Creating bathymetric mesh using field surveyed channel elevation data.

Additional information is available in the GeoRAS manunal and in the tutorial document below. The tutorial document b describes how to download the tool. The tutorial also describes how to run the tool but steps below describes in more detail how to run the tool and shows some modified use of the tool. (http://web.ics.purdue.edu/~vmerwade/research/bathymetry_tutorial.pdf).

- 1. Filter the field data if needed with Haversine (or something similar) program to about 50 100 points per xsection. Project the field data to match the rest of base GIS data (i.e. State Plane West/East).
- 2. Start the GeoRAS geometry process to create center line, bank lines, flowpath lines and xscutlines as you would do normally. Be sure to follow streamflow direction (i.e. upstream to downstream, left to right bank...).



Run all the "RAS Geometry" steps (as normal) prior to and including the highlighted step below.

KAS Geometry - KAS mapping - ID	BM	tit 🛠 🚓 🗠 🟞 Whoringes , Heil
Create RAS Layers	⊁	1 9/18/10/201
Layer Setup		63
Stream Centerline Attributes	•	Jell Andrew
XS Cut Line Attributes	•	River/Reach Names
Manning's n Values	۲	Stationing
Levees	۲	Bank Stations
Ineffective Flow Areas	۲	Downstream Reach Lengths
Blocked Obstructions	•	Elevations
Bridges/Culverts	۲	All
Inline Structures	۲	Update Elevations

RAS Geometry 🔹 RAS Mapping 🔹 🙀 🙀 👯 👯 🏹 🥪 😓 🖨 ApUtilities 🍷 Helj

Make sure "Station" column is populated in XScutlines table.

Table								
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XSQ	XSCutLines							
	Shape_Length	HydrolD	Station	River	Reach	LeftBank		
	20108.44914	7	19062.33	white	reach1	0.47867		
	18708.601547	8	17780.54	white	reach1	0.50479		
	17434.154268	9	16251.5	white	reach1	0.47899		
	17365.341326	10	15079.73	white	reach1	0.55065		
	15878.007764	11	14003.58	white	reach1	0.62503		
	14577.279433	12	13138.11	white	reach1	0.66523		
	12738.86339	13	11847.03	white	reach1	0.73241		
	11149.379549	14	10865.63	white	reach1	0.77405		
	10715.03437	15	9907.294	white	reach1	0.67825		
	10696.043768	16	8701.413	white	reach1	0.5495		
	9775.336453	17	6959.407	white	reach1	0.54806		

3. Update Xscutline3D layer with field surveyed channel elevation data by using "Update Elevations" tool in GeoRAS (see the second image in previous page). More details of the tool can be found in GeoRAS manual.

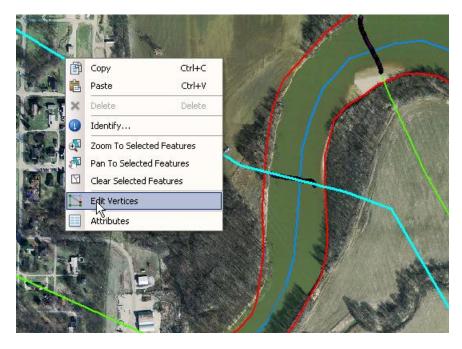
💹 Update XS Cutline F	Profiles 👗	>	K
XS Cutlines	XSCutLines		
XS Cutlines Profiles	XSCutLines3D	_	
Bathymetry Points	appended_spw	•	
Elevation Field	Elevation	•	
Select interpolation lim	its		
Interpolation Area	Channel	-	
Bank Lines	Banks	•	
C Bank Points	Null	•	
XS Tolerance	40	(maps units)	
C Bathymetry Extents	;		
Bathymetry Extents	Null		
XS Extents	Null	Y	
Updated XS Profiles	XSCutLines3DUpdated	t	
Draw graphics			
ОК	Help	Cancel	

• When it's done, you should see a message similar to one below and graphics to indicate how the buffer and the points used in updating elevation.

_	Start Time	Туре	Message	
	4/15/2013 3:15:32 PM	Information	Updated elevations for XS feature OID : 37 at station : 18350.62	
	4/15/2013 3:15:41 PM	Information	Updated elevations for XS feature OID : 38 at station : 16760	
	4/15/2013 3:15:50 PM	Information	Updated elevations for XS feature OID : 39 at station : 15755.35	
	4/15/2013 3:15:57 PM	Information	Updated elevations for XS feature OID : 40 at station : 14369.44	
	4/15/2013 3:16:04 PM	Information	Updated elevations for XS feature OID : 41 at station : 13571.29	
	4/15/2013 3:16:09 PM	Informati	te XS Cutline Profiles	
	4/15/2013 3:16:13 PM	Informati	plat station : 11389.87	
	4/15/2013 3:16:16 PM	Informati XS	CutLine elevations updated successfully! 4 at station : 10398.11	
	4/15/2013 3:16:20 PM	Informati	OK 5 at station : 9186.51	
	4/15/2013 3:16:23 PM	Informati	6 at station : 8185.457	
	4/15/2013 3:16:26 PM	Information	Updated elevations for XS feature OID : 47 at station : 7371.029	
	4/15/2013 3:16:29 PM	Information	Updated elevations for XS feature OID : 48 at station : 5590.176	
	4/15/2013 3:16:32 PM	Information	Updated elevations for XS feature OID : 49 at station : 4400.653	
	4/15/2013 3:16:34 PM	Information	Updated elevations for XS feature OID : 50 at station : 3200.259	
	4/15/2013 3:16:36 PM	Information	Updated elevations for XS feature OID : 51 at station : 2193.414	



• If you would like to check to see if the field data have been applied, you can check in editor mode. Select one of the "XSCutLines3DUpdated" lines; right click on the highlighted line and select "Edit Vertices";



• Right click on one of the vertices and select "Sketch Properties".



• Box select vertices around the channel width and you should see a table similar to one below and see that the channel elevations have been applied. Make sure you stop editing before next steps.

Edit :	Sketch Pr	operties			
12-	×Z	M 📶 Fi	nish Sketch		
	#	Х	γ	Z	
	824	29081	12906	453.722	
	825	29081	12906	453.662	
	826	29081	12906	453.662	
	827	29081	12906	453.662	
	828	29081	12905	453.662	
	829	29081	12905	453.491	
	830	29081	12905	453.337	
	831	29081	12905	453.334	
	832	29081	12905	453.135	
	833	29081	12905	452.814	
	834	29081	12905	452.493	
	835	29081	12905	452.436	
	836	29080	12905	432.670	
	837	29080	12905	430.870	
	838	29080	12905	430.570	
	839	29080	12905	430.470	
	840	29080	12905	430.070	
	841	29080	12905	429.870	
	842	29080	12905	429.970	
	843	29080	12905	429.970	
	844	29080	12905	429.870	
	845	29080	12905	430.370	
	846	29080	12905	430.370	
	847	29080	12905	430.870	
	848	29080	12905	431.070	
	849	29080	12905	431.070	
	850	29080	12905	431.470	

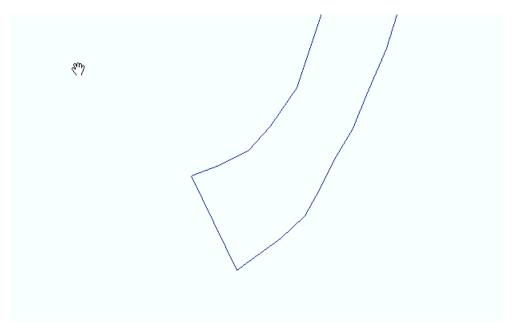
4. Before you start using the bathymetry mesh tool, in a new folder/workspace, you will need to create new personal geo-database and then create new feature dataset using DEM layer as a reference for coordinate system (As you copy/create new set of layers, add these layers to a new ArcMap session for bathymetry mesh tool process).

ew Feature Dataset		? ×
	6	
Choose the coordinate system that will be u	ised for XY coordinates in this	; data.
Geographic coordinate systems use latitude of the earth's surface. Projected coordinate transform latitude and longitude coordinate	systems use a mathematical	conversion to
Name: NAD_1983_StatePlane_In	diana_West_FIPS_1302_Fee	ıt
🕀 🔚 Geographic Coordinate Systems		Import
Projected Coordinate Systems		Now -
⊡… 🚰 USGS_Favorites Unknown>		<u>New</u> -
		Modify
1		
	< Back Next >	Cancel

5. Copy "River" and "Banks" (as "Banks_line") layers from GeoRAS database to Mesh database by using "Copy Features" toolbox.

Copy Features		×
Input Features	<u>I</u>	
	2	
Output Feature Class		
	2	
Configuration Keyword (optional)	_	
	-	
Output Spatial Grid 1 (optional)		
0		
Output Spatial Grid 2 (optional)		
0		
Output Spatial Grid 3 (optional)		
]0		-1
OK Cancel Environments Show H	elp >>	

6. Banks line needs to be converted to polygon for mesh tool to work. Edit "Banks_line" by connecting the lines at both upstream and downstream ends.



• Convert "Banks_line" to "Banks_poly" by using "Feature to polygon" toolbox.

🔨 Feature To Polygon	_ 🗆 🗙
Input Features	<u> </u>
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	+
	×
	Ŧ
Output Feature Class	الا ا
	6
XY Tolerance (optional)	
OK Cancel Environments Show	Help >>

7. Create empty/new "Mesh" layer in the new geo-database in ArcCatalog; be sure to check mark M and Z values. And add fields called "ProfileID" and "CrossID" as shown below.

New Feature Class					? ×
Name:	Mesh			_	
Alias:					
Type Type of featu	ures stored in this feature c	lass:			
Line Featur	es			•	
	ies include M values. Used to include Z values. Used to :				
	include 2 values. Used to :	store 3D data	а.		
		< Back	< Next >		ancel
	Field Name		Data Type		

Data Type	
Object ID	
Geometry	
Long Integer	
Long Integer	
Double	
	_
	-
	Object ID Geometry Long Integer Long Integer

8. To copy "Xscutline3DUpdated" layer and copy all of its attribute table, first use "Create Feature Class" toolbox create empty "Xsection3D" layer (with m and z values enabled) using "Xscutline3DUpdated" layer as a template; then append the "Xscutline3DUpdated" to "Xsection3D".

1	Create Feature Class	
	Feature Class Location	*
`		
	Feature Class Name	
'		
	Geometry Type (optional)	
	POLYLINE	•
	Template Feature Class (optional)	
	▼	6
		<u>+</u>
		×
		1
	Has M (optional)	
	ENABLED	_
	Has Z (optional)	
	Coordinate System (optional)	
	Unknown	~
	,	
×	Geodatabase Settings (optional)	-
	OK Cancel Environments Show H	telp >>
		ieip >>

🔨 Append		N		_	
 Input Datasets 		N			_
				-	3
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				<u> </u>	
				>	ς
				<u> </u>	
					_
				1	
🖕 Target Dataset					
				-	3
Schema Type (optional)					-
Field Map (optional)					<u>-</u>
				H	
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				1	
					- -
	ок	Cancel	Environments	Show Help	>>

9. In order for mesh tool to work, you will need to add a field called "StationNo" in attribute table of "Xsection3D" layer and copy the values from "Station" (aka ProfileM) column.

Table			
	· 🗄 • 🖫 👧	M 👘 🗙	
Ø9	Find & Replace		
5	Select By Attribute	es	th 146
M	Clear Selection		555
2	Switch Selection		274
	Select All		331 772
	Add Field		439
	Turn All Fields On		395 553
~	Show Field Aliases	;	374
	Arrange Tables		▶ 774 456
Add	Field	h	? ×
Nar	ne: StationN	0	
Тур			
1 YE	e: Double		
Fi	eld Properties		
-	Alias		
	Allow NULL Values Default Value	Yes	
		OK	Cancel

• Then right click on the "StationNo" column and select "Field Calculater".

XS	ection3D				
Γ	NodeName	XS2DID	Shape_Length	C4-4:	
	≺Null≻	7	20108.449146	Sort A:	scending
	≺Null>	8	18708.601555	🗾 🗾 Sort De	escending
	<null></null>	9	17434.154274	0 dy ap	ced Sorting
	≺Null>	10	17365.341331	Muvan	cea borang
	≺Null>	11	15878.007772	Summa	arize
	≺Null>	12	14577.279439	∑ Statist	ics
	≺Null>	13	12738.863395		
	≺Null>	14	11149.379553	📓 Field C	Nculator
	≺Null>	15	10715.034374	Calcula	NG até Geometry
	≺Null>	16	10696.043774		•
	<null></null>	17	9775.336456	Turn F	ield Off
	≺Null>	18	9761.197743	Freeze	/Unfreeze Column
	≺Null>	19	9583.124722	116626	
	≺Null>	20	9560.214133	X Delete	Field
	≺Null>	21	9072.153247	Duese a	b:
	≺Null>	22	8381.0213	Proper	des

• In "Field Calculator", double click "ProfileM" (aka Station) and OK to copy station values to "StationNo" column.

Field Calculator			? ×
Parser • VB Script Fields: OBJECTID Shape	C Python	К Туре: ⊙ Number	Functions: Abs () Atn ()
HydroID ProfileM RiverCode ReachCode LeftBank RightBank LLength ChLength RLength		C String C Date	Cos() Exp() Fix() Int() Log() Sin() Sqr() Tan()
Show Codeblock	_	*	/ & + - =
[ProfileM]			×
	Clear	Load	Save Help
			OK Cancel

10. In order to run mesh tool properly, you will need to flip directions of the "River" and "Xsection3D" lines before running the mesh tool by using "Flip Line" toolbox.

🔨 Flip Line				
Input Features				
				⊥ 🖻
				_
	ОК	Cancel	Environments	Show Help >>

11. You are now ready run mesh tool. Input appropriate parameters for the tool. More details are available in the tutorial here (<u>http://web.ics.purdue.edu/~vmerwade/research/bathymetry_tutorial.pdf</u>).

	Create Bathymetry Mesh		×		
	Input Layers Cross Section Layer	XSection3D			
	Centerline Layer	River			
	Boundary Layer	Banks_poly			
	Output Layers				
	3D Mesh Layer	Mesh			
	Parameters				
·	Avg. Channel Width	400			
	No. Profile Lines	41			
	Cross Section Spacing	200			
Mesh	×	OK Cancel			
Bachyme	etry interpolated successfully!			1	
	ОК			-	

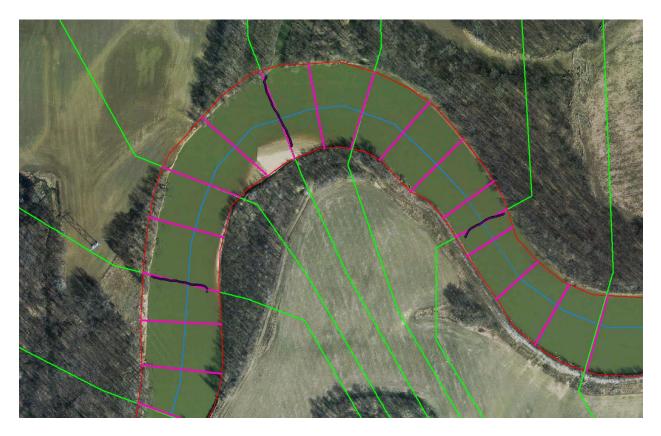
12. Elevation data points (x, y, z) from the mesh can be extracted by using "Feature Class Z to ASCII" toolbox (if any of you know of better toolbox, please let me know).

📕 n	nesh_	pts1_or	ig.txt	- Notepad	N			_ 🗆 🗙
File	Edit	Format	View	Help	hg			
291 291 291 291 291 291	0095 0255 0439 0643 0900 1157 1341	2398 6375 2746 9257 7799 2164	6084 0592 0584 7134 1642 1142	1298831 1298974 1299100 1299214 1299282 1299262	.52666426 .11725834 .53465643 .42517668 .29216693	453.27980000 453.72360000 454.16740000 454.61130000))))	
290 290 290 290 290 290 290	7820 7894 7944 7983 8015 8034	.2214 .9493 .0794 .0610 .2243 .6084	4501 1392 6501 1434 3584 8342	1287100 1287283 1287471 1287660 1287851 1288046	.56029684 .36209659 .36139251 .45615868 .02762793 .32120059	445.31370000))))	•

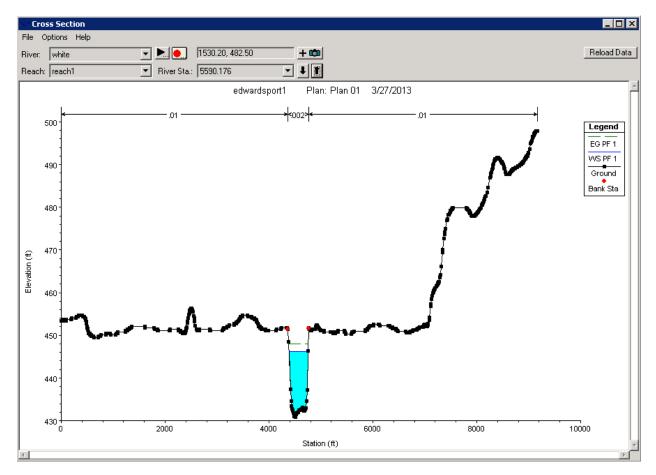
13. You will need to edit/delete the file to have xyz fields with NO additional row like shown above. Open the edited txt file in excel and add xyz column headings.

	А	В	С	D	E	F	
1	х	у	elev				
2	2907805.81399350	1287091.73255859	452.30				
З	2907811.46555701	1287103.28142001	452.13				
4	2907886.91094417	1287285.66163268	451.55				
5	2907936.21432325	1287473.27772726	450.96				
6	2907975.43734192	1287661.93122134	450.38				
7	2908007.69416717	1287852.12801943	449.79				
8	2908027.05633317	1288047.22605443	449.21				
9	2908035.98741767	1288217.38581909	448.73				
10	2908037.68032767	1288235.16235834	448.82				
11	2908026.15508825	1288402.82868968	449.35				_
i i	▶ ▶ mesh_pts1 /	1	*** **				

14. Create a point layer from the mesh points. Then add the point layer back in the GeoRAS ArcMap session (you may need to edit/delete some of the points depending on how close they are to each other). Add additional XScutlines for interpolated cross sections as needed in between the existing XScutlines. Re-run the GeoRAS geometry process as before, then "Update Elevations" using the mesh point layer to incorporate field surveyed and interpolated channel elevation data.



15. Export the GeoRAS geometry to RAS import file and review the cross section to verify that the field surveyed and interpolated channel bottom data have been applied reasonably.



Trouble Shooting

If you see an error message like this one below, click OK each one by one and at the end, you should get a message saying that tool ran successfully.

	reate Bathymetry Mesh	×
_	Input Layers	
	Cross Section Layer	Xsection3d
		Asectorist
	Centerline Layer	River 💌
	Boundary Layer	Banks polu
rogram In	terruption	×
Error in get	tting station number from me	easures: Index was outside the bounds of the array.
	Г	
		ОК
		ок
_	Avg. Channel Width	
-	Avg. Channel Width	ок 130
	Avg. Channel Width No. Profile Lines	
	No. Profile Lines	130 51
		130 51
	No. Profile Lines	130 51
	No. Profile Lines	130 51 200
	No. Profile Lines	130 51

Contact Information

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