("Flood Attenuation Assessment failed")
    sys.exit(1)
for handler in logger.handlers:
    logger.removeHandler(handler)

# run Habitat and Ecological Integrity Assessment
logger.info("Running Habitat and Ecological Integrity Assessment")
arcpy.AddMessage("Running Habitat and Ecological Integrity Assessment")
try:
    HabEco.RunHabEco(fcWU)
    arcpy.AddMessage("Habitat and Ecological Integrity Assessment completed")
except arcpy.ExecuteError:
    msgsg = "EXECUTE ERRORS:\n" + arcpy.GetMessages(2) + "\n"
    arcpy.AddError(msgsg)
    logger.error(msgsg)
    arcpy.AddMessage("Habitat and Ecological Integrity Assessment failed")

```



```

sys.exit(1)
for handler in logger.handlers:
    logger.removeHandler(handler)
except:
    tb = sys.exc_info()[2]
    tbinfo = traceback.format_tb(tb)[0]
    pymsg = "PYTHON ERRORS:\nTraceback info:\n" + tbinfo + "\nError Info:\n" +
str(sys.exc_info()[1])
    msgsg = "ArcPy ERRORS:\n" + arcpy.GetMessages(2) + "\n"

    arcpy.AddError(pymsg)
    arcpy.AddError(msgsg)
    logger.error(pymsg)
    logger.error(msgsg)
    arcpy.AddMessage("Habitat and Ecological Integrity Assessment failed")
    sys.exit(1)
for handler in logger.handlers:
    logger.removeHandler(handler)

# run Final Assessment that aggregates all three previous sections
logger.info("Running final assessment that aggregates all three previous sections")
arcpy.AddMessage("Running final assessment that aggregates all three previous sections")
try:
    calcFunction.CalcFunction()
    arcpy.AddMessage("Final Assessment (Pt.1) completed")
except arcpy.ExecuteError:
    msgsg = "EXECUTE ERRORS:\n" + arcpy.GetMessages(2) + "\n"
    arcpy.AddError(msgsg)
    logger.error(msgsg)
    arcpy.AddMessage("Final Assessment failed")

```

```

sys.exit(1)
for handler in logger.handlers:
    logger.removeHandler(handler)
except:
    tb = sys.exc_info()[2]
    tbinfo = traceback.format_tb(tb)[0]
    pymsg = "PYTHON ERRORS:\nTraceback info:\n" + tbinfo + "\nError Info:\n" +
str(sys.exc_info()[1])
    msgsg = "ArcPy ERRORS:\n" + arcpy.GetMessages(2) + "\n"

    arcpy.AddError(pymsg)
    arcpy.AddError(msgsg)
    logger.error(pymsg)
    logger.error(msgsg)
    arcpy.AddMessage("Final Assessment (Pt.1) failed")
    sys.exit(1)
for handler in logger.handlers:
    logger.removeHandler(handler)

# run Final Assessment that aggregates all scoring fields
logger.info("Running final assessment that aggregates all three previous sections")
arcpy.AddMessage("Running final assessment that aggregates all three previous sections")
try:
    calcAllResults.CalcAllResults(fcWU)
    arcpy.AddMessage("Final Assessment (Pt.2) completed")
except arcpy.ExecuteError:
    msgsg = "EXECUTE ERRORS:\n" + arcpy.GetMessages(2) + "\n"
    arcpy.AddError(msgsg)
    logger.error(msgsg)
    arcpy.AddMessage("Final Assessment (Pt.2) failed")

```

```

sys.exit(1)
for handler in logger.handlers:
    logger.removeHandler(handler)
except:
    tb = sys.exc_info()[2]
    tbinfo = traceback.format_tb(tb)[0]
    pymsg = "PYTHON ERRORS:\nTraceback info:\n" + tbinfo + "\nError Info:\n" +
str(sys.exc_info()[1])
    msgsg = "ArcPy ERRORS:\n" + arcpy.GetMessages(2) + "\n"

    arcpy.AddError(pymsg)
    arcpy.AddError(msgsg)
    logger.error(pymsg)
    logger.error(msgsg)
    arcpy.AddMessage("Final Assessment (Pt.2) failed")
    sys.exit(1)
for handler in logger.handlers:
    logger.removeHandler(handler)

logger.info("program ended")
for handler in logger.handlers:
    logger.removeHandler(handler)

```