

I. Fully Automated Geoprocessing Procedures:

1. Add the following fields to wetland polygon layer:

- UniqueID (long integer) = ObjectID
- AveSlope (float)
- Waterbody (text) (Length = 2)
- LandPosit (text) (Length = 2)
- Gradient (text) (Length = 1)
- WaterFlow (text) (Length = 1)
- SpecMod (text) (Length = 1)
- Landform (text) (Length = 2)
- FlowPath (text) (Length = 2)
- Pond field (text) (Length = 2)
- hgmCode (text)

**It may be useful to create a scratch GDB to deposit tables and layers that will only be necessary for analysis, not the final product.*

2. Use field calculator to populate UniqueID field with FID or ObjectID field.

3. To the current MXD, add the NHDFlowline and NHDArea layers from the High Resolution NHD geodatabase. Export new shapefiles after selecting FType = 460 for NHDArea, FCode = 46006 for Perennial, FCode=46003 for Intermittent, and FCode=46007 for Ephemeral, FCode = 33600 for Canals/Ditches, and FCode = 55800 for Artificial paths. Also export a shapefile from NHDPoints with FCodes 45800 for Spring/Seep.

4. Calculate the average slope value from the integerized slope raster and zonal statistics as table.

5. Populate the attribute table using the following queries:

Assign Waterbody Descriptors:

1. Lake (LK):

Select features where "ATTRIBUTE" LIKE 'L1%'. Populate Waterbody field with "LK"
Export selected records to a temporary LK layer for use later.

2. River (RV):

Select by Attributes: Create a new selection: "ATTRIBUTE" LIKE 'R2UB%' OR "ATTRIBUTE" LIKE 'R2AB%'.

Populate Waterbody field with "RV".

Select by Attributes: Create a new selection: "ATTRIBUTE" LIKE 'R%UB%' OR "ATTRIBUTE" LIKE 'R%AB%' AND "ATTRIBUTE" NOT LIKE 'R%x'.

Select by Location: select from the currently selected features from Target layer: check wetland layer.

Source layer: NHDArea attribute = StreamRiver.

Spatial selection method: Target layer(s) features intersect the Source layer feature (NHDArea).

Populate Waterbody field with "RV".

3. Stream (ST):

Select by Attributes: Create new selection: "ATTRIBUTE" LIKE 'R%UB%' OR "ATTRIBUTE" LIKE 'R%AB%' OR "ATTRIBUTE" LIKE 'R4%' OR "ATTRIBUTE" LIKE 'R%x'

Select by Attributes: Remove from current selection "Waterbody" = 'RV' OR "Waterbody" = 'LK'

Populate Waterbody field with "ST"

Select RV and ST and export selected records to a temporary RVST layer for use later.

4. Pond (PD):

Select by Attributes: Create new selection: ("ATTRIBUTE" LIKE 'PAB%' OR "ATTRIBUTE" LIKE 'PUB%')

Populate Waterbody field with "PD"

Export selected records to a temporary PD layer for use later.

Assign Water Flow Path Descriptors:

5. Throughflow (TH):

FlowPath = Throughflow (TH):

Select by Attribute: Create new selection

("Waterbody" = 'RV' OR "Waterbody" = 'ST')

Use field calculator to assign "TH" to FlowPath field

Assign Landscape Position Types:

6. Lentic (LE):

Select by Attributes: Create new selection: "ATTRIBUTE" LIKE 'L2%'

Populate LandPosit field with "LE"

7. Lotic River (LO):

Select by Attributes: Create new selection: "ATTRIBUTE" LIKE 'R%US%'.

Populate LandPosit field with "LO".

Field = Gradient:

8. Low Gradient = 1:

"AveSlope" < 1.15 AND ("Waterbody" = 'RV' OR "Waterbody" = 'ST')

Populate Gradient field with 1

9. Mid-gradient = 2:

("AveSlope" >= 1.15 AND "AveSlope" < 2.3) AND ("Waterbody" = 'RV' OR "Waterbody" = 'ST')

Populate Gradient field with 2

10. High Gradient = 3:

"AveSlope" >= 2.3 AND ("Waterbody" = 'RV' OR "Waterbody" = 'ST')

Populate Gradient field with 3

Field = WaterFlow:

11. Select by Attributes: Create a new selection:

"ATTRIBUTE" LIKE 'R4%'

Populate WaterFlow field with 4

Field = SpecMod:

12. Select by Attribute: Create a new selection:

"ATTRIBUTE" LIKE '%b'

Use field calculator to assign a "b" to the SpecMod field

"ATTRIBUTE" LIKE '%d'

Use field calculator to assign a "d" to the SpecMod field

"ATTRIBUTE" LIKE '%f'

Use field calculator to assign a "f" to the SpecMod field

"ATTRIBUTE" LIKE '%h'

Use field calculator to assign a "h" to the SpecMod field

"ATTRIBUTE" LIKE '%x'

Use field calculator to assign a "x" to the SpecMod field

II. Water Flow Path Geoprocessing Procedures:

Populate the attribute table using the following queries:

Field = FlowPath:

1. Throughflow (TH):

Select by Location: Create new selection: Select features from the wetlands layer that intersect the NHD Flowline layer

Remove from current selection those features with Flowpath already assigned.

Use field calculator to assign "TH" to FlowPath field.

*****Note: Include those polygons assigned as part of the Riparian classification, so that these polygons are included in subsequent steps.**

*****Note: Select by Location can be done based FCode to assign Throughflow-Intermittent (TI) to those wetlands with intermittent or ephemeral streams flowing through them.**

*****The following steps will help assign remaining Throughflow wetlands:**

2. Throughflow (TH):

Select by Attributes: Create new selection "FlowPath" = 'TH'

Export 'TH' polygons to temporary 'TH' layer

With the 'TH' polygons selected within your original wetlands layer, use the Union tool and add both the selected 'TH' polygons and the temporary 'TH' layer (***unchecked Gaps Allowed***)

Dissolve the result of the union (dissolve all features; do not choose to dissolve by an attribute)

Select by Attribute: Create new selection: "FlowPath" is blank

Select by Location: Select from the currently selected features: wetlands that intersect the dissolved 'TH' features.

Remove from current selection "ATTRIBUTE" LIKE 'Rp%'

***These features will need to be manually examined.

HELPFUL TIP: Pan the project area and view the selected features. You can either edit the layer OR under Selection, Interactive Selection Method – Remove from current selection those features that will NOT get 'TH' assigned to the FlowPath field.

3. Throughflow (TH):

Select by Attribute: Create new selection

("Waterbody" = 'LK')

Selection by Location: Select from currently selected 'LK' polygons: that intersect All Flowlines

***Review 'LK' polygons manually to assign FlowPath.

4. Throughflow (TH):

Select by Attribute: Create new selection ("SpecMod" = 'h')

****Manual examination can be done to assign Throughflow-Intermittent (TI) to those wetlands with intermittent or ephemeral streams flowing through them.**

5. Bidirectional (BI):

Select by Attribute: Create new selection: ("ATTRIBUTE" LIKE 'L2%')

Use field calculator to assign "BI" to FlowPath field

6. Isolated (IS):

Select by Location: Create new selection: wetland polygons that are within a distance of 5 meters of NHD Flowline layer

Select by Location: Create new selection: wetland polygons that intersect selected wetland polygons from previous query.

Continue to do this query until no new polygons are selected.

Switch Selection.

Remove from selected features those polygons with FlowPath already assigned.

Remove from selected features where "ATTRIBUTE" LIKE 'Rp%'

Use Field calculator to assign "IS" to the FlowPath field.

Export Isolated polygons to temporary Isolated layer.

Convert temporary IS polygons to points using the Data Management Tool: Features: Feature Vertices to Points Tool

Dissolve points by unique ID, creating multipoint features

Use near function in Arctoolbox (Analysis: Proximity: Near) - input and near features are the dissolved points layer

Set search radius = 5 meters

If no feature is found within 5 m, then NEAR_FID field will be -1

Join multipart features with NEAR_FID field to wetland layer table based on unique ID

Select by Attributes: Create a new selection: "NEAR_FID" = -1

Remove polygons from selected features with FlowPath already assigned.

Use field calculator to assign "IS" to FlowPath field

***Note: These will need manual examination later to reassign Outflow wetlands.

7. Isolated Complex: (IC) (Wetlands that are part of an isolated complex)

Select by attributes: *Create a new selection:* "NEAR_FID" >= 0

Use field calculator to assign "IC" to FlowPath field

***Note: If desired, these can be further examined and assigned Isolated-Inflow (II); Isolated-Outflow (IO); Isolated-Throughflow (IT).

8. Outflow (OU)

Select by location: Create a new selection: wetland polygons that are within a distance of 5 meters of the Seep/Spring layer.

Remove from selected features where "ATTRIBUTE" LIKE 'Rp%'

***Note: Manually examine selected polygons to assign FlowPath. Most will either be OU, **OI**, or IO.

9. Reassign incorrect TH wetlands for those wetlands that occur at the margin of other wetlands where the upland boundary is distinct and have groundwater discharging to a stream. These will get assigned Landscape Position = Terrene, Landform = Slope, Wter Flow Path = Outflow (TESLOU).

Create new selection: "FlowPath" = 'TH'

Remove from selection: "Waterbody" = 'LK' OR "Waterbody" = 'PD' OR "Waterbody" = 'ST' OR "Waterbody" = 'RV'

Remove from selection: "LandPosit" = 'LE'

Remove from selection: "ATTRIBUTE" LIKE 'R%' OR "ATTRIBUTE" LIKE 'PUS%' OR
"SpecMod" = h or "SpecMod" = x.

HELPFUL TIP: Pan the project area and view the selected features. You can either edit the layer OR under Selection, Interactive Selection Method – Remove from current selection those features that will not get a TESLOU.

10. Reassign Isolated (IS) wetlands that are incorrect:

Select by Attributes: Create new selection: "Flowpath" = 'IS'

HELPFUL TIP: Pan the project area and view the selected features. You can either edit the layer OR under Selection, Interactive Selection Method – Remove from current selection those features that will keep the 'IS' in the FlowPath field. Use the Seep/Spring layer and the DRG to identify areas with potential Outflow wetlands.

11. Make sure all Ponds have the correct Flowpath:

Select by Attributes: Create new selection: "Waterbody" = 'PD' AND "Flowpath" = 'TH' OR "Flowpath" IS NULL

HELPFUL TIP: Pan the project area and view the selected features. You can either edit the layer OR under Selection, Interactive Selection Method – Remove from current selection those features that will keep the 'TH' in the FlowPath field. These will typically have an AveSlope value of around 0 and be located along major rivers/streams.

***These will need manual examination.

Check that all wetlands have a Flowpath assigned:

Select by Attributes: Create new selection: "FlowPath" is blank and "Waterbody" is blank.

III. Landscape Position Geoprocessing Procedures:

Populate the attribute table using the following queries:

1. Lotic (LO):

Select by attribute: Create new selection: "FlowPath" = 'TH'. Remove from current selection: "Waterbody" = 'RV' OR "Waterbody" = 'ST' OR "Waterbody" = 'PD' OR "Waterbody" = 'LK' OR "LandPosit" = 'LE' OR "LandPosit" = 'TE' OR "ATTRIBUTE" LIKE 'Rp%'

Populate "LandPosit" field with 'LO'.

2. Lentic (LE):

Select by Attributes: Create new selection "Waterbody" = 'LK'

Select by Location: select features from Target layer: check wetland layer.

Source layer: Wetlands layer with LK polygons selected.

Spatial selection method: Target layer(s) features that intersect the Source layer feature.

Select by Attributes: Select from current selection: "ATTRIBUTE" LIKE 'P%'

Populate LandPosit field with "LE"

***These wetlands will require manual examination.

3. Landscape Position = Terrene (TE):

Select by Attributes: Create new selection: "FlowPath" = 'IO' OR "FlowPath" = 'IS' OR "FlowPath" = 'IT' OR "FlowPath" = 'OU' OR "FlowPath" = 'IC' OR "FlowPath" = 'II'

Remove from selection: "Waterbody" = 'LK' OR "Waterbody" = 'PD' OR "Waterbody" = 'RV' OR "Waterbody" = 'ST'

Remove from selection: features where "LandPosit" is already assigned

Populate the "LandPosit" field with 'TE'.

4. Lentic (LE):

Select by Attributes: Create new selection "LandPosit" = 'LE'

Select by Location: select features from Target layer: check wetland layer.

Source layer: Wetlands layer with LE polygons selected.

Spatial selection method: Target layer(s) features that intersect the Source layer feature.

In the Select by Attributes window:

Select from current selection: "ATTRIBUTE" LIKE 'P%' AND ("ATTRIBUTE" NOT LIKE 'PAB%' AND "ATTRIBUTE" NOT LIKE 'PUB%')

Remove from current selection: "LandPosit" = 'LE'

Populate LandPosit field with "LE".

***These wetlands will need to be examined manually.

5. Make sure all wetland features have a Landscape Position assigned:

Select by attribute: Create new selection: "Waterbody" is blank AND "LandPosit" is blank. This should return no records.

Field = Gradient:

13. Low Gradient = 1:

Select by Attribute – Create new selection: ("LandPosit" = 'LO') AND "AveSlope" < 1.15.

Populate Gradient field with 1

14. Mid-gradient = 2:

Select by Attribute – Create new selection: ("LandPosit" = 'LO') AND ("AveSlope" >= 1.15 AND "AveSlope" < 2.3)

Populate Gradient field with 2

15. High Gradient = 3:

Select by Attribute – Create new selection: ("LandPosit" = 'LO') AND ("AveSlope" >= 2.3)

Populate Gradient field with 3

IV. Landform Geoprocessing Procedures for western Montana:

Populate the attribute table using the following queries:

For Lotic Landscape Positions:

1. Island (IL):

Select by Attributes: Create a new selection: “Waterbody” = ‘RV’ OR “Waterbody” = ‘ST’
With the RV and ST polygons still selected within your original layer, use the Union tool and add both the original riverine polygons with tempRVST layer (***uncheck Gaps Allowed***)

Dissolve the result of the union (dissolve all features, do not choose to dissolve by an attribute)

Select by Attributes: Create a new selection: “LandPosit” = ‘LO’

Select by Location: Select from the currently selected features: wetlands that are completely within the dissolved union layer

Use field calculator to assign “IL” to Landform field

***These will require manual examination.

HELPFUL TIP: You can either edit the layer OR under Selection, Interactive Selection Method – Remove from current selection those features that will NOT get ‘IL’ assigned to the Landform field.

2. Floodplain (FP):

("LandPosit" = 'LO') AND ("ATTRIBUTE" LIKE 'PEMA%' OR "ATTRIBUTE" LIKE 'PEMC%' OR "ATTRIBUTE" LIKE 'PSSA%' OR "ATTRIBUTE" LIKE 'PSSC%' OR "ATTRIBUTE" LIKE 'PFOA%' OR "ATTRIBUTE" LIKE 'PFOC%')

Select by Attributes: Remove from current selection: features with Landform already assigned.

Use field calculator to assign “FP” to Landform field.

***These will require manual examination.

HELPFUL TIP: If available, use the SSURGO soils layer to help identify floodplain wetlands. Pan the project area and view the selected features. You can either edit the layer OR under Selection, Interactive Selection Method – Remove from current selection those features that will NOT get ‘FP’ assigned to the Landform field. Floodplain wetlands will typically have an AveSlope value of around 0 and be located in the larger valley bottoms.

3. Basin (BA):

("LandPosit" = 'LO') AND ("ATTRIBUTE" LIKE 'PEMA%' OR "ATTRIBUTE" LIKE 'PEMC%' OR "ATTRIBUTE" LIKE 'PSSA%' OR "ATTRIBUTE" LIKE 'PSSC%' OR "ATTRIBUTE" LIKE 'PFOA%' OR "ATTRIBUTE" LIKE 'PFOC%')

Select by Attributes: Remove from current selection: features with Landform already assigned.

Use field calculator to assign “BA” to Landform field.

4. Fringe (FR):

("LandPosit" = 'LO') AND ("ATTRIBUTE" LIKE 'PEMB%' OR "ATTRIBUTE" LIKE 'PSSB%' OR "ATTRIBUTE" LIKE 'PFOB%' OR "ATTRIBUTE" LIKE 'PSSF%' OR "ATTRIBUTE" LIKE 'PEMF%' OR "ATTRIBUTE" LIKE 'PFOF%' OR "ATTRIBUTE" LIKE '%US%')

Select by Attributes: Remove from current selection: features with Landform already assigned.

Use field calculator to assign “FR” to Landform field.

5. Need to check for Lotic wetlands that have no assigned Landform.

Select by Attributes: Create new selection: “LandPosit” = ‘LO’ AND “Landform” is blank/NULL. This should return no records.

For Lentic Landscape Positions:

6. Basin (BA):

Select by Attribute: Create new selection:

("LandPosit" = 'LE') AND ("ATTRIBUTE" LIKE '%A%' OR "ATTRIBUTE" LIKE '%C%' OR "ATTRIBUTE" LIKE 'PAB%' OR "ATTRIBUTE" LIKE 'PUB%') AND ("ATTRIBUTE" NOT LIKE 'L2%' AND "ATTRIBUTE" NOT LIKE 'PUS%')

Select by Attributes: Remove from current selection: features with Landform already assigned.

Use field calculator to assign “BA” to Landform field

7. Fringe (FR):

("LandPosit" = 'LE') AND ("ATTRIBUTE" LIKE '%MB%' OR "ATTRIBUTE" LIKE '%SSB%' OR "ATTRIBUTE" LIKE '%EMF%' OR "ATTRIBUTE" LIKE '%SSF%' OR "ATTRIBUTE" LIKE 'PUS%' OR "ATTRIBUTE" LIKE 'L2%')

Select by Attributes: Remove from current selection: features with Landform already assigned.

Use field calculator to assign “FR” to Landform field

8. Island (IL):

Select by Attributes: Create a new selection: “Waterbody” = ‘LK’

With the LK polygons still selected within your original layer, use the Union tool and add both the original LK polygons with the tempLK layer (**unchecked Gaps Allowed**)

Dissolve the result of the union (dissolve all features, do not choose to dissolve by an attribute)

Select by Attributes: Create a new selection: “LandPosit” = ‘LE’

Select by Location: Select from the currently selected features: wetlands that are completely within the dissolved union layer

Use field calculator to assign "IL" to Landform field (**Note: This may change some of the previously assigned Landforms, which is OK.)

Select by Attributes: Create a new selection: "Waterbody" = 'PD'

With the PD polygons still selected within your original layer, use the Union tool and add both the original PD polygons with the tempPD layer (**uncheck Gaps Allowed**)

Dissolve the result of the union (dissolve all features, do not choose to dissolve by an attribute)

Select by Attributes: Create a new selection: "LandPosit" = 'TE'

Select by Location: Select from the currently selected features: wetlands that are completely within the dissolved union layer

Use field calculator to assign "IL" to Landform field (**Note: This may change some of the previously assigned Landforms, which is OK.)

For Terrene Landscape Positions:

9. Slope (SL):

("LandPosit" = 'TE') AND ("AveSlope" >= 2.3)

Remove from current selection: "ATTRIBUTE" LIKE 'PUS%'

Remove from current selection: "Landform" = 'SL'

Selection by Location: Remove from current selected features: those features that intersect Ponds.

HELPFUL TIP: Pan the project area and view the selected features. You can either edit the layer OR under Selection, Interactive Selection Method – Remove from current selection those features that will NOT get 'SL' assigned to the Landform field.

Use field calculator to assign "SL" to Landform field.

10. Basin (BA):

Assign Basin landform to all excavated Terrene wetlands:

"LandPosit" = 'TE' AND ("ATTRIBUTE" = 'PEMAx' OR "ATTRIBUTE" = 'PSSAx' OR "ATTRIBUTE" = 'PFOAx' OR "ATTRIBUTE" = 'PEMCx' OR "ATTRIBUTE" = 'PSSCx' OR "ATTRIBUTE" = 'PFOCx' OR "ATTRIBUTE" = 'PEMKx')

Use field calculator to assign "BA" to Landform field

**Note: This will change some previously assigned Landforms.

Assign Basin landform to all impounded Terrene wetlands:

"LandPosit" = 'TE' AND ("ATTRIBUTE" = 'PEMAh' OR "ATTRIBUTE" = 'PSSAh' OR "ATTRIBUTE" = 'PFOAh' OR "ATTRIBUTE" = 'PEMCh' OR "ATTRIBUTE" = 'PSSCh' OR "ATTRIBUTE" = 'PFOCh' OR "ATTRIBUTE" = 'PEMKh')

Use field calculator to assign "BA" to Landform field

("LandPosit" = 'TE') AND ("ATTRIBUTE" LIKE 'PEMA%' OR "ATTRIBUTE" LIKE 'PSSA%' OR "ATTRIBUTE" LIKE 'PFOA%' OR "ATTRIBUTE" LIKE 'PEMC%' OR "ATTRIBUTE" LIKE 'PSSC%' OR "ATTRIBUTE" LIKE 'PFOC%')

Select by location from current selection features that intersect tempTEponds
Remove from current selection: Landform already assigned.
Use field calculator to assign "BA" to Landform field
**Ponds in high elevation areas will need to be examined manually, as these may actually be groundwater discharge (slope) wetlands.

HELPFUL TIP: Pan the project area and view the selected features. You can either edit the layer OR under Selection, Interactive Selection Method – Remove from current selection those features that will NOT get 'BA' assigned to the Landform field.
Use field calculator to assign "BA" to Landform field.

("LandPosit" = 'TE') AND ("ATTRIBUTE" LIKE 'PEMA%' OR "ATTRIBUTE" LIKE 'PSSA%' OR "ATTRIBUTE" LIKE 'PFOA%' OR "ATTRIBUTE" LIKE 'PEMC%' OR "ATTRIBUTE" LIKE 'PSSC%' OR "ATTRIBUTE" LIKE 'PFOC%') AND ("AveSlope" < 1.15).
Remove from current selection: Landform already assigned.

HELPFUL TIP: Pan the project area and view the selected features. You can either edit the layer OR under Selection, Interactive Selection Method – Remove from current selection those features that will NOT get 'BA' assigned to the Landform field.
Use field calculator to assign "BA" to Landform field. Repeat this process until all Terrene wetlands have a Landform assigned.

11. Fringe (FR):

"LandPosit" = 'TE'
Select from currently selected features
("ATTRIBUTE" LIKE '%MB%' OR "ATTRIBUTE" LIKE '%FOB%' OR "ATTRIBUTE" LIKE '%SSB%' OR "ATTRIBUTE" LIKE '%MF%' OR "ATTRIBUTE" LIKE '%FOF%' OR "ATTRIBUTE" LIKE '%SSF%' OR "ATTRIBUTE" LIKE 'PUS%')
SELECT BY LOCATION FROM CURRENT SELECTION FEATURES THAT INTERSECT tempPonds
Use field calculator to assign "FR" to Landform field

12. Basin (BA):

"LandPosit" = 'TE' AND "ATTRIBUTE" LIKE 'PUS%' AND "Landform" <> 'FR'
OK to replace existing Landform assignment.

Select remaining unassigned Landforms:
Select by Attributes: Create new selection: "LandPosit" = 'TE' AND "Landform" is blank/NULL.

13. Pond field: (pd)

Select by Location: Create new selection: select features that intersect the Ponds layer.
Remove from selection: "Waterbody" = 'LK' OR "Waterbody" = 'PD' OR "Waterbody" = 'RV' OR "Waterbody" = 'ST' AND "ATTRIBUTE" LIKE 'Rp%'

Use field calculator to assign “pd” to Pond field.