

November, 2017

Arc Hydro Stormwater Processing

380 New York Street Redlands, California 92373-8100 usa 909 793 2853 info@esri.com esri.com



Table 1. Authors and Participants

Author	Role/Title	E-mail Address	Phone Number
Christine Dartiguenave	Main Author	archydro@esri.com	

Table 2. Document Revision History

Version	Description	Date
1.0	First Version.	10/03/2017
2.0	Additional review step after Create Sink Structure	11/10/2017

Table 3. Related Documents

Description	Date

Table of Contents

Section	on Title	Page
1.0 I	ntroduction	
1.1	System Environment	5
1.2	Arc Hydro Version	5
1.3	Dataset	5
1.4	Preprocessing Methodology	5
2.0 F	Review Input Data	6
2.1	Data Projection	6
2.2	Digital Elevation Model	6
2.3	Identifying Stormwater Network Layers	9
2.4	Review Pipe Layer	
2.5	Review Stream Layer	
2.6	Review HydroJunction used as Inlet/Sinks	
2.7	Fix network connectivity issues	
3.0	Create Input Draft Sink Polygon	32
3.1	Create Sink Polygons for defined HydroJunctions	
3.2	Add Sink Polygons associated to Stream	
4.0 F	Processing Steps	37
4.1	Required Inputs	
4.2	Outputs Supporting the Stormwater Delineation process	
4.3	Summary and Processing Times	
4.4	Create Drainage Line Structures	
4.5	Create Sink Structures	41
4.6	DEM Reconditioning	
4.7	Level DEM	
4.8	Fill Sinks	
4.9	Flow Direction	
4.10	Adjust Flow Direction in Sinks	
4.11	Adjust Flow Direction in Streams	

6.0	Troubleshooting the Resulting Dataset	60
5.0	Stormwater Delineation	59
4.20) Create Snap Data	58
4.19	9 Flow Accumulation	57
4.18	3 Create Stormwater Network	56
4.1	7 Link Sink Watershed to HydroJunction	55
4.10	Sink Watershed Delineation	54
4.1	5 Adjoint Catchment Processing	53
4.14	Catchment Polygon Processing	52
4.13	3 Catchment Grid Delineation	51
4.12	2 Combine Stream Link and Sink Link	50

List of Figures

Figure 1 - CSS Data and Stream Datasets	5
Figure 2 – Define Projection Tool	7
Figure 3 - Define Z Coordinate System	7
Figure 4 - Projected Coordinate System	8
Figure 5 - Sample Input Geometric Network	9
Figure 6 - Open_Channel_NoNetwork Attributes Table	10
Figure 7 – Features with pseudo nodes	11
Figure 8 - Remove Stream Pseudo Nodes Tool	11
Figure 9 - Remove Stream Pseudo Nodes Tool	12
Figure 10 - Adding Stream entering the DEM	13
Figure 11 – Adding Stream leaving the DEM	14
Figure 12 – QC Roads Tool	15
Figure 13 – QC Streams Tool	16
Figure 15 - Stream QC Interface	16
Figure 16 - Streams in same cell	17
Figure 17 - Streams collapsed	18
Figure 18 – Streams in same cells	18
Figure 19 - Streams moved to another cell	19
Figure 20 - Overlapping streams	19
Figure 21 - Missing HydroJunction at end of Terminal Stream	20
Figure 22 - Missing HydroJunction at end of Terminal Stream	21

Figure 23 - Missing Catchments due to filled in stream	21
Figure 24 - Create Sinks for Line Structure tool	22
Figure 25 - Identifying Disconnected Network Features	29
Figure 26 - Line not connecting to end point	30
Figure 27. Identifying Disconnected Features	30
Figure 28. Selecting Network Features to Connect	30
Figure 29 – Connect Tool	31
Figure 30. Buffer Tool	32
Figure 31 - Create Sink Structures Tool	41
Figure 32 - Create Sink Structures Interface	41
Figure 33 - Create Drainage Line Structures	40
Figure 34 - Create Drainage Line Structures Interface	40
Figure 35 - DEM Reconditioning Tool	43
Figure 36 - DEM Reconditioning Interface	43
Figure 37 - Leveling Sensitivity	44
Figure 38 – Level DEM Tool	45
Figure 39 – Level DEM Interface	45
Figure 40 - Fill Sinks Tool	46
Figure 41 - Flow Direction Interface	47
Figure 42 - Adjust Flow Direction in Sinks Interface	48
Figure 43 - Adjust Flow Direction in Streams	49
Figure 44 - Combine Stream Link and Sink Link Interface	50
Figure 45 – Catchment Grid Delineation Interface	51
Figure 46 - Catchment Polygon Processing	52
Figure 47 - Adjoint Catchment Processing Interface	53
Figure 48 - Example of missing Hydrojunction at end of Stream	70

List of Tables

Table 1. Authors and Participants	i
Table 2. Document Revision History	i
Table 3. Related Documents	i
Table 4. Processing Steps Table	38
•	

1.0 Introduction

This document describes how to prepare the data required to support the Arc Hydro stormwater delineation tool.

1.1 System Environment

This workflow requires ArcGIS for Desktop 10.3.1 or greater with the Spatial Analyst Extension.

1.2 Arc Hydro Version

All processing may be performed using the versions of the Arc Hydro tools released after August 2017. Ensure you are using the Arc Hydro Tools Python toolbox, not the old Arc Hydro Tools, and not the Arc Hydro Tools menu bar:

1.3 Dataset

The dataset used as an example in this document is the Saint Louis combined storm sewer dataset provided by the USGS. An associated Stream dataset and Digital Elevation Model raster dataset were provided as well.

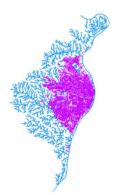


Figure 1 - CSS Data and Stream Datasets

1.4 Preprocessing Methodology

The data preprocessing is based on standard Arc Hydro terrain preprocessing tools.

- 1. All vector layers in the dataset must have HydroIDs assigned. The tools used in this document require geodatabase feature class layers as input and output data layers.
- 2. If errors are encountered, it is advised that users use a new ArcMap document to continue tasks.
- 3. Ensure that Target Locations are set in all new map documents.

2.0 Review Input Data

- Stormwater Network
- Stream
- DEM

2.1 Data Projection

The same projection must be used for raster and vector data. Projection must use a projected coordinate system that makes sense to support further analyses (area/length).

2.2 Digital Elevation Model

The DEM should be integer to speed up processing time.

Check units. If the DEM is in meters, convert it to centimeters. You can use the following map algebra expression in the Raster Calculator: Int(("floating_point_DEM" * 100) + .5)

The input dem_raw has values ranging from 22511 to 5899. The linear unit is meters, which means the elevation are in centimeters.

When looking at the projection information, the Coordinate System is "NAD_1983_Albers" but there is no Z unit defined. So the assumption is that the elevations are in meters.

6

The Define Projection tool may be used to correctly set the z-unit.

· · · · · · · · · · · · · · · · · · ·
- 2
1944 - 1944 - 1944 - 1944 - 1944 - 1944 - 1944 - 1944 - 1944 - 1944 - 1944 - 1944 - 1944 - 1944 - 1944 - 1944 -

Figure 2 – Define Projection Tool

Spatial Reference Properties	×
XY Coordinate System Z Coord	inate System
Type here to see	rch 🗸 🧐 😨 🗸
 North America CGVD 1928 CGVD2013 (IGLD 1955 IGLD 1985 	height)
NAD 1982 NAVD 19 NAVD 19 NAVD 19 NAVD 19 NAVD 19 NAVD88 NAVD88	Add To Favorites Remove From Favorites Copy and Modify
Current coordinate system	Save As
NAD_1983 WKID: 115702 Authority: ES Linear Units: Meter Direction: positive up Vertical Shift: 0.0 Datum: D_North_American Spheroid: GRS_1980 Semimajor Axis: 637813 Semiminor Axis: 635675	.1983 7.0
	OK Cancel

Figure 3 - Define Z Coordinate System

• Set the Linear Unit to centimeter and click Apply.

	NAD	1983 Albers			
	Teno,	_1909_/10013			
rojection					
Name:	Albe	rs			~
Paramet	er	Val	je	1	~
False Northing		0.00000000000	0000000		
Central_Meridian		-96.000000000	000000	00	
Standard Parallel	1	29.500000000	0000000	0	
Standard_Parallel	2	45.500000000	0000000	0	
Latitude_Of_Origin		23.000000000	0000000	0	
	1.4440.0	imeter			
Meters per unit:	0.01				
Meters per unit: Geographic Coordin		n			
an na manana k ana na kaning kaning ka	ate System _America ree (0.017 ireenwich American_ 1980	n_1983 (4532925199433) (0.0) 1983	^ ~	Change	•

Figure 4 - Projected Coordinate System

Executing: DefineProjection dem raw

```
PROJCS['NAD_1983_Albers',GEOGCS['GCS_North_American_1983',DATUM['D_North_Ame
rican_1983',SPHEROID['GRS_1980',6378137.0,298.257222101]],PRIMEM['Greenwich'
,0.0],UNIT['Degree',0.0174532925199433]],PROJECTION['Albers'],PARAMETER['Fal
se_Easting',0.0],PARAMETER['False_Northing',0.0],PARAMETER['Central_Meridian
',-
96.0],PARAMETER['Standard_Parallel_1',29.5],PARAMETER['Standard_Parallel_2',
45.5],PARAMETER['Latitude_Of_Origin',23.0],UNIT['Centimeter',0.01]],VERTCS['
NAD_1983',DATUM['D_North_American_1983',SPHEROID['GRS_1980',6378137.0,298.25
7222101]],PARAMETER['Vertical_Shift',0.0],PARAMETER['Direction',1.0],UNIT['C
entimeter',0.01]]
Start Time: Thu May 11 15:48:44 2017
```

8

2.3 Identifying Stormwater Network Layers

2.3.1 Defining Layers Roles

The requirements for the network that will support the stormwater delineation process are as follows:

- Pipe line layer
- Stream line layer,
- HydroJunction: point location where the water may enter the closed pipe system via an inlet or seep into the ground via a sink. These HydroJunctions will be related to an associated SinkWatershed.

The input data must be reviewed to determine which input features will be used to create this network and to ensure proper connectivity when tracing through the network

lame: CS5_global_Net			
Build Snapping 0.01		Meters	
eature classes participating in this ne Feature Class Name	Role	Sources & Sinks	
CSS_global_Net_Junctions	Simple Junction	<none></none>	
CSS_lines	Simple Edge	<none></none>	
Open_Channel_Flowlines	Simple Edge	<none></none>	
😳 Sinks	Simple Junction	Yes	
SS_Inlets	Simple Junction	Yes	
SS_Manhole_Combined_Sewe	er Simple Junction	Yes	

Figure 5 - Sample Input Geometric Network

For example, in the data shown above, the CSS_lines will be used to create the Pipe layer, Open_Channel_Flowlines to create the Stream layer and Sinks, SS_Inlets and SS_Manhole_Combine_Sewer will be combined to create the HydroJunction point layer.

2.4 Review Pipe Layer

Surface water enter the Pipe via a HydroJunction (Inlet).

A pipe may connect to another pipe or stream feature without requiring a HydroJunction (Inlet or Sink) at its end.

Pipe may end in a HydroJunction (Sink).

2.5 Review Stream Layer

If your input data is part of an existing network export the layer so that it does not belong to the network.

For example, in the CSS network, the Open_Channel network edge layer was exported to the layer Open Channel NoNetwork.

2.5.1 Remove pseudo nodes

Review the data and check whether there is only one feature between 2 confluences.

The input Open_Channel_NoNetwork has 47805 features.

ber	Channel_Not	Vetwork									
Г	OBJECTID *	Shape *	ARCID	GRID_CODE	FROM_NODE	TO_NODE	Shape_Leng	Enabled	HydroID	Shape_Length	T
	1	Polyline	128	1060	62	91	6	True	1248277	6	1
	2	Polyline	128	1060	62	91	4.242641	True	1248278	4.242641	1
	3	Polyline	128	1060	62	91	6.588341	True	1248279	6.588341	1
	4	Polyline	128	1060	62	91	25.351636	True	1248280	25.351636	1
	5	Polyline	128	1060	62	91	9.486833	True	1248281	9.486833	1
	6	Polyline	128	1060	62	91	12.369317	True	1248282	12.369317	1
	7	Polyline	128	1060	62	91	12.369317	True	1248283	12.369317	1
_	8	Polyline	128	1060	62	91	6.708204	True	1248284	6.708204	l
	9	Polyline	128	1060	62	91	8.244992	True	1248285	8.244992	ŝ
Ξ	10	Polyline	128	1060	62	91	15.954601	True	1248286	15.954601	1
-	11	Polyline	128	1060	62	91	13.416408	True	1248287	13.416408	1
_	12	Polyline	128	1060	62	91	16.155494	True	1248288	16.155494	1

Figure 6 - Open_Channel_NoNetwork Attributes Table

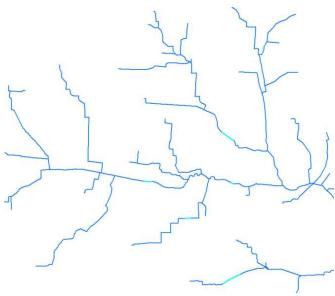


Figure 7 – Features with pseudo nodes

The tool Remove Pseudo Nodes is in the Arc Hydro Tools toolbox under the Watershed Processing > Line Processing toolset. Before running the tool, ensure that target locations are set and the following attributes are assigned in the input layer: HydroID, FROM_NODE, TO NODE, NEXTDOWNID. Save map document.



Figure 8 - Remove Stream Pseudo Nodes Tool

The processing time will depend on the number of existing pseudo nodes that need to be removed.

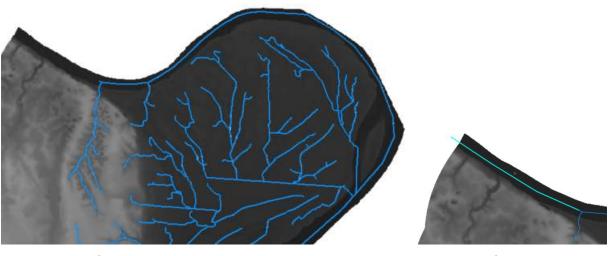
Input Stream						^
Open_Channel_NoNe	twork			•	8	
Output StreamWithoutPse	udoNode					
C:\Projects\Stormwater\	FinalNetwork\CSS_	Global.gdb\Laye	rs\Stream		8	

Figure 9 - Remove Stream Pseudo Nodes Tool

2.5.2 Extend lines outside of DEM extent

The Stream layer may need to be edited so that they cross the DEM's boundaries at the upstream and downstream end of Stream. Water needs to be able to enter and exit the DEM, either through a sink/inlet or by crossing the boundary.

Stream features will be burnt into the DEM during the processing, and the reconditioned DEM will be later filled back in if the water cannot "exit" the DEM. The water flowing through the stream must be able to flow out of the streams through a sink or an outlet.



Before

After

Figure 10 - Adding Stream entering the DEM

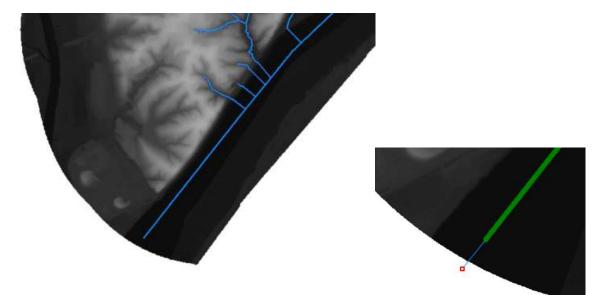


Figure 11 – Adding Stream leaving the DEM

2.5.3 QC Stream Geometry



Figure 12 - QC Roads Tool

QC input lines with the following checks:

- Zero length lines
- Multipart lines
- Overlapping lines
- Lines with From Node = To Node

Ran this tool and corrected bad geometry, then re-ran the tool and got clean geometry:

```
Executing: QCRoads Streams no pseudonodes
F:\project_work\StreamStats_MO CSS\from Rodney\ESRI 040617\ESRI 040617\CSS g
lobal.gdb\CSS global\Stream QC Geometry2
Start Time: Thu Jul 20 12:53:16 2017
Running script QCRoads...
Total number of input features:
                                           2641
Number of features with zero length:
                                           0
Number of single part features:
                                           2641
Number of multipart input features:
                                           0
Number of features in output:
                                           2641
Number of features with overlap:
                                           Ο
Number of features with loops:
                                           0
Number of features with end loops:
                                           0
2641 record(s) updated on
F:\project work\StreamStats MO CSS\from Rodney\ESRI 040617\ESRI 040617\CSS g
lobal.gdb\CSS global\Stream QC Geometry2. The HydroID values ranged from
263560 to 266\overline{2}00.
Completed script QCRoads...
Succeeded at Thu Jul 20 12:53:42 2017 (Elapsed Time: 26.38 seconds)
```

2.5.4 QC Streams

The QC Streams tool may be used to review the geometries of the input Stream in association with the DEM.





Click error and warning icons for more information	Stream QC	1
Input DEM		
fdr	Generate a rasterized vect	
Input Stream	version of the input Stream class using the input DEM	
Stream		
Output Stream Adjusted	The tool performs the follow	
C:\Projects\Stormwater\FinalNetwork\CSS_Global.gdb\Layers\StreamAdjusted	 checks and writes the rest error code in the field QCV the ouput feature class: 1: VerticesWithinC4 Vertices in a line lo to a single cell, bas river line visited the cell multiple times. 2: SegmentLTCellS line is < 5.8 * cell s 4: LinesParallelOrX lines come too close cellsion 	VALUE in ell. op back ically a same ize. River ize. 2 river
	cellsize). • 8: OutletLinesTooSI Outlet line (nextdow does not extend ove DEM's edge.	mid = -1) er the
	 16: StreamsCloseTe Outlet line comes to to the DEM edge (d n*cellsize, n*cellsiz the Agree's buffer e 	o close listance < e defines

Figure 14 - Stream QC Interface

Review the lines with QCVALUE > 0.

amAdjusted													
OBJECTID *	Shape *	ARCID	GRID_CODE	Shape_Leng	Enabled	HydroID	FEATUREID	From_Node *	To_Node *	NextDownID *	QCVALUE	GRIDID	Shape_Length
2023	Polyline	828	1006	3.824632	True	4696733	2564909	2026	1936	4696643	2	<null></null>	
2193	Polyline	0	0	3.566998	True	4696903	2565079	2196	2195	4696902	2	<null></null>	4.24264
2194	Polyline	0	0	2.272254	True	4696904	2565080	2197	2195	4696902	2	<null></null>	
2213	Polyline	0	0	0	True	4696923	2565099	2216	2214	4696921	2	<null></null>	
2326	Polyline	0	0	0	True	4697036	2565212	2332	2331	4697035	2	<null></null>	7.24264
2327	Polyline	0	0	0	True	4697037	2565213	2333	2331	4697035	2	<null></null>	10.2426
2341	Polyline	0	0	0	True	4697051	2565227	2348	2347	4697050	2	<null></null>	
2344	Polyline	0	0	0	True	4697054	2565230	2351	2350	4697053	2	<null></null>	
2346	Polyline	0	0	0	True	4697056	2565232	2353	2352	4697055	2	<null></null>	
2370	Polyline	0	0	0.015095	True	4697080	2565256	2392	2390	4697079	2	<null></null>	
2372	Polyline	0	0	0.015095	True	4697082	2565258	2394	2392	4697080	2	<null></null>	5
2400	Polyline	0	0	7.487966	True	4697110	2565286	2422	2396	4697084	2	<null></null>	
2401	Polyline	0	0	0	True	4697111	2565287	2423	2395	4697083	2	<nuli></nuli>	
2402	Polyline	0	0	19.946291	True	4697112	2565288	2394	2392	4697080	2	<null></null>	
2403	Polyline	0	0	2.103646	True	4697113	2565289	2392	2390	4697079	2	<null></null>	
2415	Polyline	0	0	0	True	4697125	2565301	2436	2435	4697124	2	<null></null>	10.24264



Figure 15 - Streams in same cell

Blue line in same cell -> need to move the lower line (pink and blue) so that they connect in the same cell.



Figure 16 - Streams collapsed

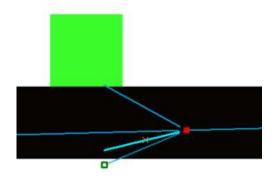


Figure 17 – Streams in same cells

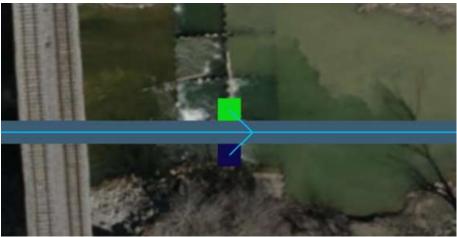


Figure 18 - Streams moved to another cell

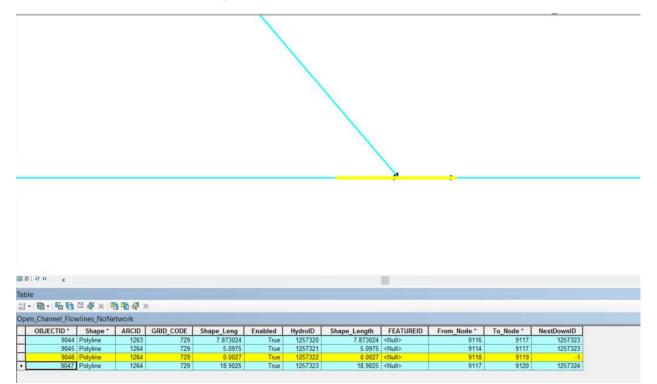


Figure 19 - Overlapping streams

2.6 Review HydroJunction used as Inlet/Sinks

2.6.1 Add Pipe Inlet/Sink HydroJunctions

All features identified as potential Inlet/Sink points need to be combined into a new HydroJunction point feature class. The various input layers may be combined using the Merge geoprocessing tool.

2.6.2 Identify Required Sinks at end of terminal Streams

The end of terminal streams, i.e. streams not connected to another downstream stream feature, must either be located outside the boundary of the DEM or coincide with a HydroJunction representing an Inlet or a Sink.

Figure 20 shows an example of missing HydroJunction at the end of a terminal Stream (blue line) connecting to a Pipe feature (purple line).



Figure 20 - Missing HydroJunction at end of Terminal Stream



Figure 21 - Missing HydroJunction at end of Terminal Stream

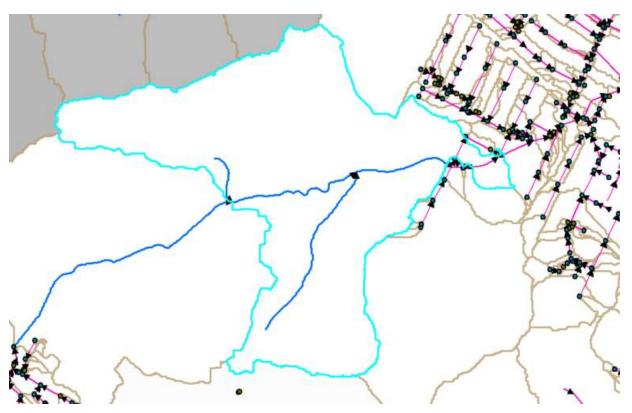


Figure 22 - Missing Catchments due to filled in stream

Connectivity issue at end of drainage line – not connected to css via inlet/sink in HydroJunction \rightarrow results in lines being filled in and only one catchment created instead of one catchment for each stream segment.

The Create Sinks for Line Structures may be used to identify the locations where HydroJunctions must exist.

Use Create Sinks for Line Structure to identify the location where the sinks/inlets should be created and check whether there are existing HydroJunction features existing in the HydroJunction feature class.

Create Sinks for Line Structure —	2000	X
Click error and warning icons for more information		×
Input Drainage Line Feature Class		-
C:\Projects\Stormwater\FinalNetwork\CSS_Global.gdb\CSS_global\Open_Channel_NoPseudoNodes	•	8
Input Snap Raster		
Fac	•	0
Option Type		
0		~
Output Structure Sink Point Feature Class		
c:\projects\stormwater\finalnetwork\css_global.gdb\Test\StructSinkPoint		8
Output Structure Sink Polygon Feature Class		
c:\projects\stormwater\finalnetwork\css_global.gdb\Test\StructSinkPoly		-
Input Structure Line Feature Class (optional)	4	-
	-	8
OK Cancel Environments	Show I	Help >>

Figure 23 - Create Sinks for Line Structure tool

Identify the StructSinkPoint that are missing in HydroJunction.

• Use Select by Location to identify StructSinkPoint that have a corresponding HydroJunction.

elect By Location	>
Select features from one or more target layers based on their loca elation to the features in the source layer.	tion in
Selection method:	
select features from	~
[arget layer(s):	
StructSinkPoint	^
WatershedPoint110	
HydroJunction	
DrainageLine100k	
Stream	
Pipe	
DrainageLine	
□ StructSinkPoly	
Watershed110	
Catchment	
□ SinkWatershed	
AdjointCatchment	V
✓]Qnly show selectable layers in this list gource layer:	10
HydroJunction	-
Use selected features (0 features selected)	
Spatial selection method for target layer feature(s):	
intersect the source layer feature	~
Apply a search distance	
Apply a search distance	

- Switch the selection to identify the missing HydroJunction and append to HydroJunction feature class.
- Copy the associated StructSinkPoly to LineDraftSinkPoly and populate JunctionID for the new features.

Stru	ctSinkPoint	witch Selec	tion				×
Т	OBJECTID *	snape	POINT_X	POINT_Y	HydroID	FeatureID *	^
	3	Point	486883.724	1746791.3492	4694662	2565317	
	5	Point	487235.3657	1746624.12	4694664	2565253	
	8	Point	487802.078	1752725.1145	4694667	2563085	
	11	Point	488789.4485	1748788.3853	4694670	2563036	
	12	Point	489675.7578	1747533.6335	4694671	2565205	
	15	Point	490068.9676	1747676.5794	4694674	2565204	
	16	Point	490145.5783	1752694.619	4694675	2565255	
	20	Point	491594,9916	1748981.8266	4694679	2565238	
	21	Point	491745.6418	1749451.0876	4694680	2565299	
	22	Point	492640,2597	1758206 7924	4694681	2565312	
1	25	Point	493207 1156	1756566.8905	4694684	2565303	
	26	Point	493675.7401	1749190.413	4694685	2565235	
	27	Point	493937.5256	1748393 2889	4694686	2565214	
	28	Point	494396 3504	1734957 4799	4694687	2563075	
	30	Point	495485.974	1759046 7352	4694689	2563089	
1	31	Point	496084.9708	1758933.4936	4694690	2563090	
	32	Point	496308 3015	1755436.347	4694691	2565249	
-		Daint	406403 774	1757105 1097	3031031	2565251	~

FeatureID allows relating back to the input line feature but also allow joining the StructSinkPoint to its related StructSinkPoly.

tru	ctSinkPoint						×
Τ	OBJECTID *	Shape *	POINT_X	POINT_Y	HydroID	FeatureID *	^
•	1	Point	483910.5	1740364.5	4694660	2563044	1.1
	2	Point	484936.5	1737046.5	4694661	2563074	
1	4	Point	487083.2551	1751792.7417	4694663	2562887	
1	6	Point	487245.048	1753659.8564	4694665	2563084	
	7	Point	487246.5333	1753659.557	4694666	2563081	
1	9	Point	488230.4355	1753933.6999	4694668	2563086	
1	10	Point	488420.6478	1748337.9868	4694669	2563037	
1	13	Point	489684.1431	1721703.1295	4694672	2565323	
1	14	Point	489830.9098	1721891 1407	4694673	2563094	
	17	Point	490178.2894	1751680.7775	4694676	2562888	
	18	Point	491243.8577	1751656.8324	4694677	2565171	
1	19	Point	491493.5924	1753794.1671	4694678	2565322	
1	23	Point	492685.5	1729089	4694682	2563080	
1	24	Point	493005.4899	1747348.209	4694683	2565206	
1	29	Point	495475.1425	1757528 258	4694688	2565252	
1	33	Point	496403.2044	1757107 215	4694692	2565290	
1	34	Point	496427.432	1755281 2289	4694693	2565248	
+	35	Daint	10210 99130h	1750468 6237	1031031	2563001	~

- Add field FeatureID to HydroJunction if it does not exist.
- Append selected missing StructSinkPoint. Do not upload HydroIDs (Right-click and delete the mapping).

Append			
nput Datasets		+	=
I StructSinkPoint			+
		-	×
		_	^
			Ť
		_	121
			*
arget Dataset			
HydroJunction		<u> </u>	8
chema Type (optional)			
NO_TEST			~
ield Map (optional)			
- SOURCE (Text) - HAZARDTYPE (Text)		^	+
- LAST_JOBID (Text)			_
WALLMATERI (Text)			×
- ROWLOC (Text)			
- HAZARD_ENT (Text)			+
- AncillaryRole (Short)			
- INTERIOR_4 (Double)			Trans.
INTERIOR_5 (Double)			Ŧ
- Traced (Short)			
Disconnected (Short)		1000	
Isolated (Short)			
- SourceType (Text)			
HYDROID (Long)			
StructSinkPoint.FeatureID (Long)			
ubtype (optional)		Y	
OK Can	cel Environments	Show F	

• Assign missing HydroIDs (uncheck option to overwrite).

Input Feature	Class or Table	E.		_
HydroJunct	ion		-	2
	HydrolD (opti	array.		

• Select StructSinkPoly intersecting the selected StructSinkPoint features.

Only 19 polygons for 20 points. Due to small line located within another sink polygon. Need to review data and eliminate this line/point. • Join HydroJunction and StructSinkPoly on FeatureID to add the HydroID of the HydroJunction

Join Field		\ <u>22</u>		×
Input Table				1
StructSinkPoly			-	8
Input Join Field				
FeatureID				~
Join Table				
HydroJunction			-	8
Output Join Field			27. 311	
FeatureID				~
Join Fields (optional)				
AncillaryRole				^
INTERIOR_4				
INTERIOR_5				
Traced				
Disconnected				
Isolated				
SourceType				100
FeatureID				
<			>	*
•				
Select All Unsele	ect All		Add Field	
ОК			-	

• Rename HydroID field JunctionID

💊 Alter Field		<u> 1955</u>		×
Input Table				
StructSinkPoly			•	8
Field Name				
HYDROID				\sim
New Field Name (optional)				
JunctionID				
New Field Alias (optional)				_
JunctionID				
New Field Type (optional) LONG				
New Field Length (optional)				
				4
New Field IsNullable (op Clear Alias (optional)	tonal)			
ОК	Cancel	Environments	Show He	elo >>

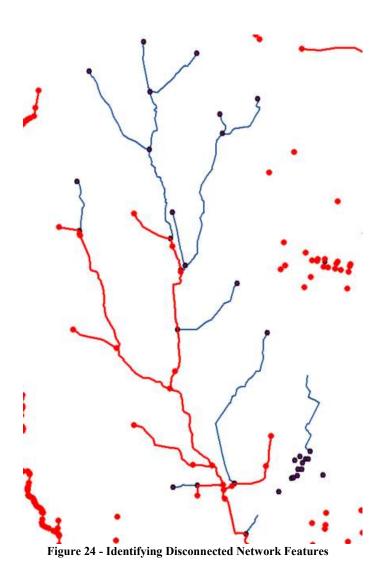
• Append selected StructSinkPoly features to DraftSinkPolyReview Stormwater Network Connectivity

Create a geometric network, set the flow direction in the digitized direction and test the connectivity. Identify the disconnected features and whether the connectivity needs to be modified. Delete disconnected HydroJunction if needed.

2.7 Fix network connectivity issues

2.7.1 Move junction to be on line features

• Use advanced editing \rightarrow connect to split the line after moving the junction



2.7.2 Fix connectivity issues for Stream features -> Lines must connect through end points.



Figure 25 - Line not connecting to end point

2.7.3 Use Find Disconnected trace and Connect

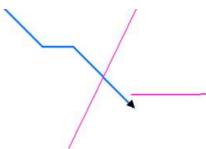


Figure 26. Identifying Disconnected Features

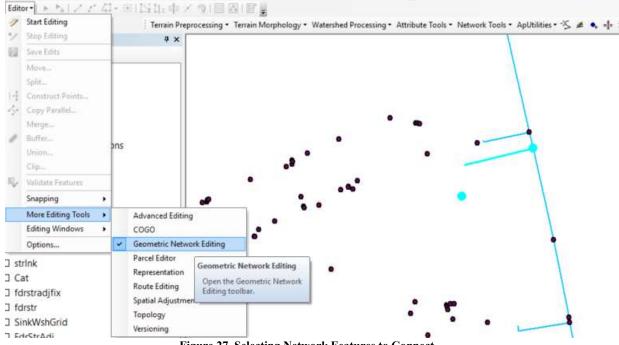


Figure 27. Selecting Network Features to Connect

• Click Connect after doing a Find Disconnected trace.



Figure 28 – Connect Tool

- Reassign HydroIDs after cleaning up.
- Update NEXTDOWNID in Streams layer.

3.0 Create Input Draft Sink Polygon

3.1 Create Sink Polygons for defined HydroJunctions

3.1.1 Using Buffering

Given the number of features, the sink polygons were created by buffering the HydroJunctions.

• Reselect connected HydroJunctions (should all be connected).

Dem is 3 cell size. So use 4.5m m for buffering.

If using 3m will end up with one cell SinkPoly and those are not considered sinks.

nput Features			
HydroJunction		• 6	3
Jutput Feature Class			
C:\Projects\Stormwater\FinalNetwork\CSS_Global.gdb\CSS_global\DraftSinkPoly		6	ð
listance [value or field] D Linear unit			-
4.5	Meters	19	-
Field			
ide Type (optional)			
FULL		2	~
nd Type (optional) ROUND			
fethod (optional)			
PLANAR			~
issolve Type (optional)			
NONE			~
issolve Field(s) (optional)			-
OBJECTID_1 OBJECTID FACILITYID		Í	Î

Figure 29. Buffer Tool

Executing: Buffer HydroJunction C:\Projects\Stormwater\FinalNetwork\CSS_Global.gdb\CSS_global\DraftSinkPoly "4.5 Meters" FULL ROUND NONE # PLANAR Start Time: Thu May 25 07:45:04 2017 Succeeded at Thu May 25 07:45:22 2017 (Elapsed Time: 17.86 seconds) • Rename HydroID field to JunctionID in output DraftSinkPoly feature class.

Alter Field						<
Input Table						1
DraftSinkPoly				*	8	
Field Name						
HYDROID					~	
New Field Name (optional)					_	
JunctionID						
New Field Alias (optional)						
JunctionID						
New Field Type (optional)						
LONG					1	
New Field Length (optional)					- 21	
New Field IsNullable (optional)					4	
Clear Alias (optional)						
						1
ок	Cancel	Environment	5	Show H	elp >>	

Executing: AlterField DraftSinkPoly HYDROID JunctionID JunctionID LONG 4 NULLABLE false Start Time: Thu May 25 07:48:34 2017 Succeeded at Thu May 25 07:48:34 2017 (Elapsed Time: 0.34 second • Assign HydroID to DraftSinkPoly.

Assign HydrolD		7 <u>82</u>		×
Input Feature Class or Table				_ /
DraftSinkPoly			•	8
Overwrite HydroID (optiona	al)			
ОК	Cancel	Environments	Show H	ielp >>

Potential Sinks created. HydroID will be used by the tool Create Sink Structures.

```
Executing: AssignHydroID DraftSinkPoly OVERWRITE_NO
Start Time: Thu May 25 07:50:13 2017
Reading Input Parameters...
Executing: AddField DraftSinkPoly HYDROID LONG # # # # NULLABLE
NON_REQUIRED #
Start Time: Thu May 25 07:50:13 2017
Adding HYDROID to DraftSinkPoly...
Succeeded at Thu May 25 07:50:13 2017 (Elapsed Time: 0.15 seconds)
Assigning HydroID...
The HYDROIDs ranged from 4214930 to 4282715.
Succeeded at Thu May 25 07:50:24 2017 (Elapsed Time: 11.14 seconds)
```

• Run Assign HydroID. Will be use to populate FeatureID in SinkPoly when using Create Sink Structures.

3.1.2 Alternative: Use Create Sinks for Point Structure

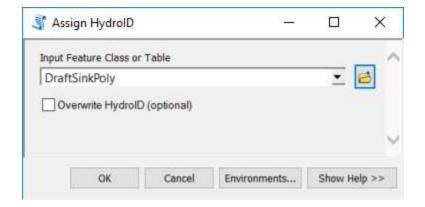
To do. Performance issue with CSS data.

3.2 Add Sink Polygons associated to Stream

The LineDraftSinkPoly features created in step 2.6.2 need to be appended to the DraftSinkPoly features.

Append			×
input Datasets			
		<u>*</u>	8
♦ StructSinkPoly			+
			×
			1
arget Dataset			_
DraftSinkPoly		<u>•</u>	6
Schema Type (optional)			
NO_TEST			~
ield Map (optional)			
- WALLMATERI (Text)		^	+
- ROWLOC (Text) - HAZARD_ENT (Text)			
- AncillaryRole (Short)			×
-INTERIOR_4 (Double)			_
- INTERIOR_5 (Double)			1000
 Traced (Short) 			Ť
- Disconnected (Short)			(Internal)
Isolated (Short)			t
SourceType (Text)			
StructSinkPoly.JunctionID (Long)		100	
- BUFF_DIST (Double)			
international states			
OK Can	cel Environments	Show	Help >>

• Assign HydroIDs to Null value



- Remove the junctions that are not connected so that they are not burnt in (unless you want to have terrain sinks).
- Assign HydroID to HydroJunction

4.0 Processing Steps

4.1 Required Inputs

The required inputs are the following:

- Pipe line feature class
- Stream line feature class
- DraftSinkPoly polygon feature class
- HydroJunction polygon feature class
- DEM

4.2 Outputs Supporting the Stormwater Delineation process

The following outputs will support the stormwater delineation process:

- Flow Direction
- Stream Link
- Snap Stream Raster
- Catchment
- Adjoint Catchment
- Pipe
- Stream
- Sink Watershed
- HydroJunction

4.3 Summary and Processing Times

 Table 4. Processing Steps Table.

Step	ΤοοΙ	Description	Processing Time (CSS dataset)
1	Create Drainage Line Structures	Create rasterized vector representation of the input streams as Drainage Line features.	11mn5s
2	Create Sink Structures	Create Sink Points and Polygons associated to DraftSinkPoly and HydroJunction. Note Review the data and make sure that the sink points are not located on the stream grid. If they are, edit the input streams to avoid this and rerun steps 1.	6mn23s
3	DEM Reconditioning from Stream Grid	Burn the stream grid generated in step 1 in the DEM to enforce the location of the streams and force water near the streams to flow toward the closest stream.	3mn46s
4	Level DEM	Level DEM within terrain and structure sink polygons using the lowest elevation along the sink polygon boundary – 10000 offset.	4mn50s
5	Fill Sinks	Fill the DEM at all locations except within the sink polygons (both terrain and structure).	5mn31s
6	Flow Direction	Generate flow direction grid.	1mn14s
7	Adjust Flow Direction in Sinks	Modify flow direction within sink polygons so that water flows toward the sink point in the sink polygon.	1mn15s
8	Adjust Flow Direction in Stream	Modify flow direction in the streams so that the water flows in the digitized direction along the streams.	39s
9	Combine Stream Link and Sink Link	Combine link grids generated from the streams and from the sinks.	24s
10	Catchment Grid Delineation	Delineate catchments for each link.	1mn55s
11	Catchment Polygon Processing	Convert catchment grid to vector.	1mn59s

12	Adjoint Catchment Processing	Generate Adjoint Catchment associated to each input Catchment and set the connectivity between Catchments.	2mn36s
13	Sink Watershed Delineation	Delineate watershed associated to terrain sinks.	4mn32s
14	Link Sink Watershed to HydroJunction	Create and populate JunctionID in SinkWatersheds with HydroID of associated HydroJunction. Create relationship.	3mn57s
15	Create Stormwater Network	Create geometric network from HydroJunction, Pipe and Stream layers and set flow direction in digitized direction.	43s
16	Flow Accumulation	Create Flow Accumulation to support next step, Create Snap Data.	8mn47s
17	Create Snap Data	Create snap raster to support snapping when delineating.	1mn54s

4.4 Create Drainage Line Structures

This tool will use the existing From_Node and To_Node fields if they exist.

Make sure they are correctly populated if they do exist.



Figure 30 - Create Drainage Line Structures

Create Drainage Line Structures					×
Input Raw DEM Raster					
dem_raw				•	8
Input Stream Feature Class					
Open_Channel_Flowlines_NoNetwork				•	8
Output Stream Flow Direction Raster					
c:\projects\stormwater\finalnetwork\Layers\F	drStr				8
Output Stream Link Raster					
c:\projects\stormwater\finalnetwork\Layers\S	StrLnk				8
Output Drainage Line Feature Class					
c:\projects\stormwater\finalnetwork\css_glob	al.gdb\Layers\Dra	inageLine			8
Output Drainage Line Flow Split Table					
c:\projects\stormwater\finalnetwork\css_glob	al.gdb\DrainageLi	ne_FS			8
☑ Clean Right Angles (optional) □ Use Raster Extent Input Divergence Flag Field (optional)					
Minimum Stream Length (optional)					17.4
					1/.4
			11 T II 1		

• Run Create Drainage Line Structures (11mn).

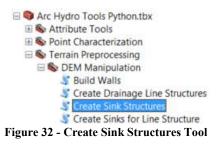
Figure 31 - Create Drainage Line Structures Interface

4.5 Create Sink Structures

HydroJunction is the point feature class storing all the junctions used as inlets or sinks.

Input Deranged Polygon feature class is the DraftSinkPoly polygon feature class created by buffering and running Create Sinks for Line Structures. Contains field HydroID and JunctionID which is the HydroID of the associated HydroJunction.

• Run Create Sink Structures (6mn).



Create Sink Structures			×
Click error and warning icons for more information			×
Input DEM Raster			_
dem_raw		<u>.</u>	6
Input Deranged Polygon Feature Class			
DraftSinkPoly		•	6
Output Sink Polygon Feature Class			_
c:\projects\stormwater\finalnetwork\css_global.gdb\tayers\Sit	nkPolygor	n	6
Output Sink Polygon Raster			
c:\Projects\stormwater\finalnetwork\Layers\SinkPolyGrid			6
Output Sink Point Feature Class			
c:\projects\stormwater\finalnetwork\css_global.gdb\Layers\Sit	nkPoint		8
Output Sink Point Raster			\equiv
c:\Projects\stormwater\finalnetwork\Layers\SinkPntGrid			6
Input Stream Line Feature Class (optional)			Ξ.
		•	8
Input Draft Sink Point Feature Class (optional)			
HydroJunction		•	6
OK Cancel Environm	ante	Chowal	lelp >>
OK Carcer Environm	C1162+++	21000	inih

Figure 33 - Create Sink Structures Interface

After running the tool, review the data and make sure that there are no sink point features located on top of stream grid cells (unless it is at the end of a stream). You can use the ExtractMultiValuesToPoints tool to identify those locations. If any points are located on streams, edit the input Stream layer so that the stream grid moves to a neighboring cell and rerun the previous step, Create Drainage Line Structures.

4.6 **DEM Reconditioning**

• Run DEM Reconditioning (3mn).

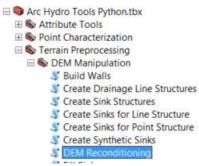


Figure 34 - DEM Reconditioning Tool

Input Raw DEM Raster		
dem_raw		8
Input Stream Raster or Feature Class		(Janea
StrLnk	•	8
Number of Cells for Stream Buffer		
		5
Smooth Drop in Z Units		
		10
Sharp Drop in Z Units		1000
Output AGREE DEM Raster		
C:\Projects\Stormwater\FinalNetwork\Layers\agreedem		8
Raise Negative Values (optional)		Land

Figure 35 - DEM Reconditioning Interface

4.7 Level DEM

Levels the DEM by filling the SinkPoly features up to their FillElev - offset value. This ensure that the SinkPoly really acts as sinks by setting all elevations in the SinkPoly features much lower than the elevations in the surrounding areas, so that the SinkPoly features act as a magnet for water.

Note

Make sure to use a large value to ensure that the leveled elevation is lower than any surrounding cell.

When using 10 below the problem still occurs because the z factor is not set so the tool assumes that the elevations are in linear units, whereas in fact they are in cm. So to avoid any issue, use a big number for the Offset (e.g. 1000).

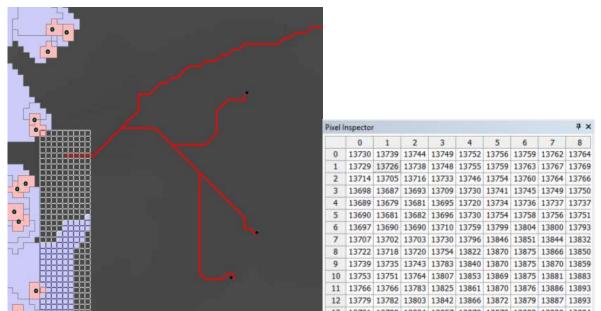
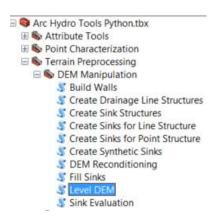


Figure 36 - Leveling Sensitivity

The leveled sink has an elevation of 13730 while the lowest point in the neighboring area is lower. So the enforced sink is not the lowest area and the connected cells will not be filled in, resulting in a missing catchment and an additional unwanted sink.

• Run Level DEM (5mns).





1 <u>05</u>		×
		~
	•	8
	•	8
		8
		~
	1.0	1000
nvironments	Show H	telp >>
	nvironments	

Figure 38 – Level DEM Interface

```
Executing: LevelDEM agreedem SinkPolygon
c:\Projects\stormwater\finalnetwork\Layers\LevelDEM # 1000
Start Time: Thu May 25 08:04:34 2017
Running script LevelDEM...
Using zUnitFactor= 1.0
Elevation field not set.
Assigning Level Elevation to the lakes...
Identifying point inside...
Extracting values under points...
Calculating fields...
Completed script LevelDEM...
Succeeded at Thu May 25 08:09:24 2017 (Elapsed Time: 4 minutes 50 seconds)
```

4.8 Fill Sinks

• Run Fill Sinks (5mn).

Fill Sinks			<u> /156</u>		×
Input DEM Raster					
LevelDEM				•	8
Output Hydro DEM Raster					
c:\Projects\stormwater\finalnetw	ork\Layers\Fil				8
Fill Threshold (optional)					
Input Deranged Polygon Feature C SinkPolygon	iass (optional)			-	10
Use IsSink Field (optional)					
	ОК	Cancel	Environments	Show I	Help >>

Figure 39 - Fill Sinks Tool

Executing: FillSinks LevelDEM c:\Projects\stormwater\finalnetwork\Layers\Fil
SinkPolygon ISSINK_NO
Start Time: Thu May 25 08:10:49 2017
Running script FillSinks...
--Identifying Deranged Polygons before filling...
--Filling the DEM...
--Updating the fill DEM with sink values of original DEM...
Completed script FillSinks...
Succeeded at Thu May 25 08:16:21 2017 (Elapsed Time: 5 minutes 31 seconds)

4.9 Flow Direction

• Run Flow Direction.

Flow Direction	<u></u>		×
Input Hydro DEM Raster			_
fil		•	6
Output Flow Direction Raster			
c:\Projects\stormwater\finalnetwork\Layers\FdrInit			8
Input External Wall Polygon Feature Class (optional)			
		-	8
			_
OK Cancel Er	wironments	Show H	inter a se

Figure 40 - Flow Direction Interface

```
Executing: FlowDirection Fil
c:\Projects\stormwater\finalnetwork\Layers\FdrInit #
Start Time: Thu May 25 08:21:02 2017
Running script FlowDirection...
--Calculating Flow direction...
--Saving c:\Projects\stormwater\finalnetwork\Layers\FdrInit...
Completed script FlowDirection...
Succeeded at Thu May 25 08:22:16 2017 (Elapsed Time: 1 minutes 14 seconds)
```

4.10 Adjust Flow Direction in Sinks

• Run Adjust Flow Direction in Sinks.

Input Flow Direction Raster			
FdrInit	<u>*</u>	8	
Input Sink Point Raster			
C:\Projects\Stormwater\FinalNetwork\Layers\sinkpntgrid	<u>•</u>	8	
Input Sink Polygon Raster			
C:\Projects\Stormwater\FinalNetwork\Layers\sinkpolygrid	<u>×</u>	6	
Output Sink Adjusted Flow Direction Raster			
c:\projects\stormwater\finalnetwork\Layers\FdrSinkAdj		8	

Figure 41 - Adjust Flow Direction in Sinks Interface

```
Executing: AdjustFlowDirectioninSinks FdrInit SinkPntGrid SinkPolyGrid
c:\projects\stormwater\finalnetwork\Layers\FdrSinkAdj
Start Time: Thu May 25 08:24:59 2017
Running script AdjustFlowDirectioninSinks...
--Adjusting flow direction in sinks...
Completed script AdjustFlowDirectioninSinks...
Succeeded at Thu May 25 08:26:14 2017 (Elapsed Time: 1 minutes 15 seconds)
```

4.11 Adjust Flow Direction in Streams

• Run Adjust Flow Direction in Streams.

FdrSinkAdj		
	-	8
Input Stream Flow Direction Raster		
fdrstr	¥	6
Output Stream Adjusted Flow Direction Raster		
c:\Projects\stormwater\finalnetwork\Layers\Fdr		8

Figure 42 - Adjust Flow Direction in Streams

```
Executing: AdjustFlowDirectioninStreams FdrSinkAdj fdrstr
c:\Projects\stormwater\finalnetwork\Layers\Fdr
Start Time: Thu May 25 08:29:41 2017
Running script AdjustFlowDirectioninStreams...
Completed script AdjustFlowDirectioninStreams...
Succeeded at Thu May 25 08:30:20 2017 (Elapsed Time: 38.61 seconds)
```

4.12 Combine Stream Link and Sink Link

• Run Combine Stream Link and Sink Link.

Combine Stream Link	and Sink	LINK				Ś
Input Stream Link Raster						1
strink				•	8	
Input Sink Link Raster						
sinkpntgrid				<u>•</u>	6	
Output Link Raster						
c:\Projects\stormwater\fina	alnetwork	\Layers\Link			8	
Input Drainage Line Feature	Class (op	itional)				
DrainageLine				•	8	
						١.,
0	к	Cancel	Environments	Show H	telp >	>

Figure 43 - Combine Stream Link and Sink Link Interface

```
Executing: CombineStreamLinkandSinkLink strlnk
C:\Projects\Stormwater\FinalNetwork\Layers\sinkpntgrid
c:\Projects\stormwater\finalnetwork\Layers\Link DrainageLine
Start Time: Thu May 25 14:37:35 2017
Running script CombineStreamLinkandSinkLink...
Min GridID in DrainageLine:7212964, Minimum value in streamlink: 2862463
Increment: 0
--Updating GridID in drainage lines...
--Updating link grid with sink links...
Completed script CombineStreamLinkandSinkLink...
Succeeded at Thu May 25 14:37:58 2017 (Elapsed Time: 23.55 seconds)
```

4.13 Catchment Grid Delineation

• Run Catchment Grid Delineation.

Input Flow Direction	n Raster			
fdr			•	8
Input Link Raster				
Link			•	8
Output Catchment	Raster			
c:\Projects\storm	water\finalnetwo	ork\Layers\Cat		0

Figure 44 – Catchment Grid Delineation Interface

Executing: CatchmentGridDelineation fdr link c:\Projects\stormwater\finalnetwork\Layers\Cat Start Time: Wed May 24 16:21:42 2017 Running script CatchmentGridDelineation... Completed script CatchmentGridDelineation... Succeeded at Wed May 24 16:23:38 2017 (Elapsed Time: 1 minutes 55 seconds)

4.14 Catchment Polygon Processing

• Run Catchment Polygon Processing.

Input Catchment Rast	ter					1
cat				•	8	
Output Catchment Fe	ature Class					
c:\projects\stormwa	ter\finalnetw	ork\css_global.ç	db\Layers\Catchment		8	

Figure 45 - Catchment Polygon Processing

```
Executing: CatchmentPolygonProcessing Cat
c:\projects\stormwater\finalnetwork\css global.gdb\Layers\Catchment
Start Time: Thu May 25 10:28:15 2017
Running script CatchmentPolygonProcessing...
--Converting raster to polygons...
       - Conversion completed in 13.6 seconds.
Dissolving features...
       - Dissolve completed in 88.9 seconds.
Renaming field to GridID ...
       - Renaming field completed in 0.2 seconds.
Assigning HydroIDs...
70009 record(s) updated on
c:\projects\stormwater\finalnetwork\css global.gdb\Layers\Catchment. The
HydroID values ranged from 4418104 to 4488112.
       - Assigning HydroIDs completed in 8.8 seconds.
Adding attributes indices...
       - Adding attributes indices completed in 4.1 seconds.
Cleaning up...
Completed script CatchmentPolygonProcessing...
Succeeded at Thu May 25 10:30:15 2017 (Elapsed Time: 1 minutes 59 seconds)
```

4.15 Adjoint Catchment Processing

• Run Adjoint Catchment Processing.

💐 Adjoint Catchment Processing 🦳 —		×
Input Drainage Line Feature Class		
DrainageLine	•	8
Input Catchment Feature Class		
Catchment	•	8
Output Adjoint Catchment Feature Class		
c:\projects\stormwater\finalnetwork\css_global.gdb\Layers\AdjointCatchment		8
Output Catchment Flow Split Table		
c:\projects\stormwater\finalnetwork\css_global.gdb\Catchment_FS		8
Input Drainage Line Flow Split Table (optional)		
C:\Projects\Stormwater\FinalNetwork\CSS_Global.gdb\DrainageLine_FS	•	8
OK Cancel Environments	Show H	lelp >>

Figure 46 - Adjoint Catchment Processing Interface

4.16 Sink Watershed Delineation

• Run Sink Watershed Delineation.

Input Flow Direction Raster				1
fdr		<u>•</u>	8	
Input Sink Point Raster				
C:\Projects\Stormwater\FinalNetwork\Layers\sinkpntgrid	i	*	6	
Input Sink Point Feature Class			_	
C:\Projects\Stormwater\FinalNetwork\CSS_Global.gdb\L	ayers\SinkPoint	•	8	
Output Sink Watershed Raster				
c:\projects\stormwater\finalnetwork\Layers\SinkWshGrid			8	
Output Sink Watershed Feature Class			_	
c:\projects\stormwater\finalnetwork\css_global.gdb\Layers\Sink	Watershed		8	

```
Executing: SinkWatershedDelineation fdr SinkPntGrid SinkPoint
c:\projects\stormwater\finalnetwork\Layers\SinkWshGrid
c:\projects\stormwater\finalnetwork\css global.gdb\Layers\SinkWatershed
Start Time: Thu May 25 15:25:01 2017
Running script SinkWatershedDelineation...
 Delineating sink watersheds...
      Delineating sink watersheds completed in 158.44 seconds.
 Vectorizing sink watersheds and populating attributes...
67601 record(s) updated on
c:\projects\stormwater\finalnetwork\css global.gdb\Layers\SinkWatershed. The
HydroID values ranged from 4559306 to 4626906.
     Vectorizing sink watersheds and populating attributes completed in
110.24 seconds.
Cleaning up...
Completed script SinkWatershedDelineation...
Succeeded at Thu May 25 15:29:34 2017 (Elapsed Time: 4 minutes 32 seconds)
```

4.17 Link Sink Watershed to HydroJunction

• Run Link Sink Watershed to HydroJunction.

HydroJunction				•	8
Input Sink Polygon Feature Class					
C:\Projects\Stormwater\FinalNetwo	ork\CSS_Global.g	db\Layers\Sir	ikPolygon	•	83
Input Draft Sink Polygon Feature Class					
C:\Projects\Stormwater\FinalNetwo	ork\CSS_Global.g	db\CSS_globa	al\DraftSinkPoly	-	8
Input Sink Watershed Feature Class					
C:\Projects\Stormwater\FinalNetwo	ork(css_diobal.g	db/rayers/sir	ik watershed		8
	ОК	Cancel	Environments		Help >>

C:\Projects\Stormwater\FinalNetwork\CSS Global.gdb\Layers\SinkWatershed

```
Start Time: Fri May 26 16:15:26 2017
```

Running script linksinkwatershedtohydrojunction...

Deleting field FeatureID from SinkWatershed.

Deleting existing relationship between SinkWatershed and HydroJunction Deleting field JunctionID from SinkWatershed.

Joining Sink Watershed with SinkPolygon...

Creating index FeatureID_Index...

Joining Sink Watershed with DraftSinkPoly...

Creating relationship class between SinkWatershed's JunctionID and HydroJunction's HydroID...

Cleaning up...

Completed script linksinkwatershedtohydrojunction...

Succeeded at Fri May 26 16:19:23 2017 (Elapsed Time: 3 minutes 57 seconds)

4.18 Create Stormwater Network

• Run Create Stormwater Network.

The tool creates a geometric network from Pipe, Stream and HydroJunction and set the flow direction in the lines to the digitized direction.

4.19 Flow Accumulation

Input Flow Direct	ction Raster			
fdr			•	8
Output Flow Acc	cumulation Rast	er		
c:\projects\sto	rmwater\finalne	etwork\Test\Fac		8

```
Executing: FlowAccumulation fdr c:\projects\stormwater\finalnetwork\Test\Fac
Start Time: Tue May 30 09:50:17 2017
Running script FlowAccumulation...
Creating output directory c:\projects\stormwater\finalnetwork\Test.
Performing flow accumulation using INTEGER option.
Building raster attribute table.
Completed script FlowAccumulation...
Succeeded at Tue May 30 09:59:27 2017 (Elapsed Time: 9 minutes 9 seconds)
```

4.20 Create Snap Data

Input Flow Accumulation Raster			_
Fac		-	0
Input Flow Direction Raster			_
Fdr		<u> </u>	8
Output Location (optional)		_	_
C:\Projects\Stormwater\FinalNetwork			6
Stream Threshold (optional)			
		1	000

```
Executing: CreateSnapData Fac Fdr C:\Projects\Stormwater\Run1 1000
Start Time: Mon Jun 05 14:44:53 2017
Running script CreateSnapData...
--Calculating stream definition...Mon Jun 05 14:44:56 2017
Using threshold = 1000 cells.
--Calculating stream segmentation...Mon Jun 05 14:45:14 2017
--Creating drainage lines...Mon Jun 05 14:45:30 2017
--Replacing flow direction in sinks with 0...
Executing Stream to Feature...
       - Stream to Feature completed in 36.4 seconds.
Copying C:\Users\chri3244\Documents\ArcGIS\scratch\scratch.gdb\tmpdl0 into
feature dataset...
       - Copying completed in 4.8 seconds.
Cleaning completed: 0 line(s) deleted.
       - Cleanup completed in 1.2 seconds.
--Adding GridID as a field...
--Adding and assigning HydroID...
36053 record(s) updated on
C:\Projects\Stormwater\Run1\Run1.gdb\Layers\DrainageLine1k. The HydroID
values ranged from 349163 to 385215.
       - Adding and assigning HydroID completed in 4.4 seconds.
--Populating NextDownID...
       - Populating NextDownID completed in 10.3 seconds.
Cleaning up...
Cleaning up...
Completed script CreateSnapData...
Succeeded at Mon Jun 05 14:46:48 2017 (Elapsed Time: 1 minutes 54 seconds)
```

5.0 Stormwater Delineation

🛐 Stormwater Delineation			×
Click error and warning icons for more information			X
Input Batch Point			
StormwaterDelineation::Input_Batch_Point		-	8
Input_Batch_Point			
Snap Distance (optional)			
Input Flow Direction Grid			2
fdr		•	8
Input Stream Raster			
strink		•	8
Input Snap Stream Raster			
strink		•	0
Input Catchment			Second Second
Catchment		•	8
Input Adjoint Catchment			
AdjointCatchment		•	8
Input Pipe Layer			
Pipe		•	8
Input Stream Layer			
Stream		•	8
Input Sink Watershed			
SinkWatershed		•	8
Input Hydro Junction			
HydroJunction		•	8
Output Watershed			_
c:\projects\stormwater\finalnetwork\css_global.gdb\Test\Watershed0	01		8
Output Watershed Point			
$\label{eq:c:projects} c:\projects\stormwater\final network\css_global.gdb\Test\WatershedPointer\css_global.gdb\Test\WatershedPointer\stormwater\final network\css_global.gdb\Test\WatershedPointer\final network\css_global.gdb\Test\WatershedPointer\final network\css_global.gdb\Test\WatershedPointer\final network\css_global.gdb\Test\WatershedPointer\final network\css_global.gdb\Test\WatershedPointer\final network\css_global.gdb\Test\WatershedPointer\final network\final networ$	pint001		8
Use Direct Surface Contribution Only			
OK Cance	Environments	Show F	ielp >>

Figure 47 – Stormwater Delineation Tool

6.0 Troubleshooting the Resulting Dataset

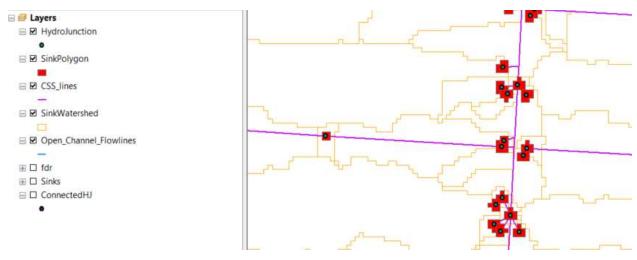
• Open Map document Stormwater.mxd.

Network

- 1. HydroJunction → related to SinkWatershed via DrainID/HydroID: should at least contain all Junctions related to sinks (and maybe all except default junctions). Created from initial junctions: Sinks, SS Inlets, SS Manhole Combined Sewer.
- 2. CSS_lines
- 3. Open_Channel_Flowlines

Related layers

- SinkWatershed: associated to HydroJunction via DrainID
- Fdr: flow direction
- ConnectedHJ: connected junctions in initial network used to burn in sinks (Sinks, SS_Inlets, SS_Manhole_Combines_Sewer)
- Catchment: catchment associated to inlet and drainage lines



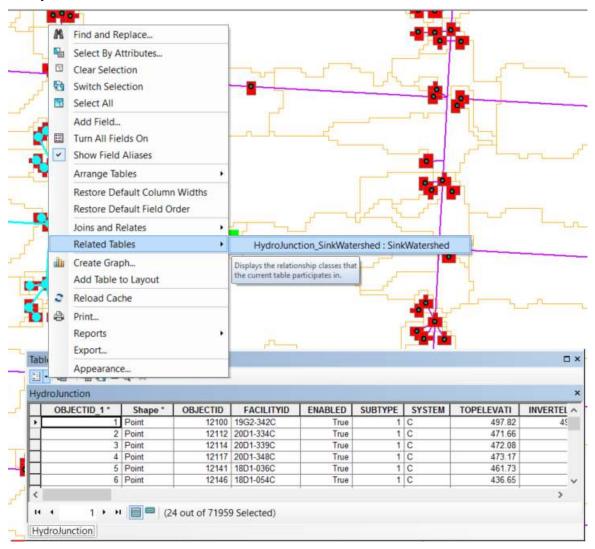
Set trace to use Selection: Analysis > Options > Results

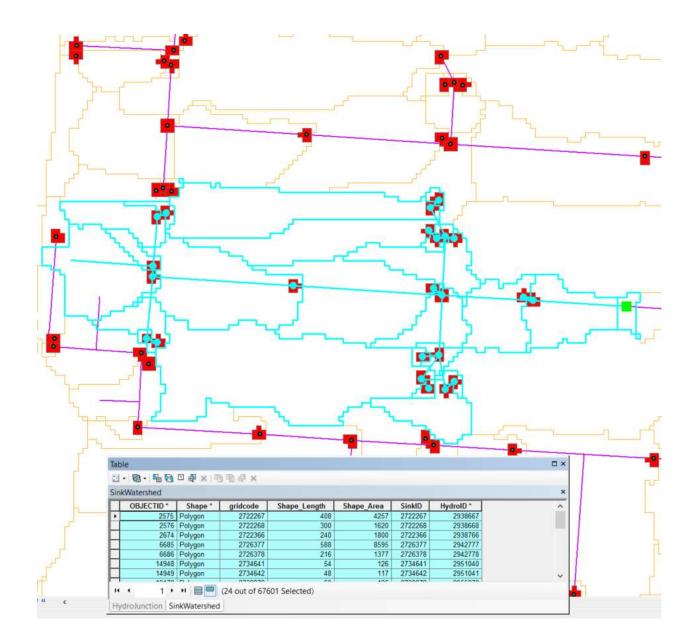


Analysis Options	~
General Weights Weight Filter Results	
Results format	
Return results as:	
O Drawings	
Draw individual elements of complex ed	iges
Trace task result color	
These addit resolution	
 Selection 	
Results content	
Results include:	
All features	
O Features stopping the trace	
Of these results include:	
✓ Edges	
Junctions	
	-11
OK Cancel	Apply

Figure 48 – Trace Analysis Options

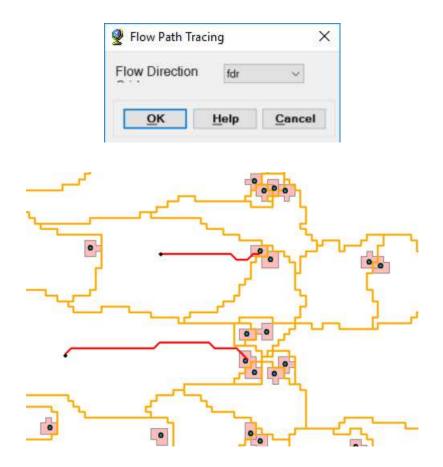
- Put a junction flag and perform an upstream trace.
- Open the attributes table of HydroJunction and select Related Tables > HydroJunction_SinkWatershed to select the SinkWatershed related to each traced HydroJunction.



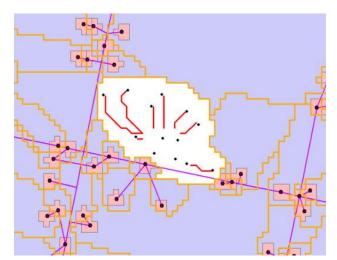


- Use the Flow Path Tracing tool to trace using the Fdr raster.
- Click the tool, click on the map and select Fdr if prompted (first time).
- Then click on the map to perform traces.

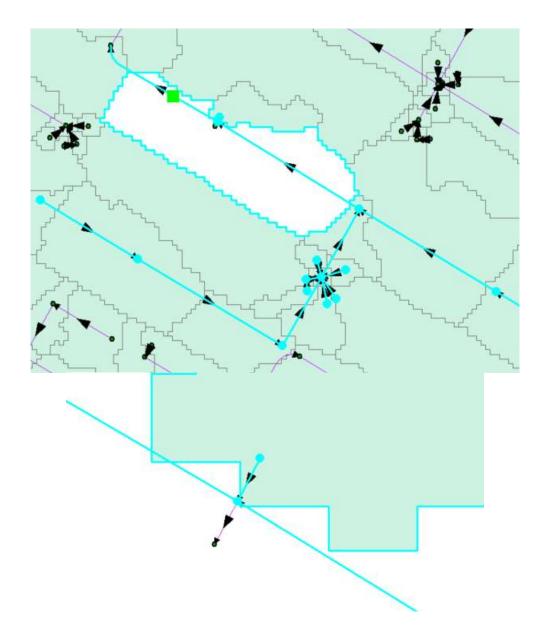




• Review Catchment to identify problem areas: looks like area was not correctly filled (probably because it connects to a neighboring sink – need to check)



Problem was offset in Level DEM was to small (the z factor was not set properly. To avoid this issue, use a large value for the offset to make sure the elevations in the sink are much lower than any neighboring elevations.



Hole in the watershed cause by wrong flow direction. Need to reverse the direction of the line to fix this issue so the water goes from the lower HydroJunction towards the main pipe instead of away from it.

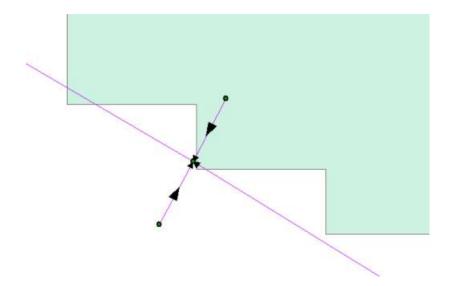
• Start Editing – Double click the line to edit, right-click and Select Flip.

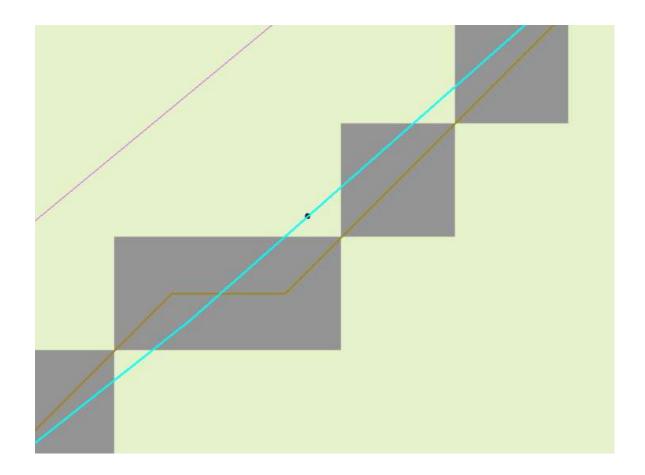
	Route Measur Insert Vertex Delete Vertex Move Move To	
	Change Segm	ent •
rī -	Trim To Lengt Part Delete Sketch Finish Sketch Finish Part	Flip Change the direction of the sketch. The first point added to the sketch becomes the last point.
	Sketch Proper	ties

The flow direction is now uninitialized.

- Stop editing.
- Select the line you just edited and reset the Flow Direction in the digitized direction.

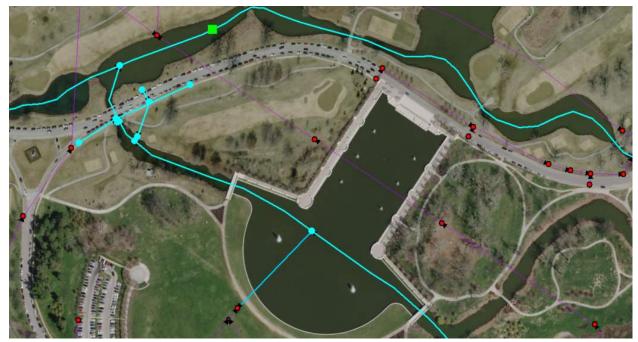
Set Flow Direction			3 <u>101</u> 9		×
input Edge Feature Classe	s				-
				ž.,	8
Pipe					+
					×
					Ť
					4
Select Flow Direction WITH_DIGITIZED					~
	ОК	Cancel	Environments	Show H	





Stream does not match DrainageLine/StrLnk perfectly. But if point is snapped to line for tracing, it should also be snapped to the stream grid for local delineation (snap to closest stream cell).

• Review direction of blue line.



Missing HydroJunction at the end of the blueline.



Figure 49 - Example of missing Hydrojunction at end of Stream

Copyright © 2017 Esri All rights reserved. Printed in the United States of America. Notice of Proprietary Information:

The information in the attached document is proprietary to Esri and contains commercial or financial information or trade secrets that are confidential and exempt from disclosure to the public under the Freedom of Information Act. This information shall not be disclosed outside of Customer's organization (except for consultants under a confidentiality obligation who are involved in the proposal evaluation process) without Esri's prior permission, and shall not be duplicated, used, or disclosed in whole or in part for any purpose other than to evaluate this proposal. If, however, a contract is awarded to Esri as a result of this information, the Customer shall have the right to duplicate, use, or disclose the data to the extent provided in the contract. This restriction does not limit the Customer's right to use information contained in this data if it is obtained from another source without restriction.

Esri, the Esri globe logo, CLIENT GIS, esri.com, and other Esri marks used in this document are trademarks, service marks, or registered marks of Esri in the United States, the European Community, or certain other jurisdictions. Other companies and products or services mentioned herein may be trademarks, service marks, or registered marks of their respective mark owners.