Geomorphic Assessment Survey for the Fenton River Project

Example Geomorphic Assessment

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Geography 5310

Advanced Fluvial Geomorphology

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Introduction

A geomorphic assessment was conducted on the Fenton River. The Fenton River watershed is approximately 21,988 acres. The location of the geomorphic assessment took place in Mansfield, CT. The entire watershed spans in Mansfield, Chaplin, Willington, Ashford, and Union, CT. Land use around the river reach is mixed land use with residential homes surrounding, and runs along Chaffeeville Rd **(Fig 1)**. The Fenton River watershed lies in the Natchaug River sub basin and Thames River major basin. A geomorphic assessment was produced to determine if geomorphological change is occurring due to stream discharge, weather, anthropogenic, and etc. These channels are frequently subjected to floods and human influences, which include damming. For a stream reach on the Fenton River, 10 geomorphic surveys were conducted to monitor for geomorphic change **(Fig 2)**. Sites along the river were selected due to the presence of cut banks and the erosion. In this assessment surveys were conducted with a total station to measure elevation changes in each of the 10 ten cross sections. Sediment substrate was monitored for and characterized on each of the cross sections. Monitoring for potential changes were also noted. These included the presence of organic debris, tree uprooting, log jams, and etc. Results from each the surveys were graphed from the total station data, and analyzed for geomorphic changes. Pictures were taken at each of the cross s sections to monitored for any visual changes. Maps were created to monitor for sediment changes in the reach of the Fenton River.

Site History and Characterization

The surveyed reach comprises a bifurcation and reconnection of the Fenton River upstream of the historic Chaffeeville silk mill dam. The east bank flood plain of the Fenton is dominated by the spillway confining mound (Appendix 16) while the west bank floodplain is a wide wetland area traversed by many overflow pathways and ponds. Flow across the western floodplain is fed by an overflow path from upstream and by runoff channels from the surrounding hillside (Appendix 17). Well forested, there is an abundance of woody debris which heavily influences channel migration. The site was chosen because of recent changes in the dominant flow path of the Fenton. The primary flow of the Fenton River had previously followed the western-most channel (Appendix 2) until in recent years a large woody debris dam (Appendix 24) altered the primary flow into what was previously a large overflow channel. The now dominant channel is adjusting to the increased discharge as shown by active cut banks (Appendix 1). The straighter flow pathway of the dominant channel has allowed for more vertical erosion than the meandering older channel, clearing away more recent fine sediments and exposing hard packed glacial till, gravel and cobble in a fine matrix, in the channel bed nearest the main debris dam and cobbles and gravel dominating the channel bed. The old channel now receives only a fraction of the flow, with fine grained sediments and leaf litter accumulating with woody debris in the channel.

The studied reach has multiple anthropogenic influences on both the morphology and the sediment distribution. The surveyed site ends at the site of. The remnants of the earthen and stone dam still remain at the site (Appendix 19 and Appendix 20) constraining the east/west

position of the Fenton. The observed dominance of finer silts and clays as bank sediment farther from the dam (Appendix 3) suggests that there are still some of the impounded sediments accumulated within the historic mill pond left within the flood plain. More recently human influence on the reach likely came from the construction of a natural gas transmission pipeline in 1953 crosses through the western flood plain and beneath the Fenton close to the upstream extent of the surveyed reach (Appendix 20). The path of the gas line is cleared of trees (visible in Appendix 1 and Appendix 12) which reduces root shielding of the banks where it meets the Fenton, though this contact lies in the old channel and is likely inactive as it does show gullying from overland runoff channels (Cross Section 9 and Appendix 13). What likely impacted the upstream position of the Fenton would have been the construction and diversion necessary to place the gas pipeline beneath the Fenton where it crosses the river. However, from viewing historic aerial photography from before the emplacement of the pipeline it does appear the flow mostly returned to its pre-pipeline position.

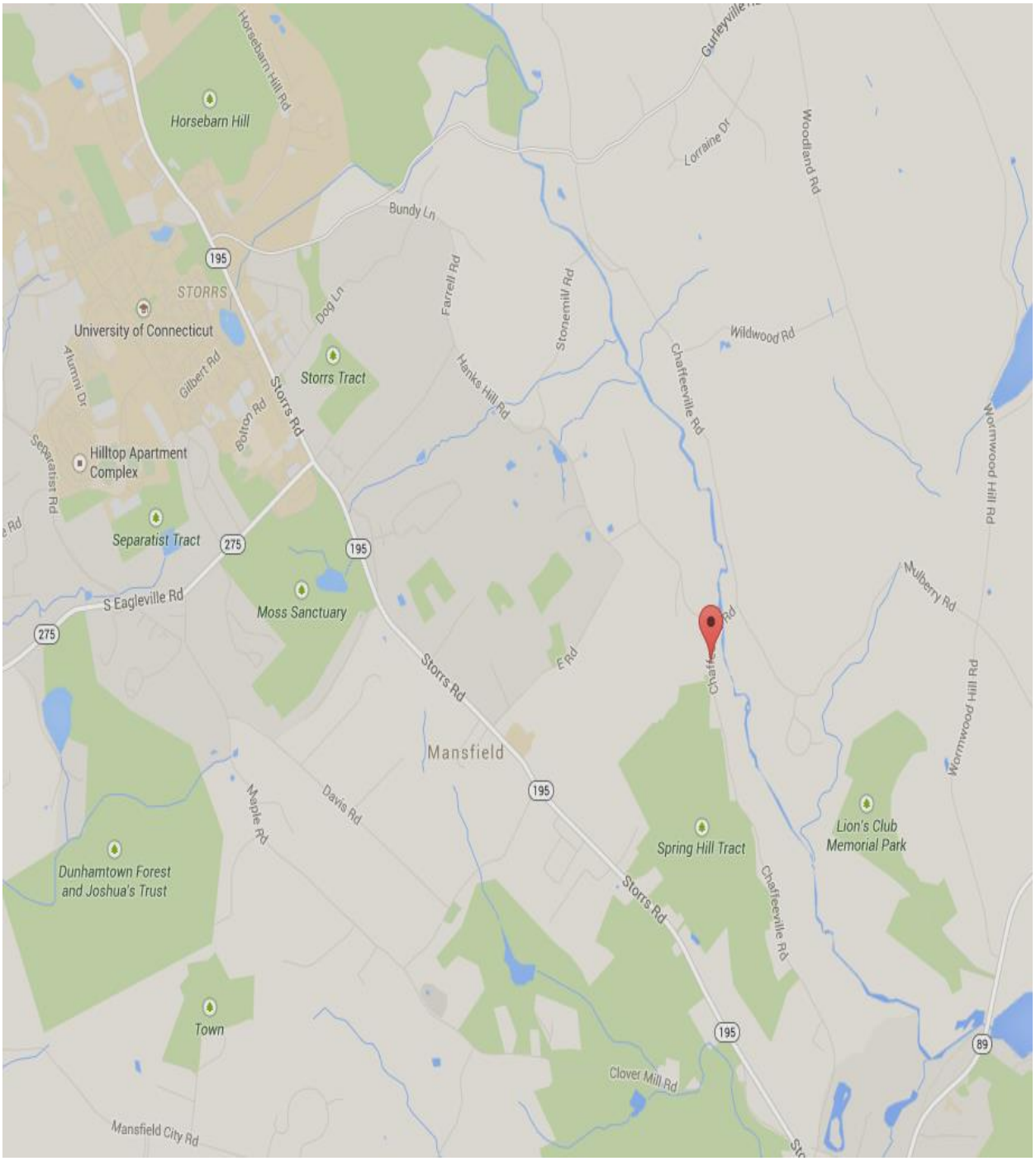


Figure 1 Location site of geomorphic assessment from Google Maps in the Fenton River

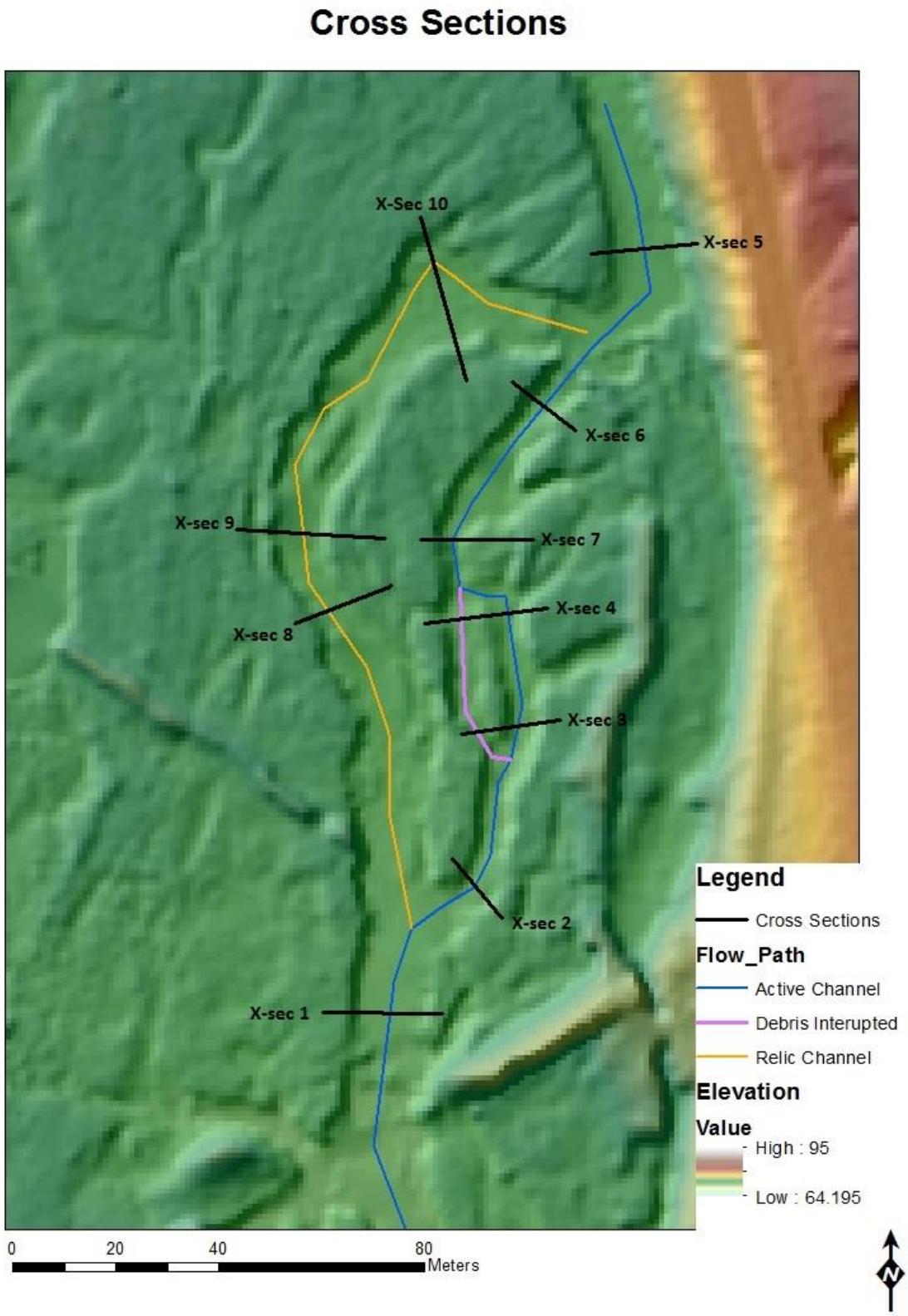


Figure 2 Locations of geomorphic assessment cross sections in the Fenton River

Cross Section 1

Cross section 1 was surveyed the most downstream of all sites. The profile of the stream was measured from a distance of 19.45 meters from each flood plain above the banks **(Fig 3)**. The channel was a chosen as a base profile for the geomorphic assessment. The general geomorphology of the stream is characterized as straight. The substrate of the stream consisted of sand and cobble. On the flood plain on the farthest side of the bank consisted mainly of cobble and sand under the loamy bank. The depth profile of the stream had a varied relief. Along the banks, the highest elevation was 100.07m on the near side and highest was 100.135m on the traversing side. At a distance of 15.1m is where the water level was and its elevation was 99.26m. The deepest point in the channel profile 98.953m.

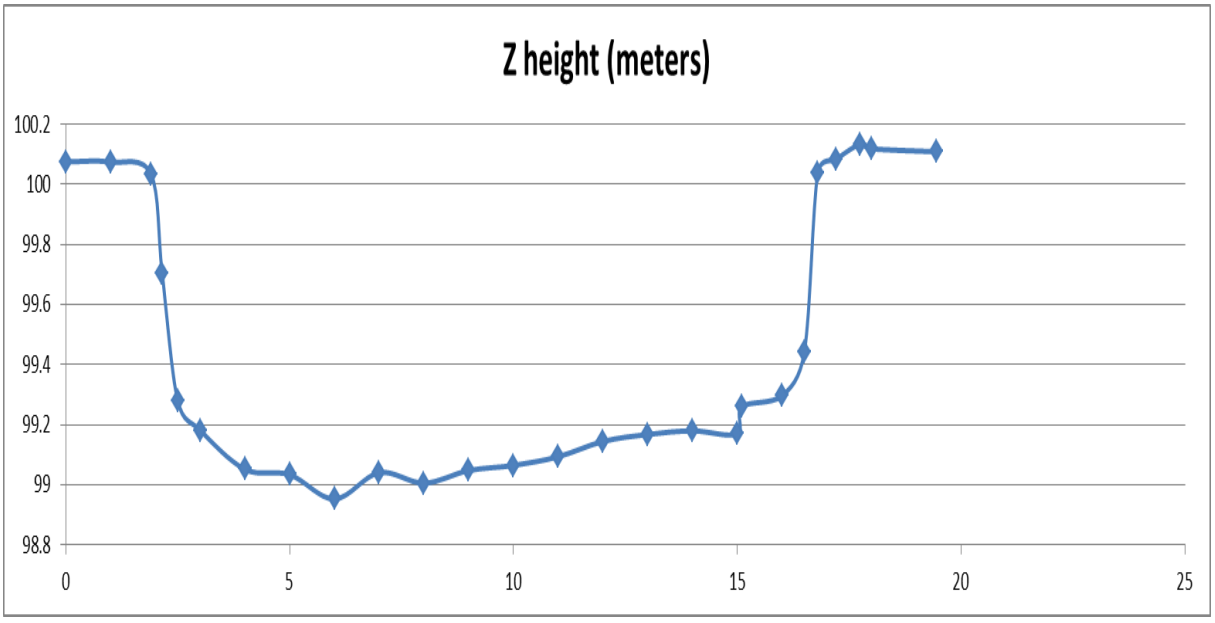


Fig 3 Cross section 1elevation gradient

Figure 4 Area of cross section 1

Cross Section 2

Cross section 2 was surveyed above the first site and downstream of the other survey sites. The location of the site was 41.79536 North and 72.20973 West. The entire channel profile of the stream was measured at distance form 12.45m from both sides of the flood plains above the banks **(Fig 5)**. This channel was surveyed due to its presence erosion on the bank. The cut bank was apparent and subjected to high flow activity and probable backflow from the stream. The substrate of the stream varied along the profile. On the near side of the channel was

undercutting with a minor slump. Along the channel of the cross section, the sediments were clay, gravel, cobble, and eventually gravel and sand mixture. This change in substrate occurs within a few meters. On the traverse side of the channel, there is an island between the new and old channel. The island is composed of different soil types. The depth profile of stream varied between the floodplains on each of the sides. Beginning on the nearest side the highest elevation was 100.01m and highest at 99.728 on the traverse side. The water levels reached from 2.2m to 9.4 meters. The deepest point the channel profile was 98.005m. This deep point was characteristic of the entire relief of the profile. Also noted upstream of the channel was large cobbles and small boulders greater than 30cm.

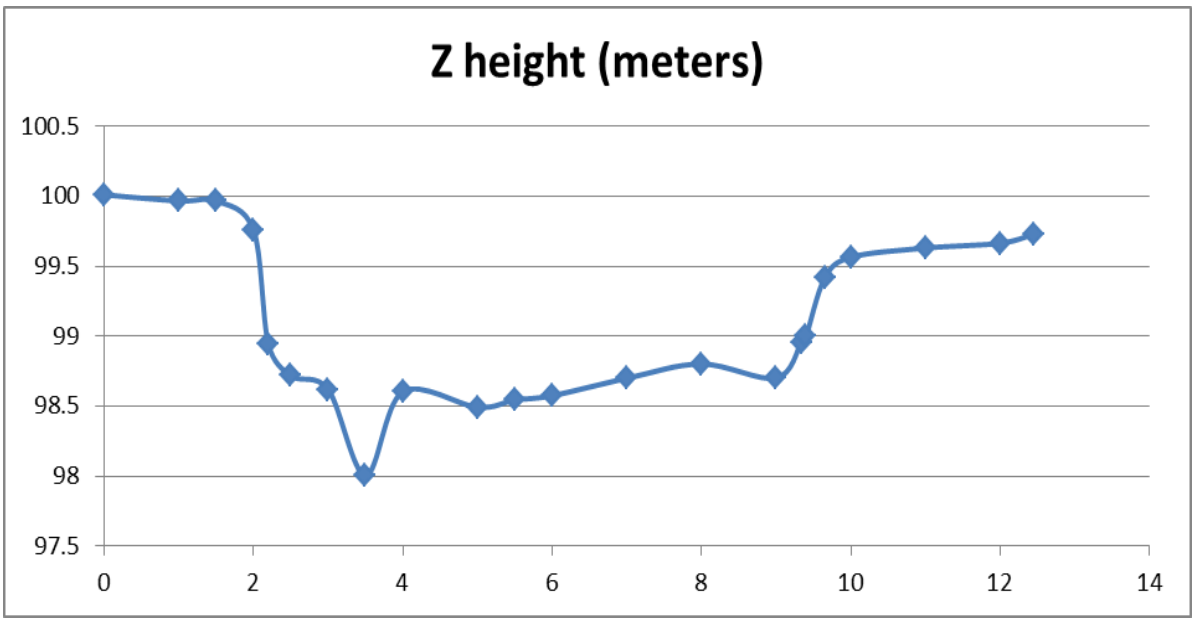


Figure 5 Cross section 2 elevation gradient

Figure 6 Area of cross section 2

Cross Section 3

Cross section 3 was surveyed downstream above sites 1 and 2. The location was 41.79559 N and 72.2053 W. The channel was surveyed for geomorphic change due to its high erosion activity along the banks. This channel was bisected with a new stream flow path created, due to the old channel being impeded by a notable log jam. Upstream of the survey was a major debris dam diversion that caused the flow path change downstream. The survey was conducted at the length of 18.6m from the flood plains of each side of the stream **(Fig 7)**. On the nearest

side of the channel there was a noticeable cut bank which consisted of loam and clay. The substrate in the stream varied with from the nearest banks being a mixture of clay, cobbles, and sand. In the middle of the stream, the substrate was a mixture of cobble and gravel varying in different sizes. The far side of the channel was the bank island body. There was also secondary overflow on this island. The depth profile of the channel varied. Along the nearest flood plain the highest elevation was 99.976m and on the far side of the channel the elevation was 99.498m. The deepest points in the stream were 98.783m in the main channel and in the minor channel before the island body was 98.961m.

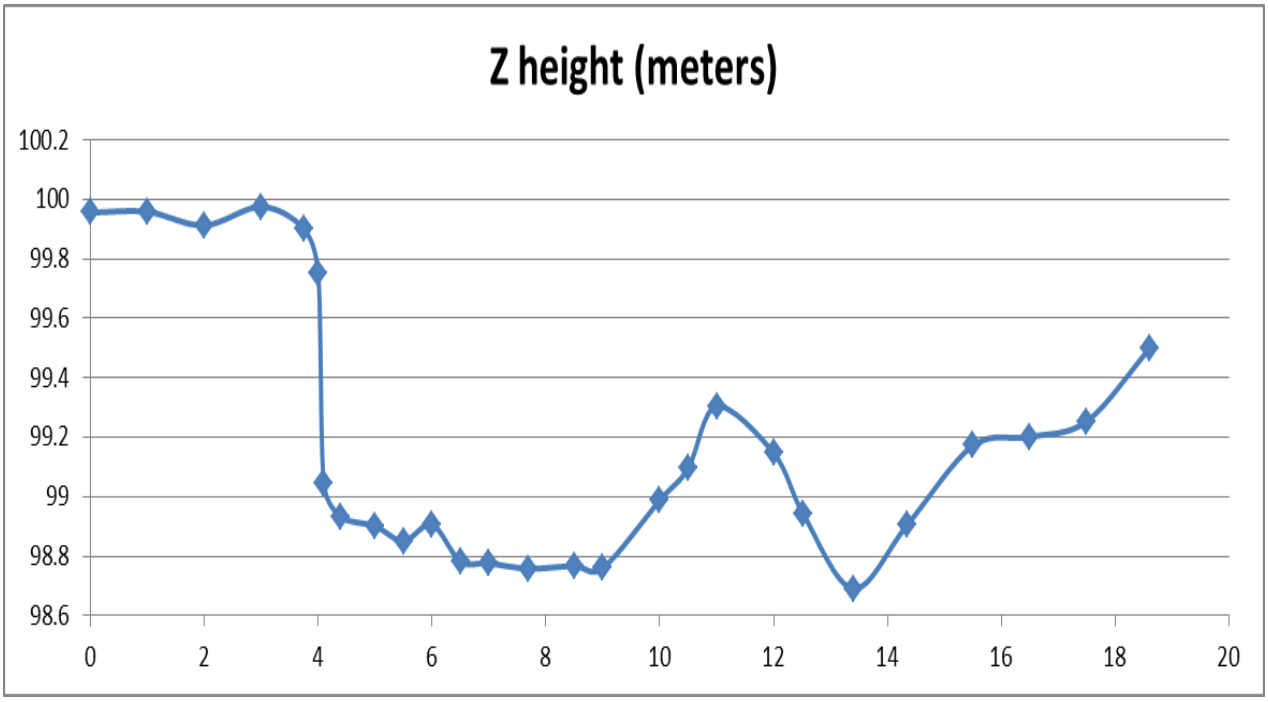


Figure 7 Cross section 3 elevation gradient

Figure 8 Area of cross section 3

Cross Section 4

Cross section 4 was surveyed downstream and above sites 1, 2, and 3. The location of the site survey was 41.79579 North and 72.20931 West. This channel exhibited a cut bank with high erosion activity. The channel was downstream of the upstream flow diversion. The geomorphic survey was conducted at a distance of 9.6m from each side of the flood plains **(Fig 9)**. The water level was from a distance 2.8m in to 7.3m. The substrate of the channel varied from each banks. On the nearest bank, there was an overhang with finer till, sand, and gravel sediments. In the middle of the stream towards the farther side the bed sediment was mostly gravel sediments. The depth profile exhibited a great slope from the nearest bank into water.

The highest elevation on the nearest flood plain was 100.126m and highest at 99.357m on the farthest side where the tip of an island body occurs. The deepest point the channel was 98.668m.

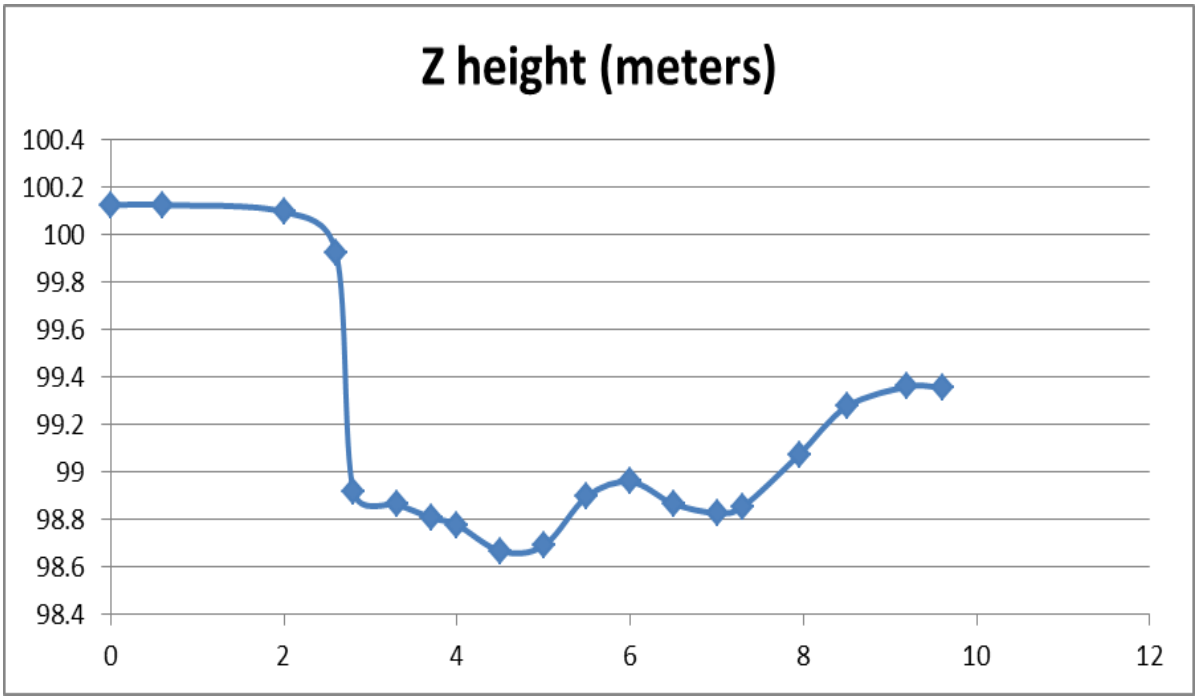


Figure 9 Cross section 4 elevation gradient

Figure 10 Area of cross section 4

Cross Section 5

Cross section 5 was surveyed upstream above all other sites. The site was located upstream of the debris jam, where the old and new channel forms. The geomorphology of this cross section of the stream is characterized as a straight channel. The geomorphic survey was conducted at distance of 18.5m from each of the flood plains on the channels **(Fig 11)**. The substrate of the stream varied. On the near side of the channel the water level begins at 2.6m with cobble rock mainly in the bed sediment. 6.5m into the stream, there was the presence of a large boulder. The far side of the channel was gravel sediments with an old point bar. The highest elevation on the near side was 100.8m and on the farther side of the channel the highest elevation was 100.055m. The deepest point in the stream was 98.646m.

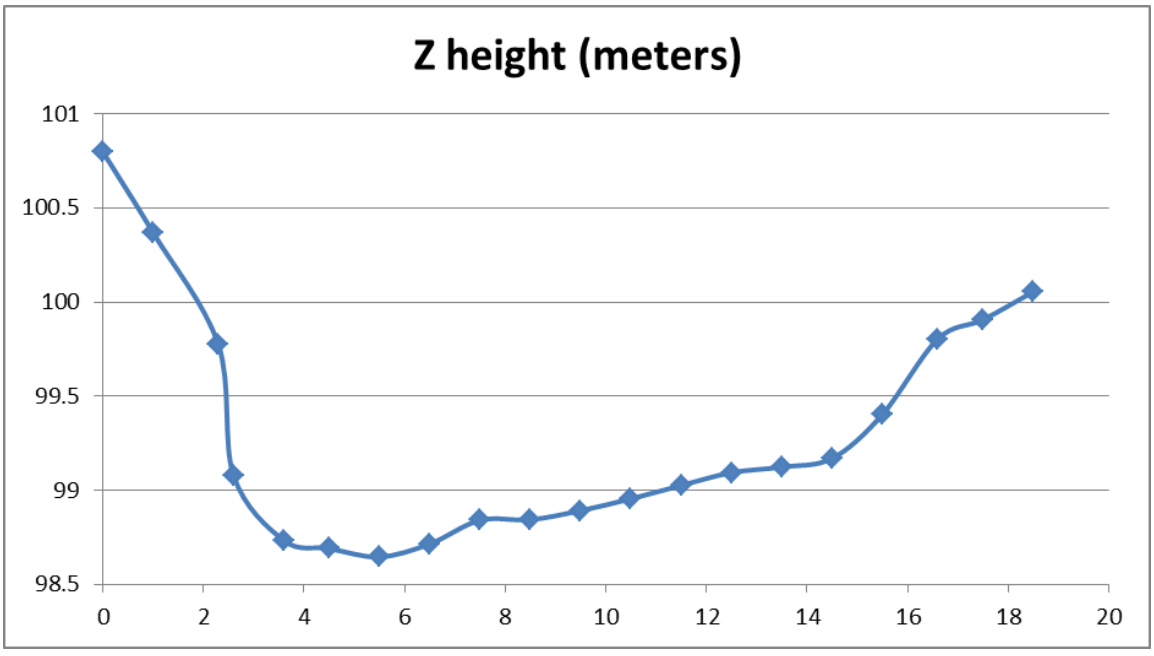


Figure 11 Cross section 5 elevation gradient

Figure 12 Area of cross section 5

Cross Section 6

Cross section 6 was surveyed upstream just below site 5. The cross section was in the primary channel approximately 5m downstream of the debris dam where it redirects stream flow. The survey of the cross section was 16.39m for each flood plain of the channels **(Fig 13)**. The substrate varied in sediments. On the near side of the floodplain there was noticeable flood debris. At 6.5m the water level begins and is mainly composed of cobbles. At 8m in, there were large rocks and cobbles greater than 30cm. On the far side of the channel before the flood plain the substrate is mixed gravel with a small cobble bar. There is a cut bank that overhangs on submerged clay and silt before the island body of the flood plain. The cut bank overhangs approximately 56cm over the stream. The highest elevation for the near side of the flood plain

was 99.624m and highest on the far side, on the island was 99.749m. The deepest point of the stream was 98.538m.

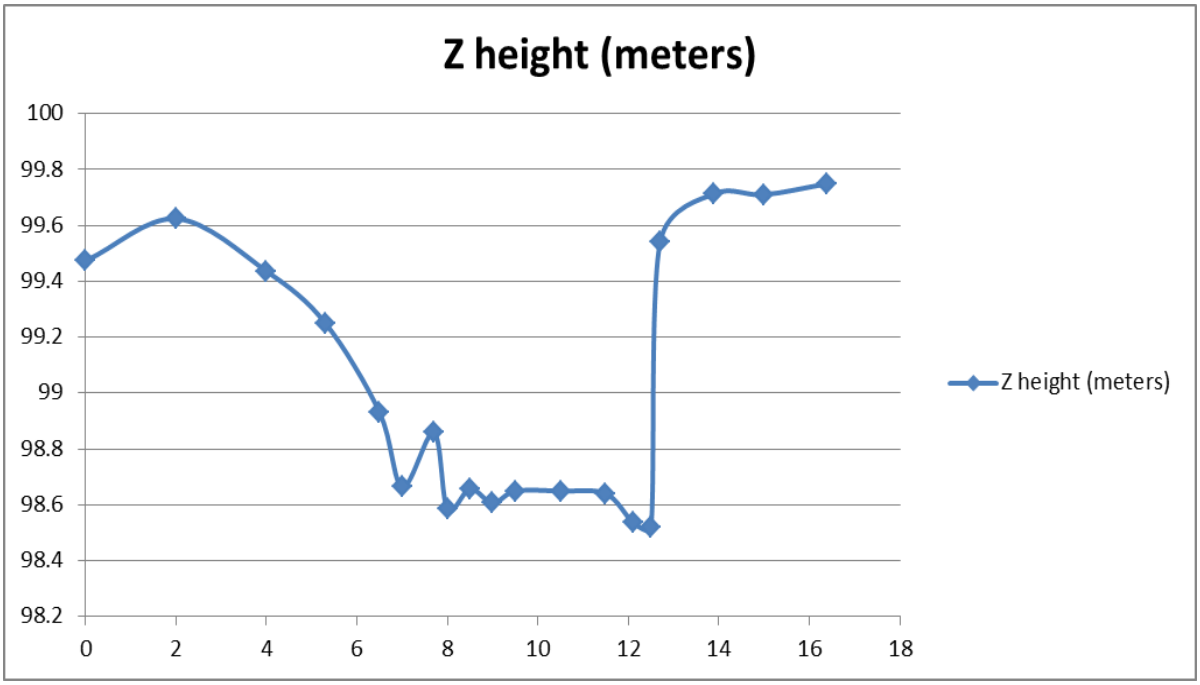


Figure 13 Cross section 6 elevation gradient

Figure 14 Area of cross section 6

Cross Section 7

Cross section 7 was surveyed upstream and below sites 6 and 5. The channel could be characterized as a meander bend that includes a "grassy" point bar like feature. The geomorphic survey was conducted at a distance of 20.2m from the flood plains of the channel **(Fig 15)**. The substrate sediments varied from one side of the channel to the other. On the near side of the channel there was a point bar predominately of soil. At 12.8m, where the water level begins soil is present, but transitions into sand and gravel. On the far side of the channel, the substrate is compacted silt and clay. The far side of the channel has a cut bank that reaches the island flood plain. The highest elevation on the near side is 99.79m on the flood plain and highest at 99.587m on the flood plain of the island. The deepest point of the stream was 98.15m.

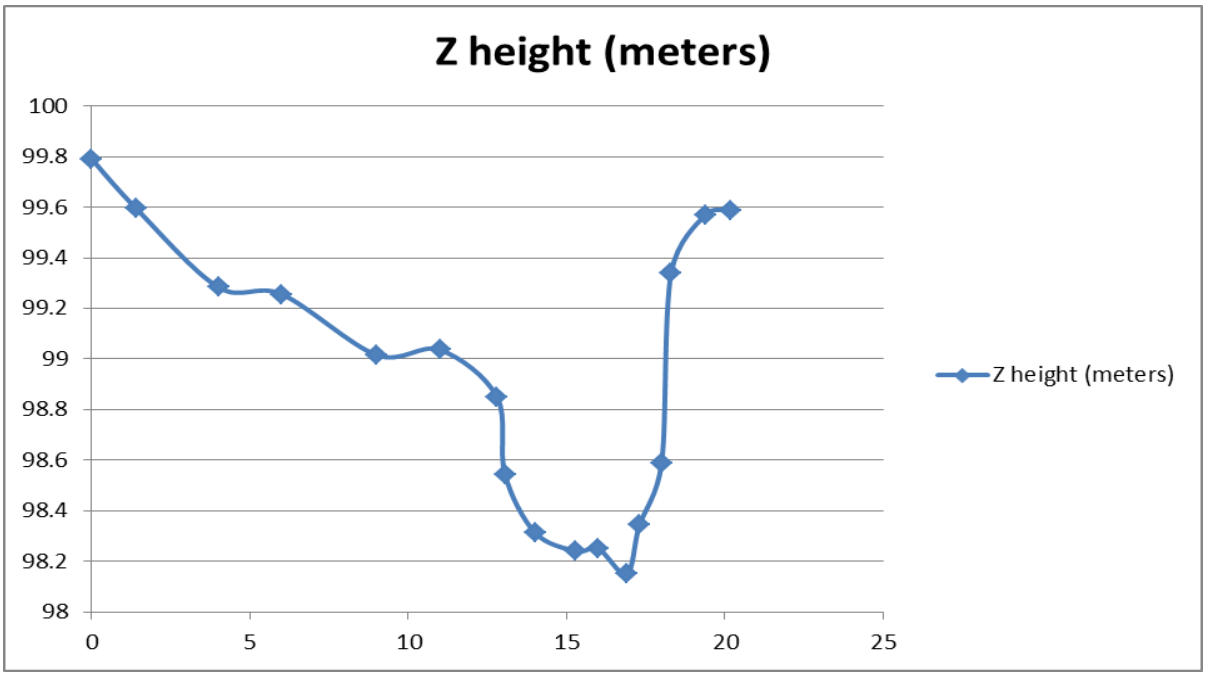


Figure 15 Cross section 7 elevation gradient

Figure 16 Area of cross section 7

Cross Section 8

Cross section 8 was surveyed on the old channel upstream of sites 1, 2, 3, and 4 in the new channel. The location of the cross section was 41.7957 North and 72.2099 West. The geomorphology of channel can be characterized as an inactive, with an undercut bank. The geomorphic survey was conducted at a distance of 16.4m from the island flood plain to flood plain, traverse of the channel **(Fig 17)**. The substrate of the stream varied in sediments and organic matter. On the near side of the channel there was terracing up to the water level 5.5m in. In the middle of the stream was an accumulation of leaves on the substrate. On the far side of the channel, the substrate becomes sandy. Before the far floodplain there is an overhanging of

the bank. The highest elevation on the near flood plain is 99.839m and highest at 100.035m on the far flood plain. The deepest point in the stream was 98.391m.

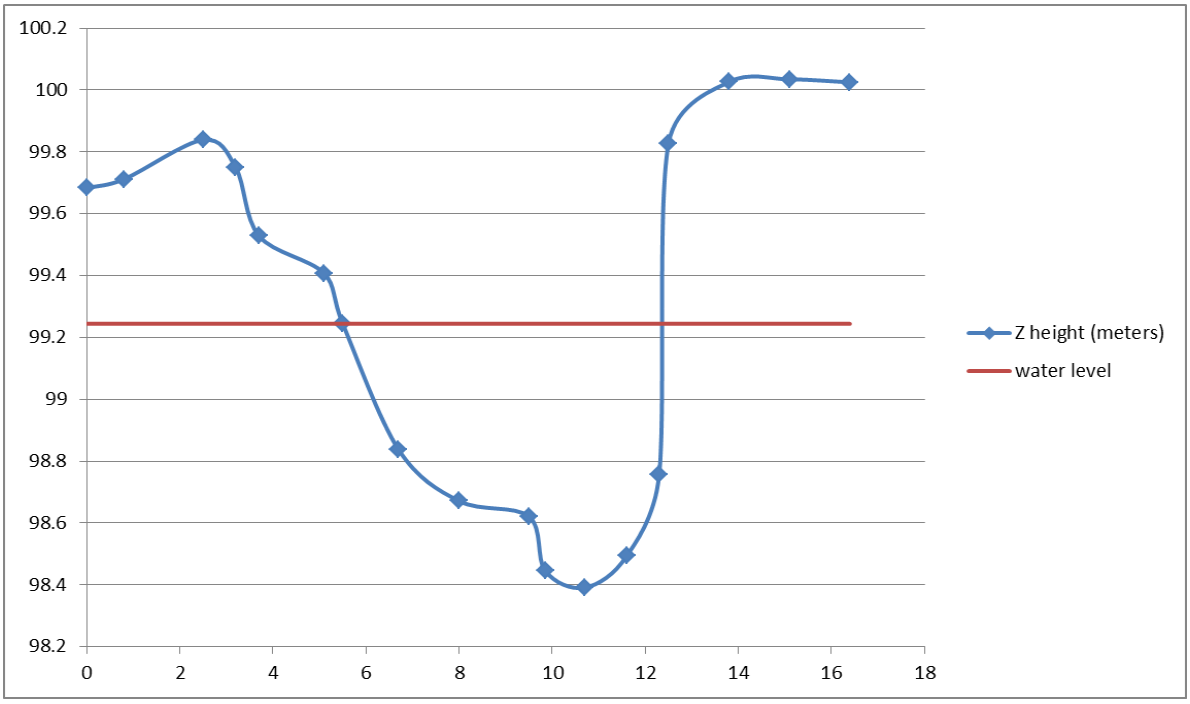


Figure 17 Cross section 8 elevation gradient

Figure 18 Area of cross section 8

Cross Section 9

Cross section 9 was surveyed upstream of site 8 in the old channel, and above sites 1, 2, 3, and 4 in the new channel. The location of the cross section was 41.79592 North and 72.2017 West. The geomorphic survey was conducted at a distance of 18.1m from the island flood plain to the flood plain traversing the channel **(Fig 19)**. The substrate of channel was mixed from one end to the other. In the near channel after the flood plain there was terracing, and the water level began 5m in. For a few meters the substrate consisted of leaves. In the middle of channel the substrate becomes sandy with some gravel. On the far side of the channel the sand becomes mixed with compacted silty clay. Before the flood plain begins there is a small clay overhang. On the far flood plain there is small overland drainage channel in cleared gas line path. The highest elevation on the near flood plain was 99.92m and highest at 99.992m on the farthest flood plain. The deepest point in the channel was 98.204m.

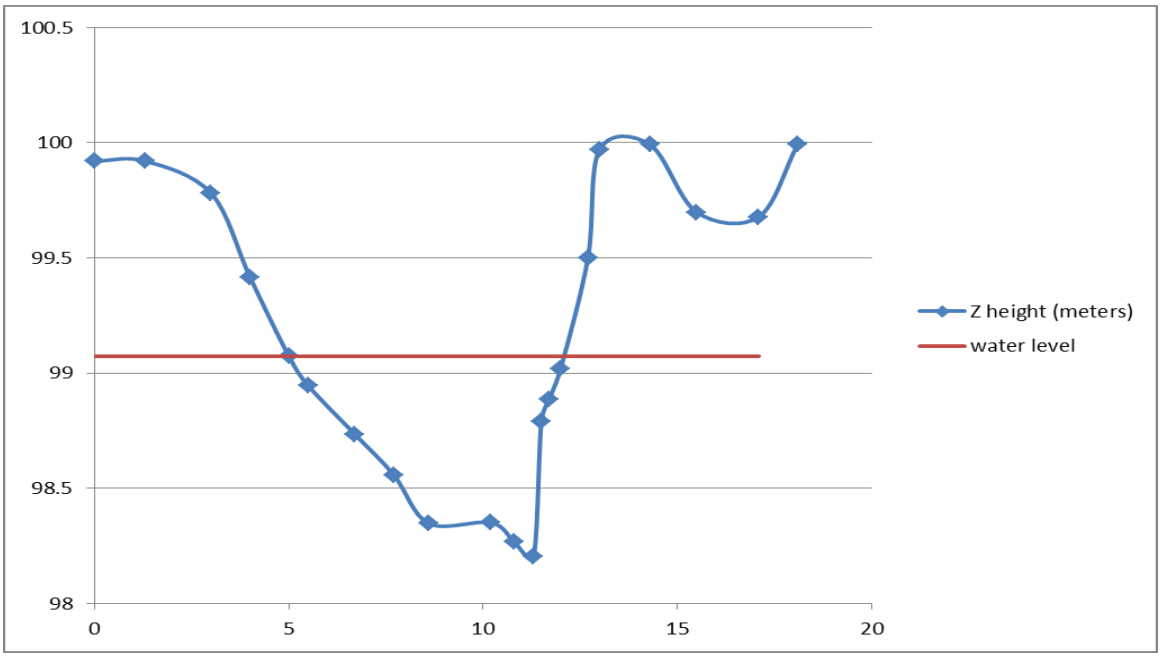


Figure 19 Cross section of site 9

Figure 20 Area of cross section 9

Cross Section 10

Cross section 10 was surveyed upstream of sites 8 and 9 in the old channel above all sites in the new channel except for site 5. The location of the site was 41.79589 North and 72.2012 West. The geomorphology of the cross section could be characterized as a stream cutting across a flood bar and splitting the main channel creating a "C bend". The geomorphic survey was conducted at a distance of 29.5m from the flood plains of the channel **(Fig 21)**. The substrate varied along the channel. On the near side of the channel after the bankfull, the bottom bank substrate was soil and gravel. After a high water level 4.4m in, a gravel flood bar is present in the stream. At 12.55m in there is a remnant of fallen tree. In the middle stream the substrate becomes gravel and then sand. After an accumulation of leaves, there is a sub-channel that

forms on the far side of the channel. The substrate on this end is mostly sand and some gravel. Before the flood plain the substrate is sandy and silty soil. The highest elevation between flood plains are 100.417m for the nearest and 100.426m for the farthest. The deepest point in the stream was 98.982m.

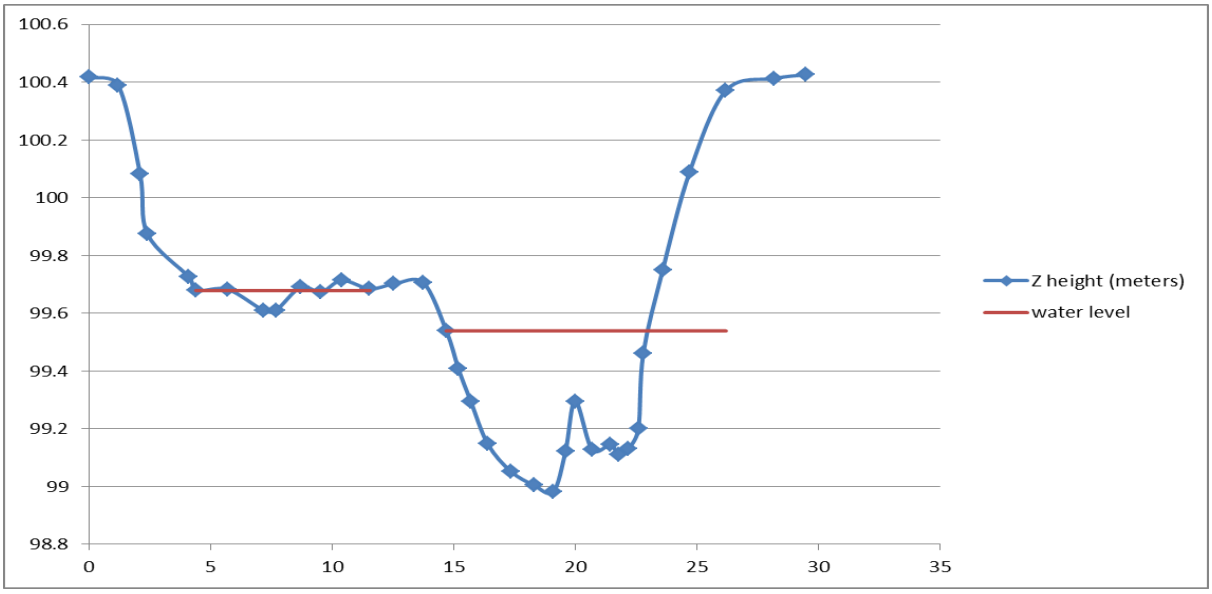


Figure 21 Cross section of site 10

Figure 22 Area of cross section 10

APPENDIX 1

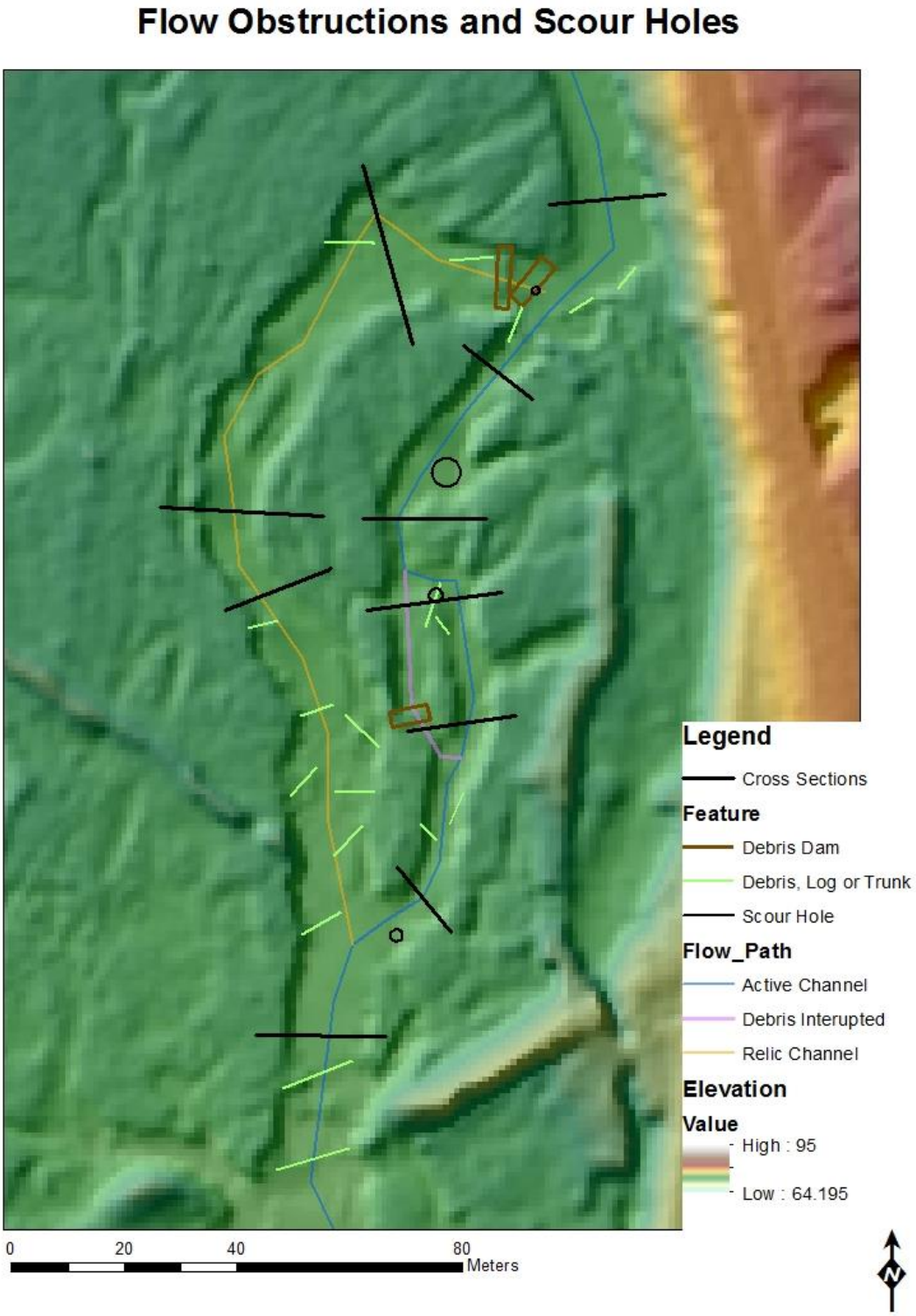
Summary of Cross Sections					
Channel Side	**Cross Section**	**Channel Width (m)**	**Mean Depth (m)**	**Max Depth (m)**	**Description**
Primary Channel	1	14.9	0.78	1.09	Downstream edge of reach, straight channel no side channels
Primary Channel	2	8	0.73	1.56	Backflow carved cut-bank
Primary Channel	3	7	0.33	0.55	connection with straighter
Primary Channel	4, main flow	6.6	0.51	0.69	cut bank with gravel bar in
Primary Channel	4, blocked flow	7	0.47	0.58	
Primary Channel	5	14.3	0.75	1.16	Upstream of Main debris
Primary Channel	6	8	0.72	1.02	about 5m downstream of debris dam re-direction of flow, cut bank on west bank, partially cut bank east bank
Primary Channel	7	7.3	0.77	1.19	meander bend and grassy point bar like feature composed of silty/and
Old Channel	8	10	0.83	1.44	inactive undercut bank with exposed packed silt
Old Channel	9	10	1.05	1.77	section with exposed
Old Channel	10	22.6	0.6	1.066	cut across large gravel body (flood bar) and split main channel creating C bend and cresenct bar of soil between flows where leaves have accumulated

Summary all cross sections for the geomorphic survey in the reach of the Fenton River

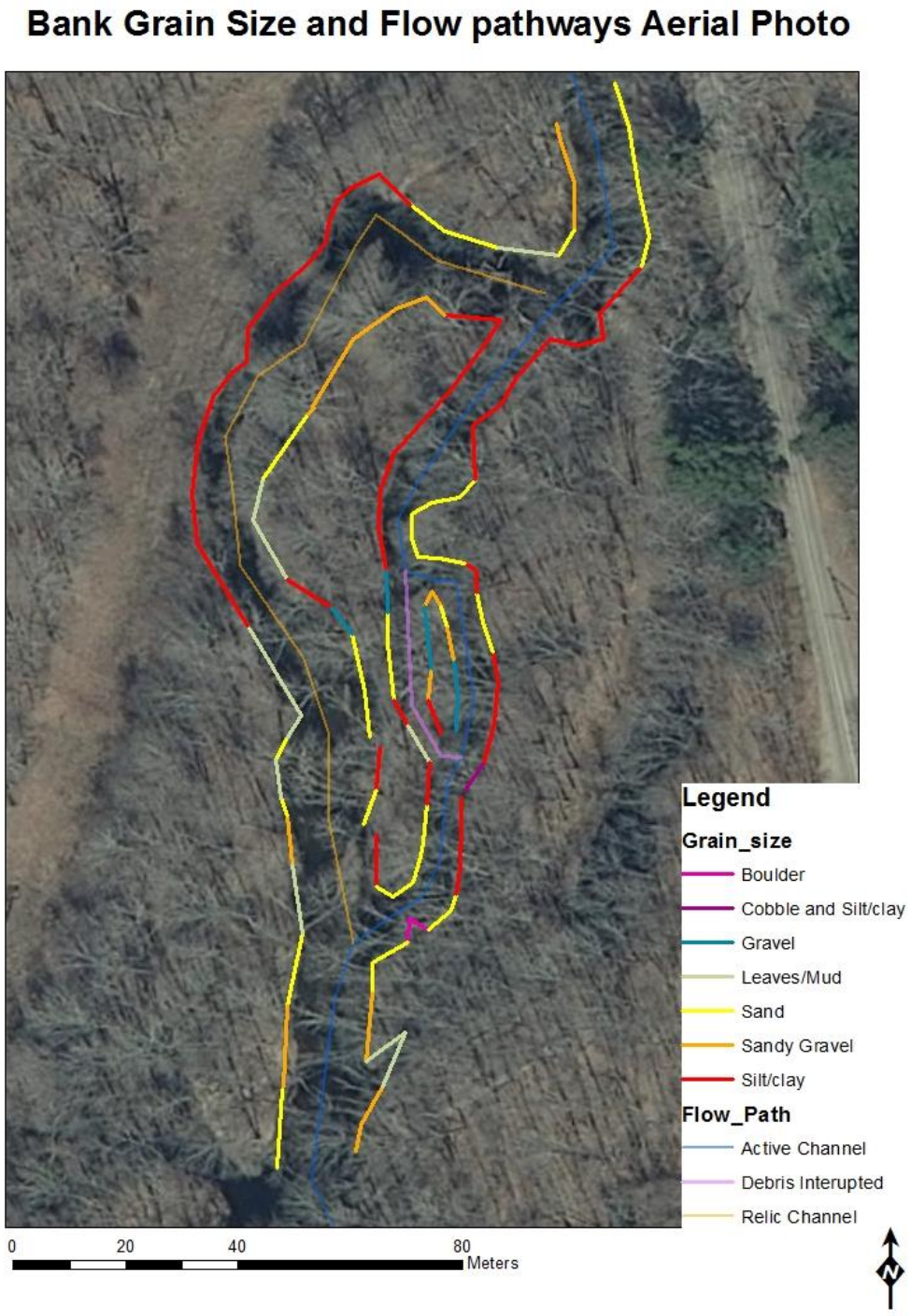
APPENDIX 2


Cross Sections
Gas Line Path
X-sec 10
X-Sec 5
X-sec 6
X-sec 9
X-sec 7
X-sec 4
X-sec 8
X-sec 3
Gas Line Path
X-sec 2
X-sec 1
Legend
Cross Sections
Geomorph
Cut Bank
Mid Channel Bar
Point Bar
Tree Roots
Vegetated Bar
Vertical Bank
0
20
40
80
Meters
N

APPENDIX 3

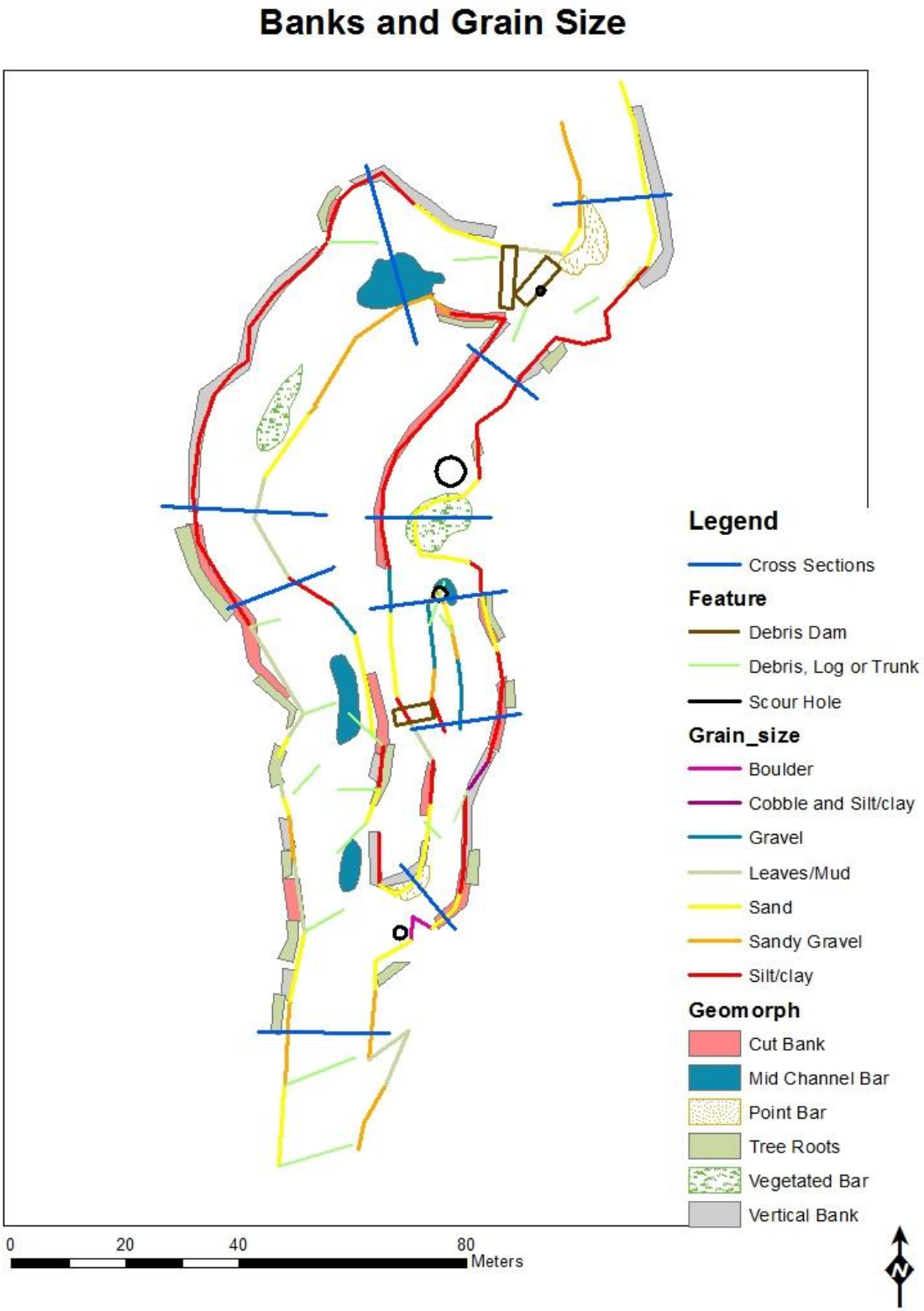

Flow Obstructions and Scour Holes
Legend
Cross Sections
Feature
Debris Dam
Debris, Log or Trunk
Scour Hole
Flow_Path
Active Channel
Debris Interupted
Relic Channel
Elevation
Value
High : 95
Low : 64.195
0
20
40
80
Meters
N

APPENDIX 4



The exposed sands still within the banks were primarily composed of very fine grained sand, understandable due to the higher cohesion of the smaller grains.

APPENDIX 5


Banks and Grain Size
Legend
Cross Sections
Feature
Debris Dam
Debris, Log or Trunk
Scour Hole
Grain_size
Boulder
Cobble and Silt/clay
Gravel
Leaves/Mud
Sand
Sandy Gravel
Silt/clay
Geomorph
Cut Bank
Mid Channel Bar
Point Bar
Tree Roots
Vegetated Bar
Vertical Bank
0
20
40
80
Meters
N

APPENDIX 6

Looking upstream at channel upstream of surveyed reach, photo taken from east bank of westward curve of the channel

APPENDIX 7

Looking west at island tip where large debris dam (on right) diverts flow into newer channel (left) a small flow can be seen entering the previous main channel which continues on the west side of the island.
Below: view of same debris dam from Cross Section 5. On the right is the relic point bar from when the area was a westward meander. On the left is the fenton continues into the newer primary flow path.

APPENDIX 8

Above: Looking west, downstream from on top of the major debris dam toward the mostly abandoned previous channel
Below: Within the abandoned channel looking toward the east at the downstream side of the debris dam

APPENDIX 9

Downstream of debris dam in old channel closer view of flow bifurcation as it flows from a gravel bar into a crescent soil and leaf bar which showed the presence of root structures. This feature could possibly have been a historic bank before the flow was diverted upstream. Most of what little flow passes the debris dam passes along the far side of the curve, eroding into the exposed soils there. This area is bisected by cross section 10 which crosses the leaf covered bar just left of the center of field.

APPENDIX 10

Trees slumping into channel with the north bank/west bank of Cross Section 10 visible. The trees are slumping from an inactive cut bank on the West bank

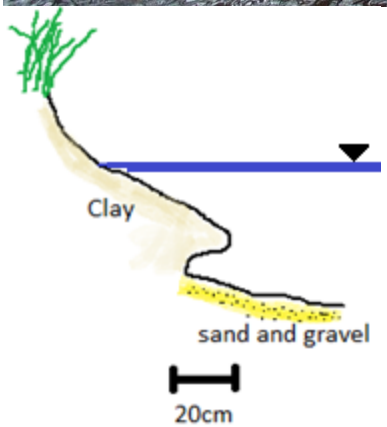
APPENDIX 11

View downstream from Cross Section 10. On left is gravel and sand mid channel bar blocking flow, possibly a point bar formed before the flow was diverted to a different channel. The right bank (west) shows inactive cut banks and trees slumping into the channel. In the far center field is a vegetated bar bounded shown in APPENDIX__ (next page)

APPENDIX 12

Vegetated bar in old flow channel bounded on the east (Top) by a now dry bed of sand and fine gravel and on west (Bottom) by the remnants flow within the channel with fine sand, silts. Both sides are now accumulating leaves and leaf derived muds.

APPENDIX 13



Looking toward the West bank in the relic channel. Note slumping trees from inactive cut banks and exposed banks. Above the exposed clays is looking down the tree cleared path of the gas line. The visible silt/clay is hard packed and continues underwater where there is a small undercut as described by the schematic.

APPENDIX 14

APPENDIX 15

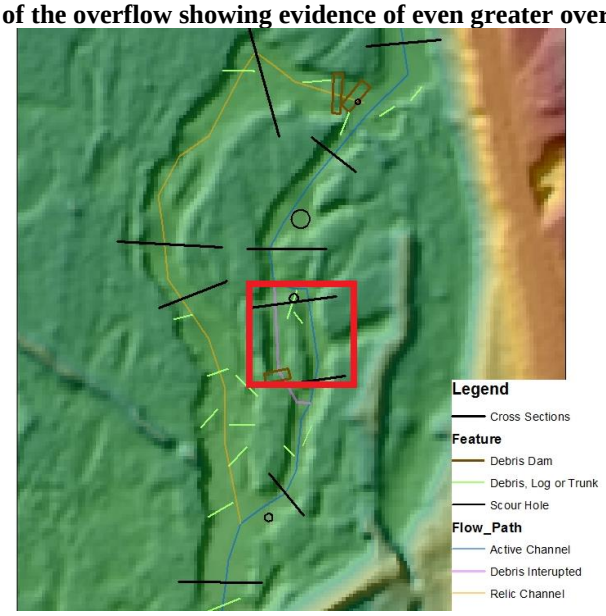
In the old channel viewing downstream from cross section 8. Reduced flow here has left many slumping trees which would otherwise have been cleared by floodwaters. The density of woody debris has created complicated flow paths around sand and gravel bars with thick accumulations of leaves in slower areas.

APPENDIX 16

Top: looking downstream toward island with debris interrupted flow (right) and main flow (left), region covered by cross section 4.
Bottom: looking upstream at the same island with the debris dam blocking the flow visible on left and the main flow curving around the island on the right (east), downstream tip of island and both flow structures encompassed in cross section 3.

APPENDIX 17

Looking from the east bank at the bifurcated flow, far is the debris dam blocked channel and close is the main channel. Overflow is seen crossing the island between the two channels with flattened grass on the right of the overflow showing evidence of even greater overflows from the blocked channel into the main channel.



APPENDIX 18

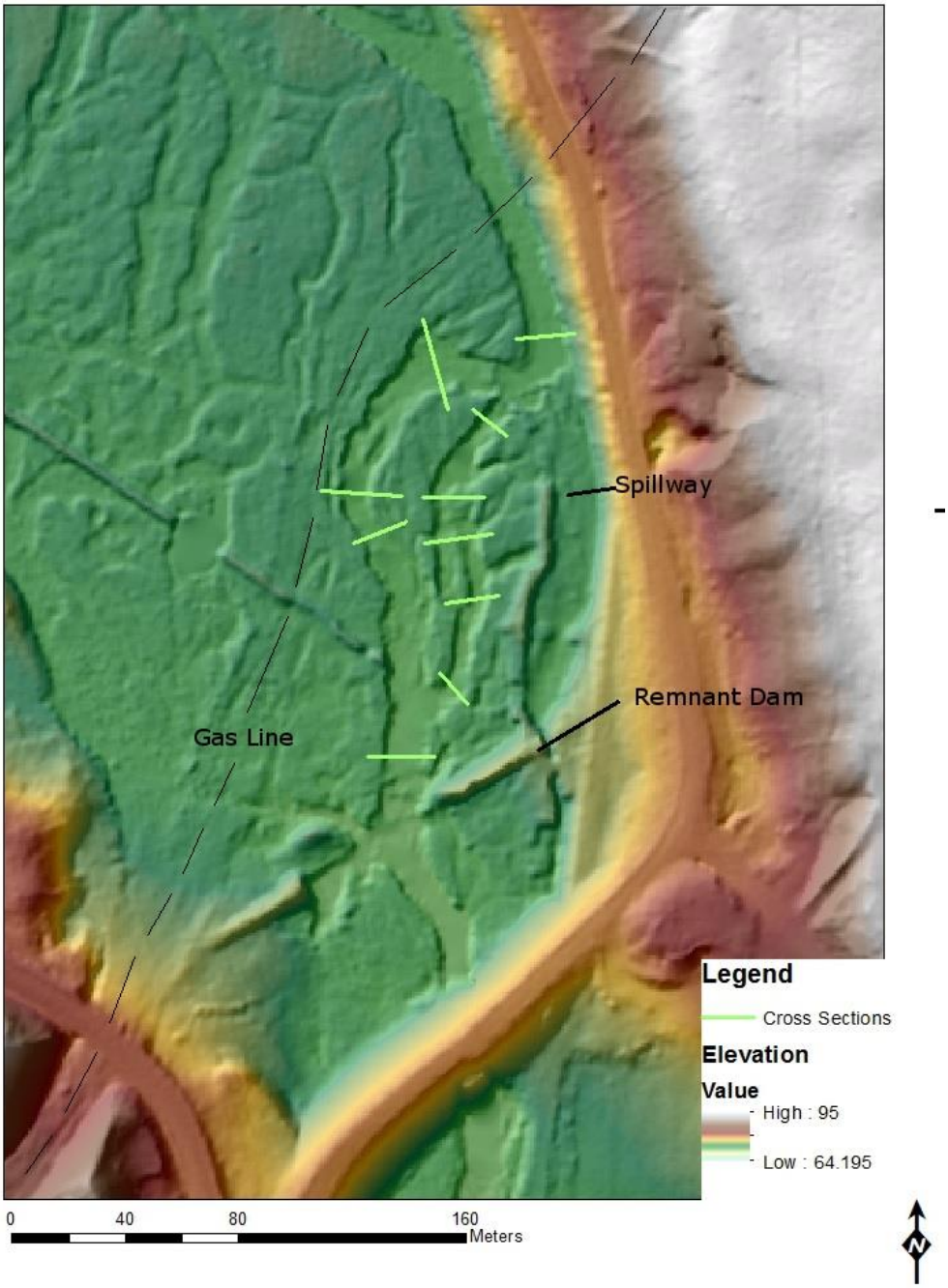
APPENDIX 19

APPENDIX 20

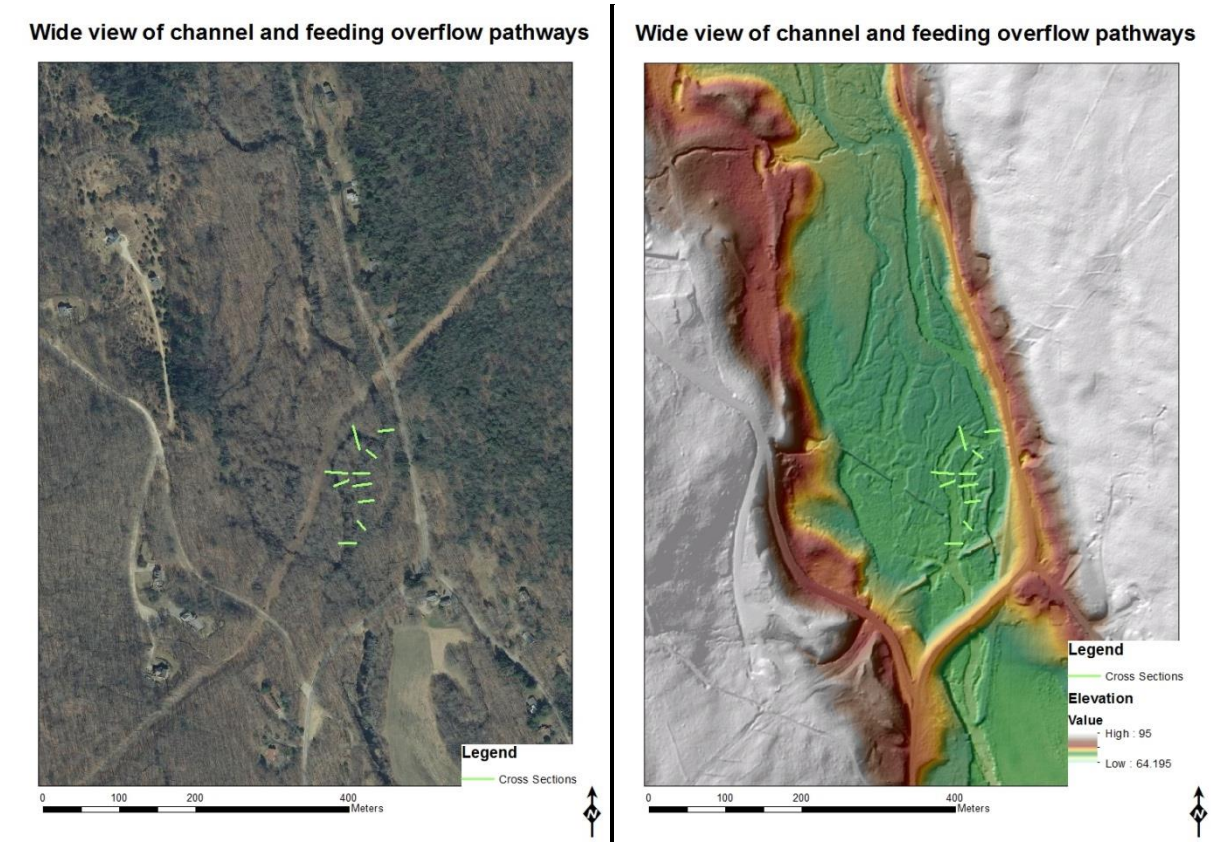
APPENDIX 21

Views from top of Old Mill Pond dam. Top: looking back toward Chaffeeville road vertical drop to the right side of the path, the earthen slope signifying the submerged side of the dam on left side of the path. Bottom: Looking west across the Fenton from the end of the dam toward the continuation of the dam on the far West bank.

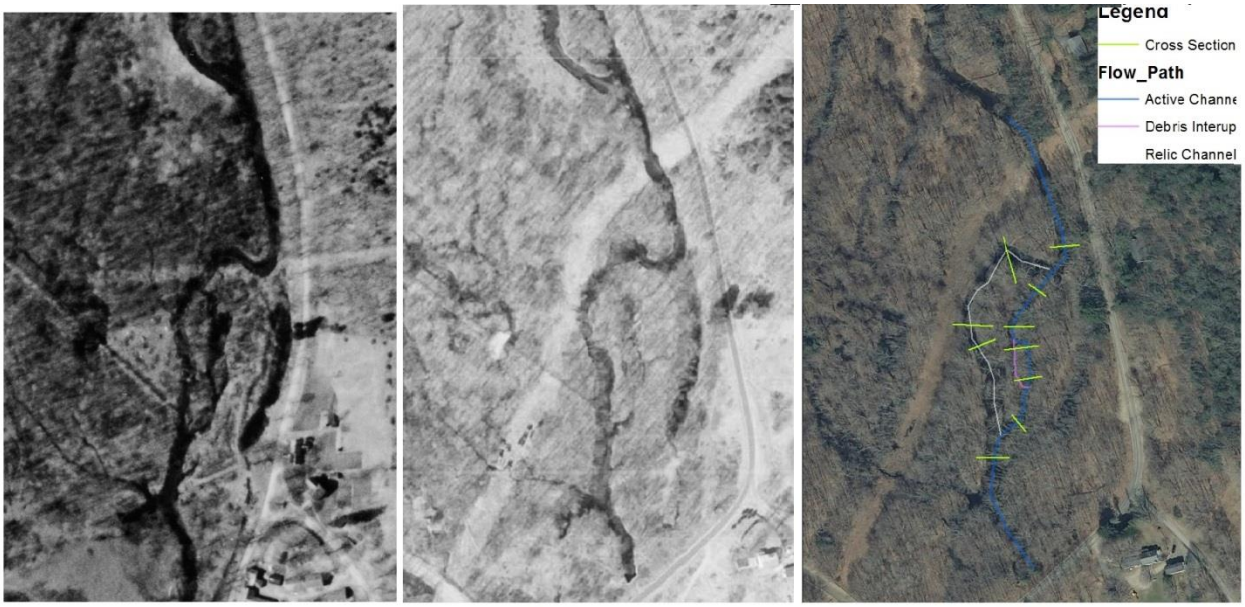
APPENDIX 22


Spillway
Remnant Dam
Gas Line
Legend
Cross Sections
Elevation
Value
High : 95
Low : 64.195
0
40
80
160
Meters
N

APPENDIX 23


Wide view of channel and feeding overflow pathways
Legend
Cross Sections
0
100
200
400
Meters
Wide view of channel and feeding overflow pathways
Legend
Cross Sections
Elevation
Value
High : 95
Low : 64.195
0
100
200
400
Meters

APPENDIX 24



Aerial photos of the studied reach over time, the water visible as darker regions on the image. The gas pipeline path cleared of trees was completed in 1953. The current main pathway shown in blue on the 2012 photo is clearly different from the past flows shown by the older photos. Water filling the historic raceway path can be seen ponded to the east (right) close to the road in all the photos. Also clear is the apparent stability of the floodplain channel entering the Fenton from the west in the lower extent of the photo, just upstream of the dam, present in each photo.