Using the DMS Spatial Data Submission Toolbox

DEPARTMENT OF ENVIRONMENTAL QUALITY

DIVISION OF MITIGATION SERVICES

NORTH CAROLINA
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Overview

This document describes how to use the Division of Mitigation Services (DMS) Stream and Wetland Asset Tool and Monitoring Features Tool, which are contained in the Spatial Data Submission Toolbox. The purpose of these tools is to provide rapid and standardized quality control throughout the life of a project (Table 1). The use of these tools will promote a consistent approach to formatting and attributing spatial features, which will allow spatial data to be associated with relevant qualitative and quantitative data, and will result in the production of a spatially verified quantities and credits table.

Table 1. Project phases where each tool will be used.

Phase	Stream and Wetland*	Monitoring
Mitigation Plan (MP)	x	
As-Built (AB)	x	x
MY0-7+	-	x

X = always; - = as needed, *Pre-Jurisdictional Wetland features will be submitted at the MP stage only

Connecting to the DMS Spatial Data Submission Toolbox

I. Steps for Connecting in ArcCatalog or ArcPro

1. **Establish connection to Spatial Data Submission Toolbox.** This connection need only be made once within your instance of ArcCatalog or ArcPro [1] and will remain for subsequent use (Fig.1).

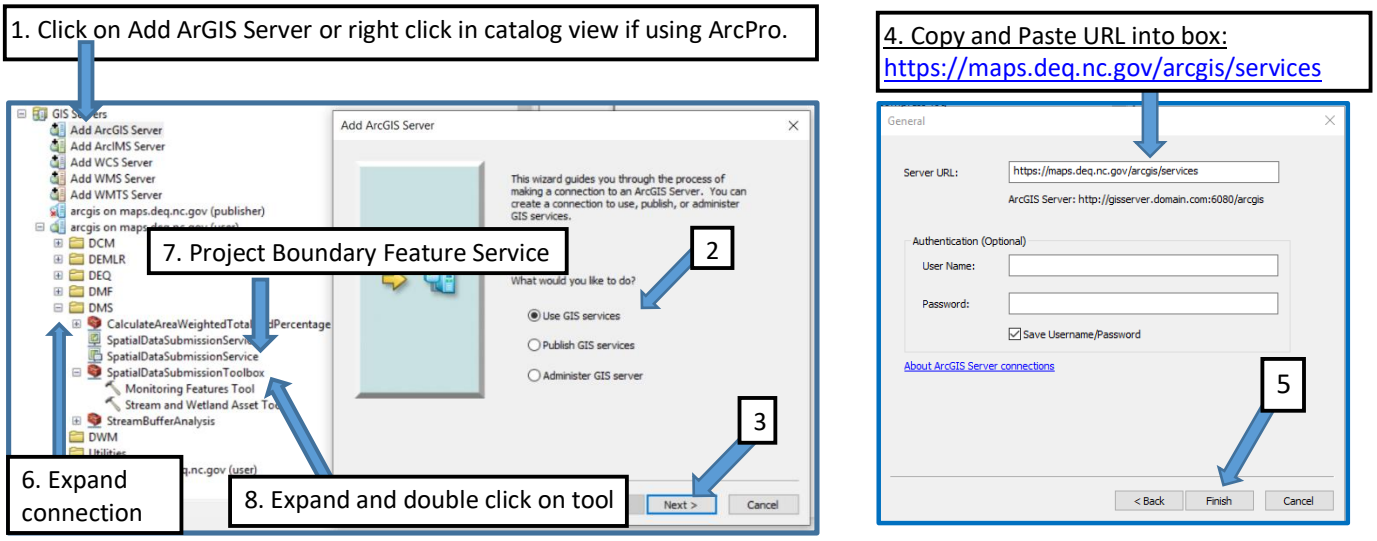


Figure 1. Steps to connect to DMS Spatial Data Submission Toolbox.

[1] https://pro.arcgis.com/en/pro-app/latest/help/projects/connect-to-a-gis-server.htm

Using the Stream and Wetland Asset Tool

I. Population of Stream and Wetland Asset Feature Classes

1. **Feature Classes.** Open the spatial data submission template (GDB) in ArcMap or ArcPro, and you will see a Stream, Wetland, and Pre-Jurisdictional Wetlands feature classes (Fig. 2).

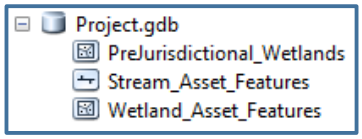


Figure 2. Geodatabase and feature classes.

2. **Segmentation.** Before the data can be imported it needs to be segmented and extracted from the sealed digital drawing file (e.g. MP or AB) using the following segmentation guidelines:

   a. Stream Assets

   Start by reviewing feature topology, ensuring that points move sequentially downstream along the line feature and that endpoints occur in the correct locations (e.g. end of segments, confluence). Begin segmentation and attribution from the top of the project mainstem to the bottom, and then segment and provide attributes for each tributary starting from the top of the watershed to the bottom. Each segment must be attributed with the reach name and sub reach ID number and should be numbered in keeping with the segmentation sequence described. The following items are the basis for segmentation:

   - Discreet hydrologic features (e.g. tributary)
   - Change in Restoration Level
   - Change in Mitigation Ratio
   - Change in Mitigation Category (e.g. cool, cold)
   - Breaks in the conservation easement
   - Crossings (e.g. internal crossings)
   - Footprint of Infrastructure

   Internal crossings and segments from breaks in the easement that connect 2 creditable segments shall be included in the submission of GDB features even though they may not be credit producing. Including these non-credit generating segments in the submission allows stream spatial features to be contiguous throughout the footprint of the project. Do not include segments above or below the start or terminus of the easement boundary. Although non-credit generating features within the project footprint are included in the submission, these segments will not be included in the project quantities and credits table.

   b. Wetland Assets

   Wetland features must be merged into multipart polygons where applicable. This will create individual records in the feature class attribute table for multiple wetlands where the following are the same:

   - Restoration Level

- Mitigation Ratio
- Mitigation Category (e.g. Riparian, Non-Riparian)
- Footprint of Infrastructure
- Wetland Assessment Method (WAM) Type

If any of the above differ for a particular wetland polygon then it must be assigned to another multipart polygon group with identical attributes for the above criteria, or kept as an individual record if the polygon is distinct from all others.

c. Pre-Jurisdictional Wetlands
Pre-Jurisdictional wetland features should be merged into a single multipart polygon.

3. **Import the Data into the GDB.** This can be accomplished using the copy and paste or load data functions [2, 3]**.** The data included in the GDB should only contain information from a single submission phase or monitoring year.

4. **Attribute Imported Features.** Open the feature class attribute tables. The definitions for these fields can be found in the data dictionary. This file also identifies those fields requiring entry by the user and those that will be auto-populated or auto-calculated by the tool. Some of the fields will typically be the same across all segments (e.g. Project_ID, Source, Feature_Phase, Stream_Mit_Category). For example, Project_ID will be auto-populated for all records using the value initially entered in the tool's project ID dialog box. Other attributes can be entered simultaneously across multiple records using the attributes editing window [4].

II. Application of the DMS Stream and Wetland Asset Tool to the Completed GDB

1. **Identify Project Boundary Feature for Use in the Tool.** DMS has a feature service containing shapes generated using the recorded metes and bounds for all conservation easements that are the result of task 2 completion (i.e. easement and plat recordation)[5]. The user must access this service to determine if their project boundary is included within (Fig. 1; see server URL). If so, the user shall use the shape in the DMS feature service in the tool by leaving the project boundary box (Fig 3, item 4) blank since the tool defaults to using this service. If not, the user shall drag the most accurate GIS boundary feature in their possession to the tool's project boundary box and the tool will utilize it for quality control**. Note: The tool will prevent the use of a user supplied boundary if the project phase is As-built or later**. The link below can also be used to pull the boundary service into ArcMap if the user wishes to use the query dialog to determine if their task 2 project exists within the boundary service.

[2] Copy and Paste Features: Copy stream or wetland segments from the shape file exported from the CAD using the copy and paste tools on the arc map main menu.

[3] Load Data: Data can be loaded using this method as well and will be more efficient if some or all of the fields in the source attribute table (e.g. the user's source file) match those for the DMS GDB Feature Classes.

[4] Editing attributes ESRI documentation.

[5] Link to feature service containing boundaries.

2. **Upload Populated Feature Classes into the DMS Stream and Wetland Asset Tool.**

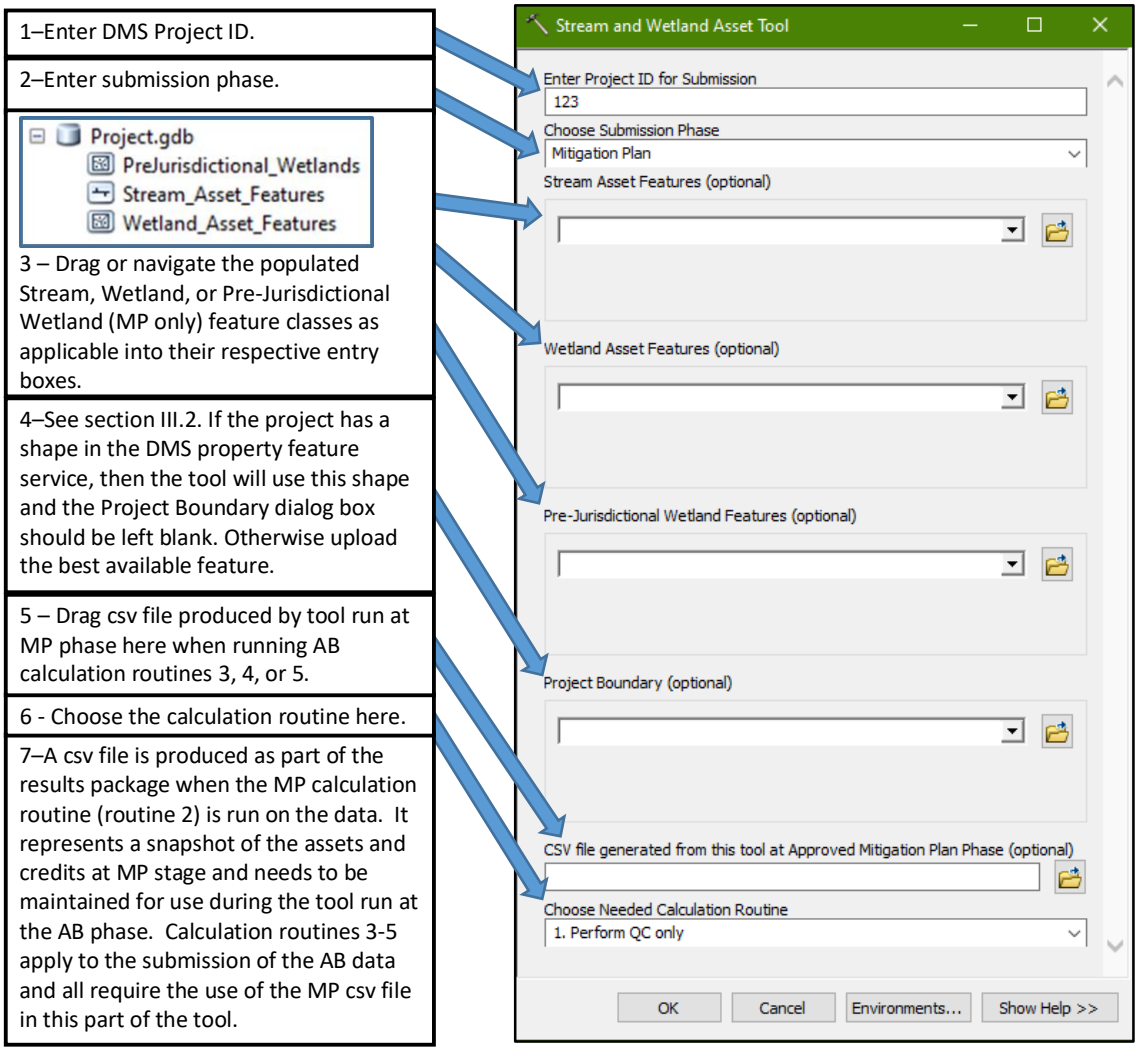


Figure 3. Steps to populate and execute the DMS Stream and Wetland Asset Tool.

3. **Determine Applicable Calculation Routine.** There are multiple calculation routines in order to accommodate different submission scenarios and to limit the required processing time. Routine 1 runs the data and QC procedures and generates an error output table. **Submission of a results package to DMS with any remaining errors must be accompanied by an explanation by the user.** Routine 2 will run the QC process in routine 1 and produce the Credits and Quantities Table. Routines 3-5 are all dedicated to the production of the Credits and Quantities Table at the AB phase under the conditions of no amendment, complete amendment, or partial amendment to the MP, respectively. **A complete or partial amendment must be the result of an official MP amendment process with the IRT and is not expected to be common.** Routines 3-5 run the QC checks described for routine 1, but using different logic based on the selected amendment scenario, and produces the Credits and Quantities Table. The output from these routines can be found in the results pane of ArcCatalog or by clicking "View Details" in the tool window in ArcPro (SI Fig. 1).

Routine 1 - QC Only Calculation Routine: This routine runs the data calculation and QC procedures and generates an error table. It is intended that the user will run the populated

GDB feature classes through this routine iteratively until no errors are displayed in the output error tables (SI Tables 1 & 2). This routine is available because it has fewer steps than routines 2-5, and will therefore execute QC checks faster. Once there are no more errors, the user can process their data using the routine that corresponds to their specific project phase and amendment scenario (e.g. routines 2-5).

Routine 2 – Submission at the MP phase (As-Designed): This routine runs the QC checks described in item 1 and creates the Credits and Quantities Table. This routine also produces a .csv file that captures a snapshot of the Credits and Quantities Table at the MP phase. This file along with the other files that make up the results package will be submitted via e-mail to the DMS PM and a copy shall be kept by the provider (SI Fig. 2). The .csv file produced here will be necessary for production of the Credits and Quantities Tables at the AB phase.

Routine 3 – No Amendment (most common): This routine simply lists the AB quantities in the output Credits and Quantities Table, none of which are used in the calculation of credits. To create the Credits and Quantities Table with this routine the .csv file generated at the MP phase (routine 2) will need to be uploaded into the tool. **This requires an entry of "N" in the Credit Supporting (CredTabl) field for each segment in each feature class**.

Routine 4 – Complete Amendment: This routine will be chosen only if there is to be a complete amendment of the MP using the AB quantities. To create the Credits and Quantities Table with this routine the .csv file generated at the MP phase (routine 2) will need to be uploaded into the tool. **This routine requires an entry of "Y" in the Credit Supporting (CredTabl) field for each segment in each feature class.**

Routine 5 – Partial Amendment: This routine will be chosen only if there is to be a partial amendment of the MP using some of the AB quantities. To create the Credits and Quantities Table with this routine the .csv file generated at the MP phase (routine 2) will need to be uploaded into the tool. This routine requires an entry of "Y" in the Credit Supporting (CredTabl) field only for those segments intended to supersede the MP quantity in the credit calculation. All features for which the amendment is not applicable require an entry of "N".

III. Reviewing Processed Data and Correcting Errors

1. **Quality Control Checks and Fields for Auto-Population or Auto Calculation.** The stream and wetland feature classes will be subject to a series of QC checks that focus on spatial integrity (e.g. overlapping segments, features outside of easement), completeness (e.g. blank fields), uniqueness, and compatibility with the schema. These checks are fully outlined in the data dictionary. If wetland asset features are included and wetland asset overlaps occur, a feature class (WetlandAssetOverlap) containing polygons representing these overlaps will be included in the results GDB. The pre-jurisdictional wetlands feature class will be used at the MP phase to verify that Rehabilitation, Enhancement, and Preservation wetlands overlay pre-jurisdictional wetlands and that Restoration, Re-establishment, and Creation wetlands do not.

   To associate errors with features, examine each asset feature class and its paired error table. The GISOID field in the error table corresponds to the ObjectID field in the corresponding asset feature class (Fig. 4; SI Tables 1 & 2). After correcting any errors in the original feature classes, the tool can be rerun using the updated original feature classes (e.g. not the asset feature classes output by

the tool). When error free outputs are obtained the results GDB can be zipped and submitted to the DMS project manager for DMS review.

StreamAsset_ErrorTable

OBJECTID *	GISOID	Station_Length	Overlap_of_Stream_Segments	Overlap_With_Wetland_Asset	Outside_Easement	
1	1					Subrea
2	2	Error	2,7: Unclear Intersection			Subrea
3	3	Error			Error	Subrea
4	4	Error				Subrea
5	5	Error				Subrea
6	6	Error				Subrea
7	7					Subrea
8	8	Error			Error	Subrea
9	9	Error	9,10: End Point Relationship unclear			Subrea
10	10	Error				Subrea

StreamAssets

OBJECTID *	Shape *	Reach Name	Subreach ID	Data Source	Line Type	Pre-Rest Feet	BSTA	ESTA	Restorati
1	Polyline M	UT1A	<Null>	<Null>	Unknown	0	1000	1087	I
2	Polyline M	UT1 Reach 2	<Null>	<Null>	Unknown	4761	1671	3033	I
3	Polyline M	UT1 Reach 3	<Null>	<Null>	Unknown	4761	1000	2463	I
4	Polyline M	UT2	<Null>	<Null>	Unknown	1	1000	1997	I
5	Polyline M	UT2	<Null>	<Null>	Unknown	1	1000	1997	I
6	Polyline M	UT1 Reach 2	<Null>	<Null>	Unknown	4761	1671	3033	I
7	Polyline M	UT1 Reach 1	<Null>	<Null>	Unknown	4761	1000	1671	I
8	Polyline M	UT3 Reach 2	<Null>	<Null>	Unknown	3313	1639	2915	I
9	Polyline M	UT3 Reach 1	<Null>	<Null>	Unknown	3313	1000	1639	I
10	Polyline M	UT4	<Null>	<Null>	Unknown	1142	1000	1531	I

Figure 4. Example error table and associated feature class with highlighted key fields that are used to match errors to features.

Using the Monitoring Features Tool

I. Population of Monitoring Feature Classes

1. **Monitoring Feature Classes and Tables**. Open the spatial data submission template (GDB) in ArcMap or ArcPro, and you will see the monitoring related feature classes and one table (Fig. 5; Table 2).

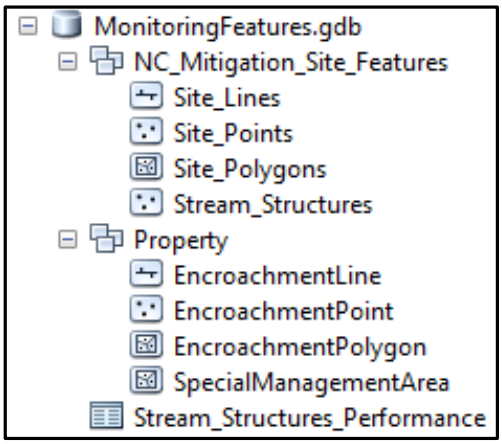


Figure 5. Schema of Spatial Data Submission Template feature classes.

Table 2. Table including the types of features expected for entry in each feature class.

Feature Class or Table	Types
SiteLine	**Cross Section (Pool, Riffle)**; **Bank Erosion (Scour, ToeErosion, BankFailure); Stream Repair**; **Open Ditch**; **Filled Ditch**; **Other**
SitePoint	**Groundwater Gauge; Continuous Stage Recorder; Crest Gauge; Precipitation Gauge; Photo Point; WQ or Biological Sampling Stations; Reference Groundwater Gauge; Survey Benchmark; Photo Point – Problem Area; Beaver Dam**
SitePolygon	**Fixed Veg Plot; Random Veg Plot; Invasive Area; Low Stem Density; Poor Growth; Bare Area; Supplemental Planting; Invasives Treatment**; **WQ Treatment Feature; Channel Polygon**
StreamStructures	**Stream Structures Feature Only**
Stream Structures Performance Table	**Annual assessment of structure performance/condition**
Encroachment point, line, and polygon	**Occurrences of encroachment**
Special Management Area	**Areas of the easement that include special management agreements allowing for access, uses or maintenance that differ from the standard easement directives**

1. **Import the Data into the DMS GDB.** Features established at the MY0 baseline are to be exported from the CAD or Micro station drawing into the tool schema using either the copy and

paste or load data functions [6, 7]. Other features that arise from annual project performance will often be the result of field-based GPS and may involve editing directly in ArcMap or ArcPro. The data included in the GDB should only contain information from a single submission phase or monitoring year.

2. **Attribute Imported Features.** The definitions, defaults and picklists for all fields can be found in the data dictionary for DMS feature classes. The process for entry is to group features by subtype (e.g. all cross sections, then the next subtype as they apply). Each feature must be attributed with a unique ID and these unique IDs should be consistent between spatial data and supporting monitoring data. This will allow these data to be synchronized in a digital environment. Enumeration for each subtype in a feature class is a simple sequential integer (1,2,3 etc.) and the user can restart at 1 for the next subtype. Fields that will **not** be auto-populated or auto-calculated may still have the same entry for many of the records (e.g. Data Source). Other attributes can be entered simultaneously across multiple records using the attributes editing window [8], which is a standard component of the ArcGIS editing bar.

II. Application of the DMS Monitoring Features Tool to the Completed GDB

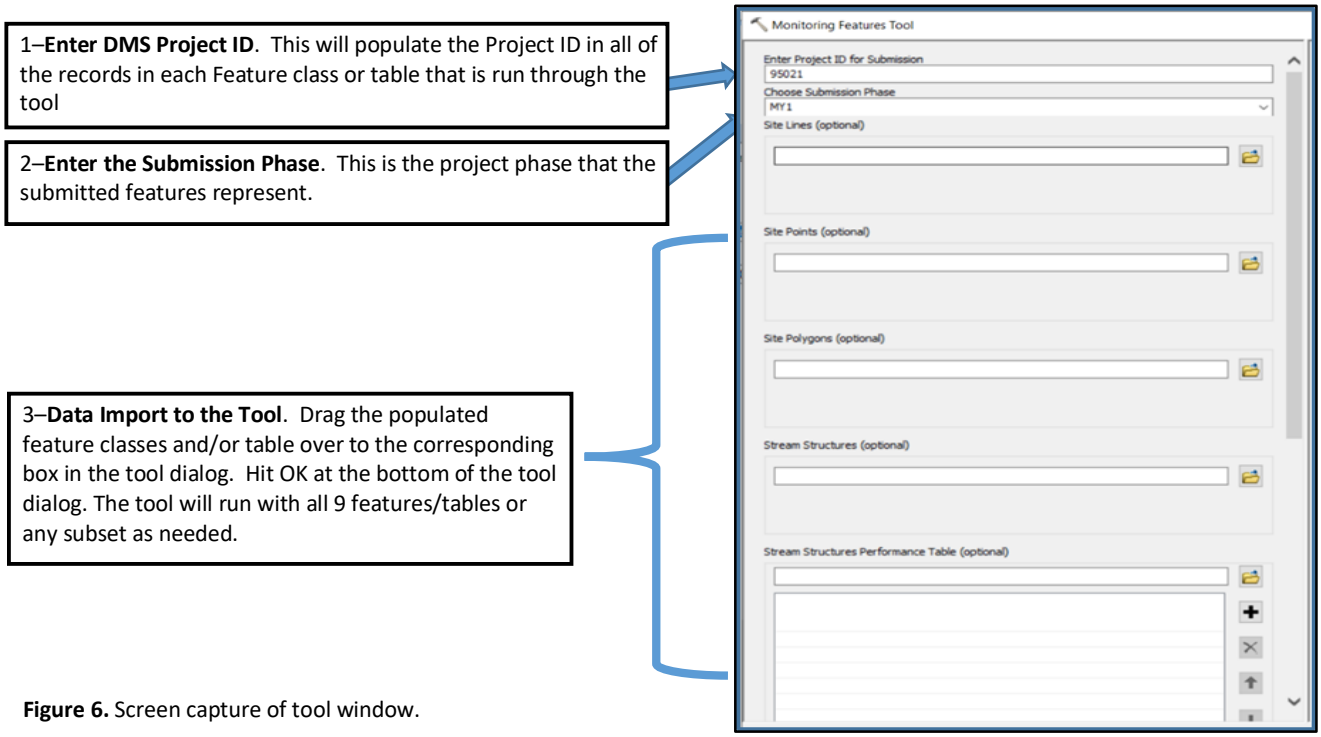


Figure 6. Screen capture of tool window.

[6] Copy and Paste Features: Copy stream or wetland segments from the shape file exported from the CAD using the copy and paste tools on the arc map main menu.

[7] Load Data: Data can be loaded using this method as well and will be more efficient if some or all of the fields in the source attribute table (e.g. the user's source file) match those for the DMS GDB Feature Classes.

[8] Editing attributes ESRI documentation.

III. Reviewing Processed Data and Correcting Errors

1. **Results Output.** The tool output includes 2 feature datasets and a set of tables (Fig. 7). The first feature dataset includes the feature classes with the auto-populated fields (e.g. ProcessedFeatures), and also includes any remaining errors. The second feature dataset contains the easement boundary and the 0.5-foot buffer of the easement that was used for QC (e.g. EasementFeatures). Any errors or omissions in the input feature classes are listed in the error tables. The original input files (e.g. not the ProcessedFeatures feature classes) should be processed through this tool until there are no errors listed in the error tables. Once there are no errors, the results GDB should be submitted to the DMS project manager.

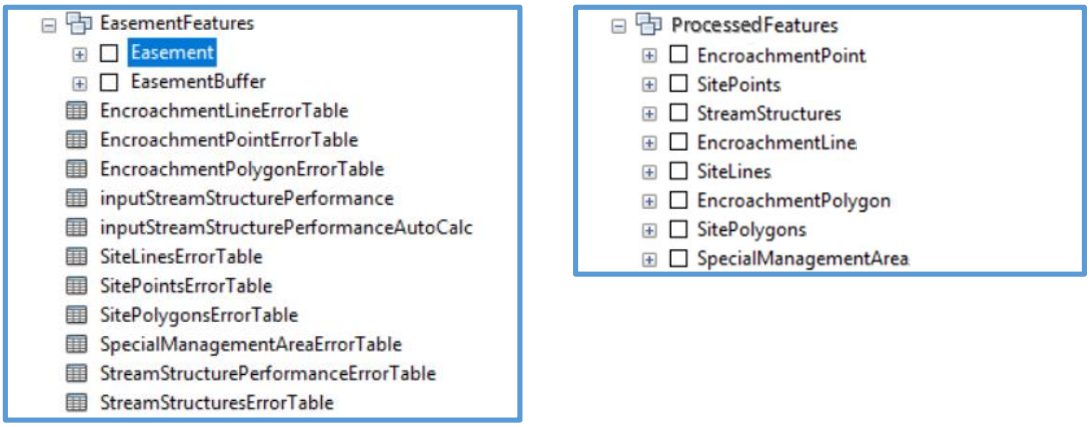


Figure 7. Screen capture including feature dataset outputs from the tool.

2. **Quality Control Checks and Fields for Auto-Population or Auto Calculation.** All feature classes and tables will be subject to a series of QC checks that focus on spatial integrity (e.g. features outside of easement), completeness (e.g. blank fields), uniqueness, and compatibility with the schema. These checks are fully outlined in the data dictionary. The Project ID and Submission Phase fields are auto-populated in all feature classes and tables from the single entry on the tool interface.

   To associate errors with features, examine each ProcessedFeatures feature class and its paired error table. The GISOID field in the error table corresponds to the OriginalOIDs field in the corresponding ProcessedFeatures feature class (Fig. 8). After correcting any errors and omissions in the original feature classes (e.g. not the ProcessedFeatures feature classes) the tool can be rerun. When error free outputs are obtained the results GDB can be zipped and submitted to the DMS project manager for review.

SitePointsErrorTable

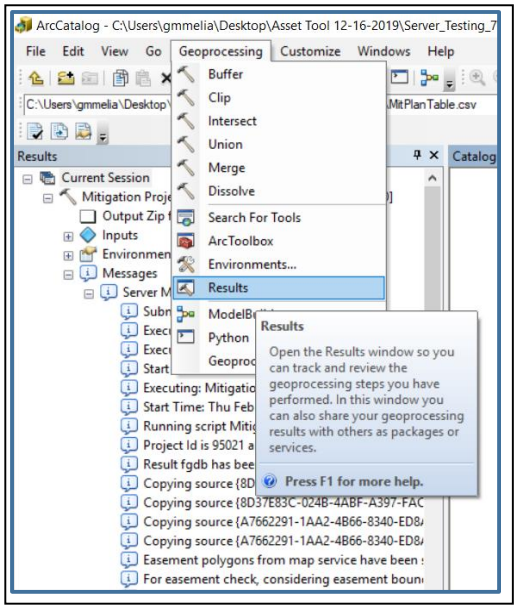
OBJECTID *	GISOID	Fields_Left_Blank	Unique_Check	Easement_Check
1	3	DataSource,SegmentName		
2	4	SegmentName		
3	6	SegmentName	Error	
4	7	SegmentName	Error	Error
5	8	DataSource,SegmentName		
6	9			Error
7	10	SegmentName		
8	11	SegmentName		
9	12			Error
10	13	DataSource,UID		

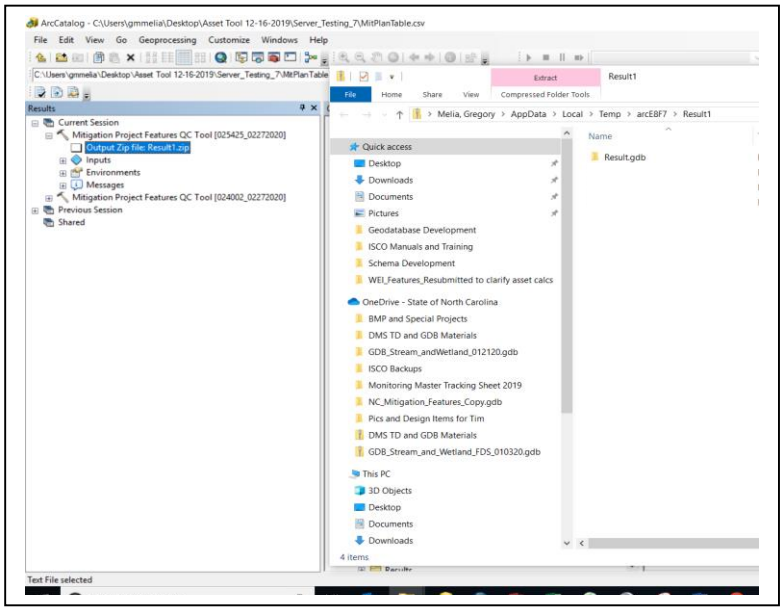
SitePoints

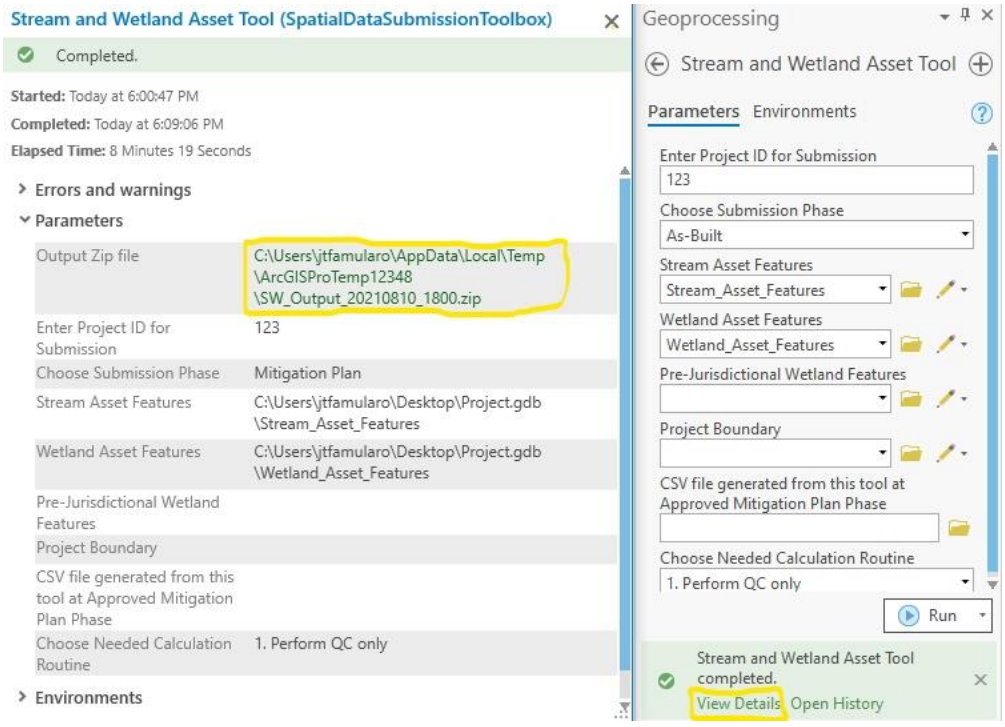
Shape *	OriginalOIDs	Project ID	Site Point Subt	Submission Phas	Data Source
Point	2	95021	10	MY1	GPS
Point	3	95021	20	MY1	<Null>
Point	4	95021	50	MY1	GPS
Point	5	95021	0	MY1	GPS
Point	6	95021	0	MY1	GPS
Point	7	95021	0	MY1	GPS
Point	8	95021	60	MY1	<Null>
Point	9	95021	0	MY1	GPS
Point	10	95021	0	MY1	GPS
Point	11	95021	0	MY1	GPS
Point	12	95021	95	MY1	GPS
Point	13	95021	40	MY1	<Null>

Figure 8. Example error table and ProcessedFeatures feature class with highlighted key fields that are used to match errors to features.

Supplementary Information (SI)

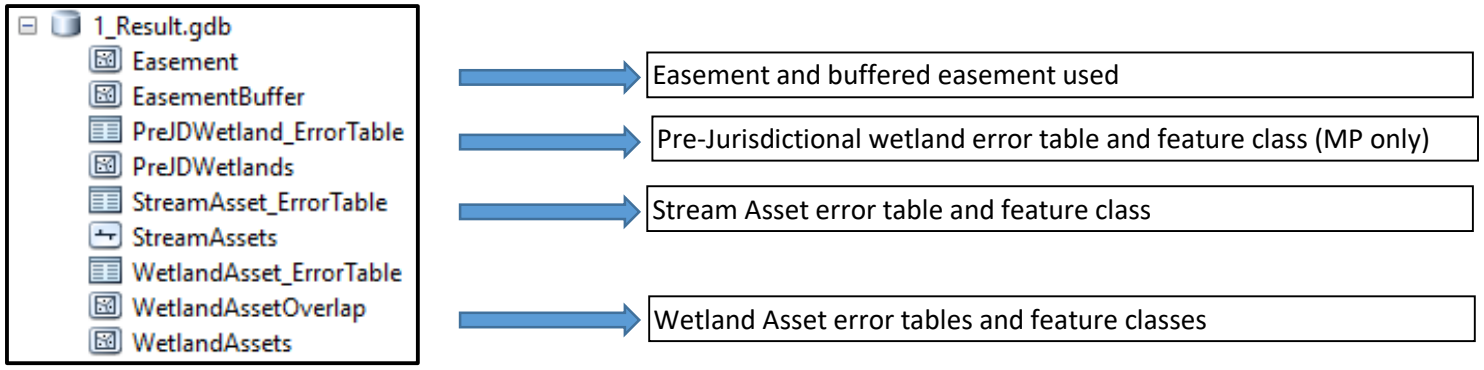




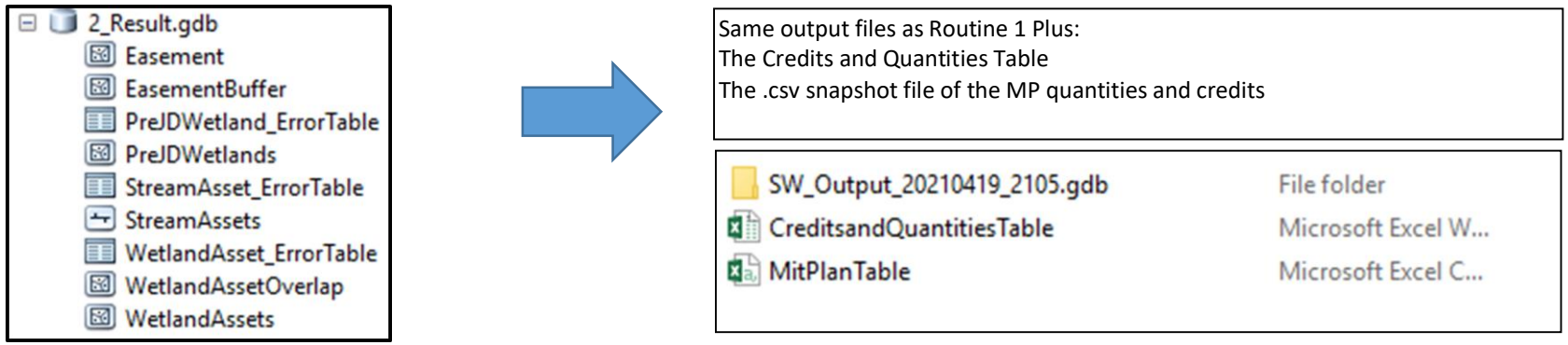


Supplementary Figure 1. Screen captures in ArcCatalog (above) and ArcPro (below) identifying where active geoprocessing can be viewed, and where the output folder can be found. The geoprocessing results window in Arc Catalog is used to observe the steps and results output of the script for a given calculation routine. This same dialog is where the results packages are found. In ArcPro, the results package can be found by selecting "View Details" in the tool's window.

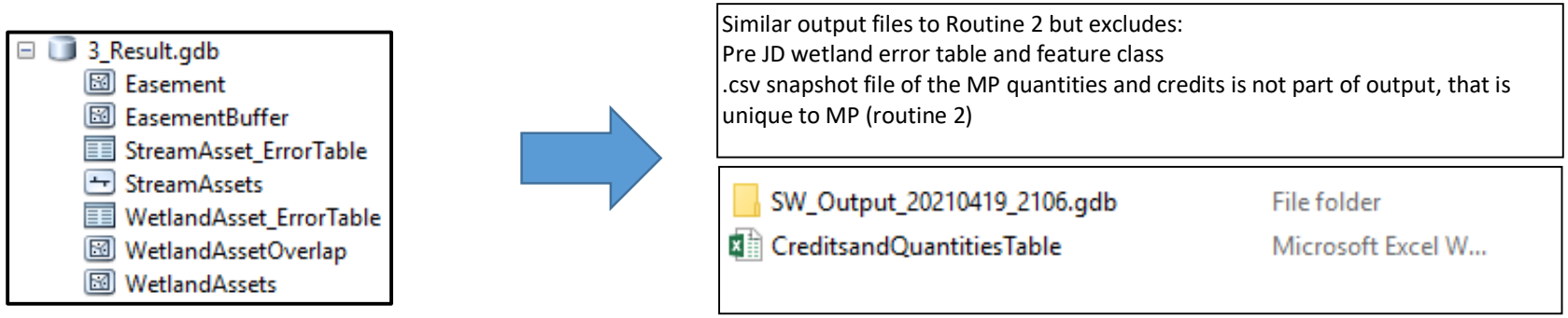
Routine 1 – Results Package



Routine 2 – Results Package



Routines 3-5 – Results Package



Supplementary Figure 2. Examples of output results packages for each routine.

Supplementary Table 1. Stream asset error table field descriptions.

Field	Description
ObjectID	Unique ID generated by ArcGIS for the error table.
GISOID	Object ID that can be used to reference the row with the error in the StreamAssets table.
Station_Length	An 'Error' value in this field indicates that Station Length (STACALC) does not equal GIS Length (Feet) (GEOMFEET).
Overlap_of_Stream_Segments	Stream overlaps will be identified using the pair of object ids where the overlap is detected.
Overlap_With_Wetland_Asset	An 'Error' value in this field indicates that the stream asset segment intersects with a wetland asset polygon by more than 0.5 feet.
Outside_Easement	An 'Error' value in this field indicates that a stream segment extends or is outside a buffered easement polygon. The current buffer is set to 0.5 feet.
Fields_Left_Blank	A list of field names that are required but have been left blank will appear here.
SubReachID_Unique	An 'Error' value in this field indicates that the Subreach ID (SRID) is not unique in the stream asset feature class.
Domain_Check	A list of field names that have invalid domain values will be listed here. The valid values are determined by the domain definitions in the DMS template.
Invalid_Type	An 'Error' in this field indicates that the Restoration Type (RestLevel) that is NA but a Credit Ratio (CreditDiv_1) that is > 0.
Credit_Support	When Calculation Routine 3 is selected, an 'Error' in this field indicates that the Credit Supporting (Cred_Tabl) value is set to Yes. All Credit Support values for calculation routine 3 should be set to No. When Calculation Routine 4 is selected, an 'Error' in this field indicates that the Crediting Supporting (Cred_Tabl) value is set to No but the Credit Ratio (CreditDiv_1) is > 0.

Supplementary Table 2. Wetland asset error table field descriptions.

Field	Description
ObjectID	Unique ID generated by ArcGIS for the error table.
GISOID	Object ID that can be used to reference the row with the error in the WetlandAssets table.
Overlap_of_Wetland_Segments	An 'Error' value in this field indicates that the wetland polygon intersects with one or more wetland polygons on the same feature class.
Outside_Easement	An 'Error' value in this field indicates that a wetland asset polygon extends or is outside a buffered easement polygon. The current buffer is set to 0.5 feet.
Field_Left_Blank	A list of field names that are required but have been left blank will appear here.
WetlandNumber_Unique	An 'Error' value in this field indicates that the Wetland Number (WetID) is not unique in the stream asset feature class.
Domain_Check	A list of field names that have invalid domain values will be listed here. The valid values are determined by the domain definitions in the DMS template.
Need_PreJD_Overlap	Rehabilitation, Enhancement, or Preservation wetlands that are not within polygons from the Pre-Jurisdictional Wetland feature class will show 'Error' in this field.
Bad_PreJD_Overlap	Restoration, Re-establishment, and Creation wetlands that intersect polygons from the Pre-Jurisdictional Wetland feature class will show 'Error' in this field.
Invalid_Type	An 'Error' in this field indicates that the Restoration Type (RestLevel) that is None but a Credit Ratio (CreditDiv_1) that is > 0 or a Restoration Type of Preservation and a Mitigation Category (LandPos) of Coastal Marsh.
Credit_Support	When Calculation Routine 3 (As-Built No Amendment) is selected, an 'Error' in this field indicates that the Credit Supporting (Cred_Tabl) value is set to Yes. All Credit Support values for calculation routine 3 should be set to No. When Calculation Routine 4 (As-Built Full Amendment) is selected, an 'Error' in this field indicates that the Crediting Supporting (Cred_Tabl) value is set to No but the Credit Ratio (CreditDiv_1) is > 0.

Supplementary Table 3. Pre-Jurisdictional Wetlands error table field descriptions.

Field	Description
ObjectID	Unique ID generated by ArcGIS for the error table.
GISOID	Object ID that can be used to reference the row with the error in the PreJDWetlands table.
Overlap_With_Stream_Assets	An 'Impact' value in this field indicates that one or more stream asset segments intersects with the wetland polygon by more than 0.5 feet. This is not necessarily an error but should be examined.
Overlap_of_PreJD_Segments	An 'Error' value in this field indicates that the PreJD wetland polygon intersects with one or more PreJD wetland polygons on the same feature class.
Outside_Easement	An 'Error' value in this field indicates that a Pre-JD wetland polygon extends or is outside a buffered easement polygon. The current buffer is set to 0.5 feet.
Field_Left_Blank	A list of field names that are required but have been left blank will appear here.
WetlandNumber_Unique	An 'Error' value in this field indicates that the Wetland Number (WetID) is not unique in the PreJD wetland feature class.