SALDANHA BAY MUNICIPALITY

LOUWVILLE HOUSING PROJECT IN VREDENBURG

FLOODLINE REPORT FOR PROPOSED DEVELOPMENT OF ERF 7752 AND PORTION OF ERF 1003

301038 – 00-SW-REP-0001-001

12 NOVEMBER 2018

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SALDANHA BAY MUNICIPALITY

SYNOPSIS.

PROJECT 301038 – LOUWVILLE DEVELOPMENT LOUWVILLE HOUSING PROJECT

REV	DESCRIPTION	ORIG	REVIEW	IX engineer APPROVAL	DATE	CLIENT APPROVAL	DATE
		R Overbeek	FW Stoffberg		2018-11-12	N/A	

CONTENTS

1. INTRODUCTION

1.1 APPOINTMENT

iX engineers were appointed by the Saldanha Bay Municipality for the determination of floodlines for the existing concrete channel adjacent and directly to the south of the proposed new 200 erven housing development on Erf 7752 and portion of Erf 1003 in Louwville, Vredenburg.

1.2 AVAILABLE INFORMATION

The following information was obtained by iX engineers:

- Proposed development proposal and erf layout from Town Planners, CK Rumboll & Partners. (Refer Appendix 1, for preliminary layout)
- Detailed digitised topographical survey (dtm = digitised terrain model) of the proposed development and the channel under investigation by CK Rumboll & Partners Townplanners and Land Surveyors. The height systems are based on metres above mean sea level (m.a.m.s.l.)
- GIS data
- Runoff data, obtained from previous reports done by Nadeson Consulting Services in 2012 and 2014 (see references 7 and 8).
- Previous stormwater masterplanning done by Wouter Engelbrecht Consulting Engineers in 1997.
- Site visit

1.3 INTERPRETATION OF FLOODLINES

Floodlines are used to indicate up to which level a certain flood magnitude will inundate an area, or which area of land will fall within the flood plain of a particular flood frequency. Flood frequency can be expressed as the chance of occurrence in any given year, which is the percentage of probability of flooding each year. For example, the 1:50 year and 1:100 year floods have a 2 % and 1 % probability of occurring in any given year respectively.

With rapid urbanisation experienced over the last decade, it has become increasingly important to manage the flood plains within the urban environment. Some of the common management issues with respect to urban flood plains are the rapid urbanisation, flow constrictions, inappropriate channelisation, flood plain in-filling, uncontrolled development, inappropriate land-use, soil erosion, etc.

Managing the flood plains and the human activities thereon will, in the long term, be financially beneficial in terms of reduced maintenance costs, will preserve the ecological functioning of the habitat adjacent to natural streams and rivers, and will be a measure of safeguarding the public against extreme flood events.

The National Water Act (NWA) of 1998 requires that the 1:100 year floodlines be indicated on township layouts and that information with regards to flood hazards be provided. Other sources were also consulted for this purpose, as the NWA does not link any specific interpretation to floodlines.

Although flood calculations are executed with great care, the possibility always exists that a more severe flood could occur or that flooding as a result of non-hydrological events could take place.

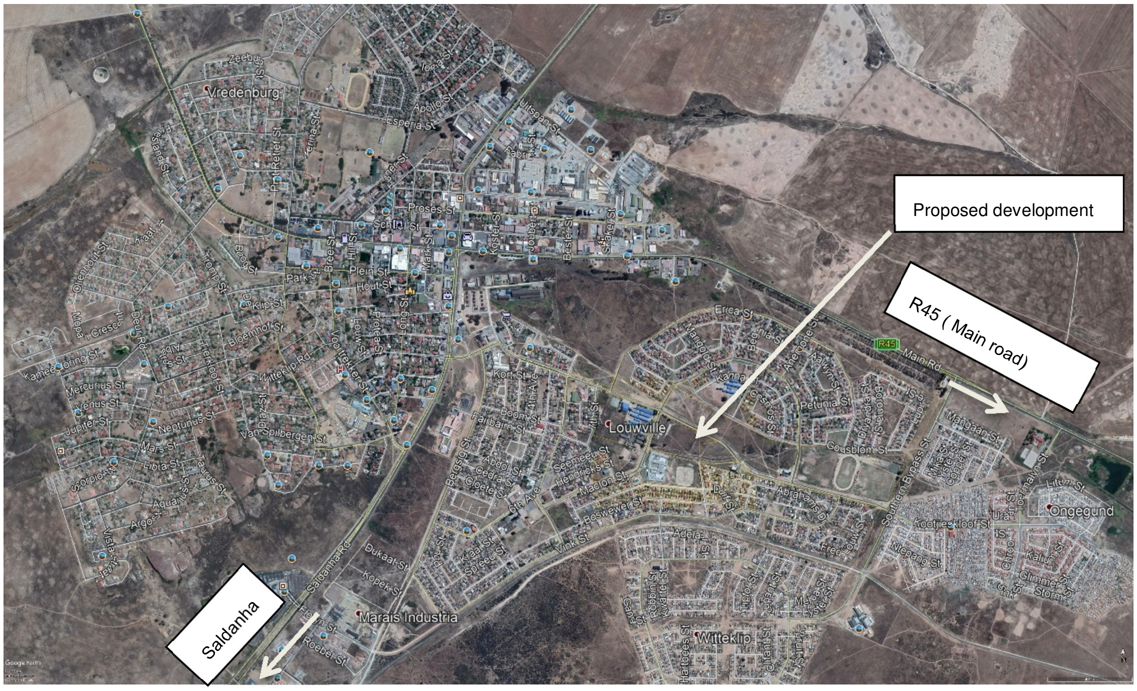
The floodlines indicated, are only reference lines.

2. HYDROLOGY

2.1 LOCALITY

The existing concrete channel, for which the floodline study is executed, is located adjacent and directly to the south of the proposed new 200 erven housing development on Erf 7752 and portion of Erf 1003 in Louwvile, Vredenburg within the Saldanha Bay Municipality. The existing channel under investigation stretches from Maclon Street in the west (at 18°00’20” East and 32°54’55” South) to Kootjieskloof Street in the east (at 18°00’37” East and 32°54’56” South), where it joins the Kootjieskloof Channel at 18°41’42” East and 33°41’55” South. The study area falls within in the winter rainfall region of the Western Cape. The location is shown in Figure 1.

Figure 1 : Location



2.2 1:50 YEAR AND 1:100 YEAR FLOOD PEAKS

The expected 1:50 year and 1:100 year peak floods directly applicable to this flood study, were obtained from the Nadeson stormwater catchment assessment report for the Louwville High School, May 2014. A copy of this report is included in Appendix 6 of this report.

The applicable peak flows to be used for the determination of floodlines along the existing channel between Maclon Street and Kootjieskloof Street, are given in Table 2.1 and indicated in Appendix 2, Drawing no.301038-00-SW-DAL-0001-001.

Table 2.1: Expected Peak Floods

Nadeson Consulting Node no.	HecRas station No.	1:50 Year Peak Flow (m^3/s)	1:100 year Peak Flow (m^3/s)
Trapezoidal concrete lined channel between Maclon Street and Kootjieskloof Street			
380	507	3.92 m^3/s	7.41 m^3/s
390	224	4.20 m^3/s	7.95 m^3/s
400	105	4.12 m^3/s	7.95 m^3/s
Kootjieskloof Trapezoidal concrete lined channel			
260		5.00 m^3/s	5.20 m^3/s
	145	5.00 m^3/s	5.20 m^3/s
280	70	9.10 m^3/s	13.27 m^3/s

The floods given in Table 2.1 will be analysed by applying the software HEC-RAS from the start of the concrete lined channel directly downstream of Maclon Street to directly downstream of the existing 1/2100mm x 900mm box culvert underneath Kootjieskloof Street, where the channel joins the Kootjieskloof Channel. The flow along Kootjieskloof Channel would also be incorporated to model the junction accurately and the effect of possible backed-up water level.

3. FLOODLINES

The 1:50 and 1:100 year floodlines for present conditions were investigated and the following assumptions were made**.**

- It is general practice to assume the energy levels as the expected flood levels. The energy level is the expected water surface level plus a freeboard height. It was decided to provide a freeboard above the expected water level in order to lower the risk of damage to and flooding of the proposed developments. The purpose of the freeboard is to serve as a safety measure to provide additional protection against the risk of wave action and banking of flows along bends in the stream.

- A freeboard height was calculated either by the velocity head $FB = \frac{v^2}{2g}$ (Froude number ≤ 1) or 0.3 x flow depth (Froude number > 1), as prescribed in the Drainage Manual (2013). The latter values were used, as the Froude numbers were generally in excess of 1.

- Cross-sections were taken through the existing channel perpendicular to the direction of flow. Refer to Appendix 3 for cross-sections.

- The computer programme HEC-RAS (Hydrological Engineering Center's (HEC) River Analysis Systems, developed by the US Army Corps of Engineers) was used to determine water flow and energy levels.

- Manning roughness values (n) of 0.015 for concrete and 0.022 to 0.025 for grassed side slopes were assumed for the existing channel. Manning roughness coefficients represent the resistance to flood flows in channels and flood plains.

Figure 2 : Channel section

The floodlines determined, are based on the existing site conditions. The floodlines are shown in Appendix 4. **Users of the floodline data are requested not to scale the position of floodlines from the drawing but shall obtain the expected flood levels from the table on Drawing 301038-00-SW-DAL-0002-001. Refer to Appendix 5 for additional HecRas flow results.**

It should be noted that three obstructions were observed during the site visit and confirmed during the analysis. These flow obstructions were included in the calculation and are discuses below.

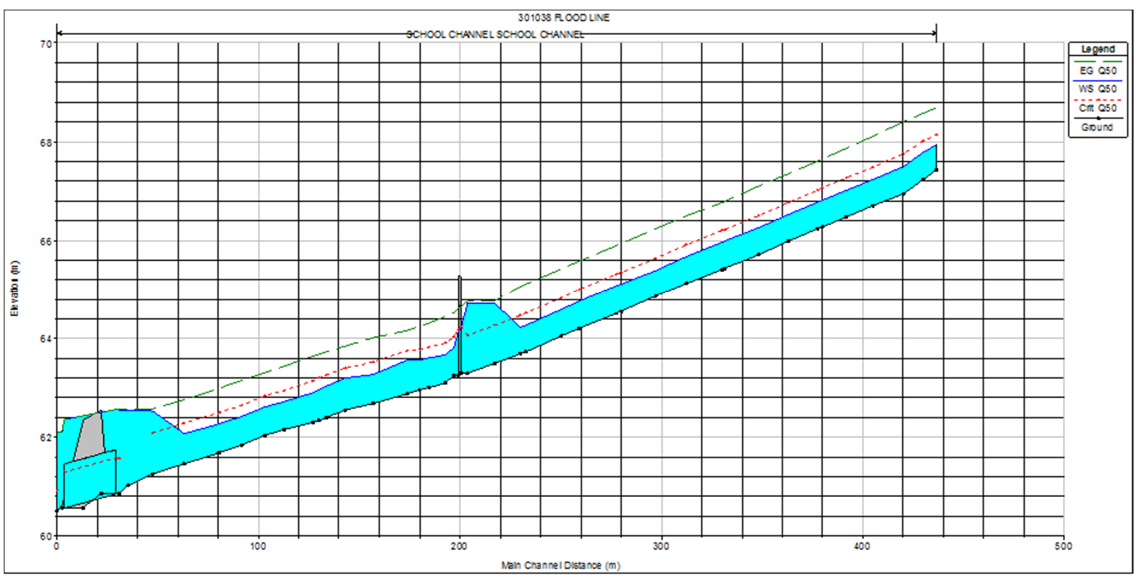
- Encased sewer main and foot bridge at station no 267. Refer to Figure 3.

Figure 3: Encased sewer line and footbridge crossing

- Existing 1/2100 x 900mm culvert crossing at Kootjieskloof. Refer to Figure 4. According to the stormwater masterplan 2/ 2100 x 900mm are required at this road crossing.

Figure 4: Kootjieskloof road crossings

Figure 5: 1:50 year Flow Profile, indicating the position of the Hydraulic jumps

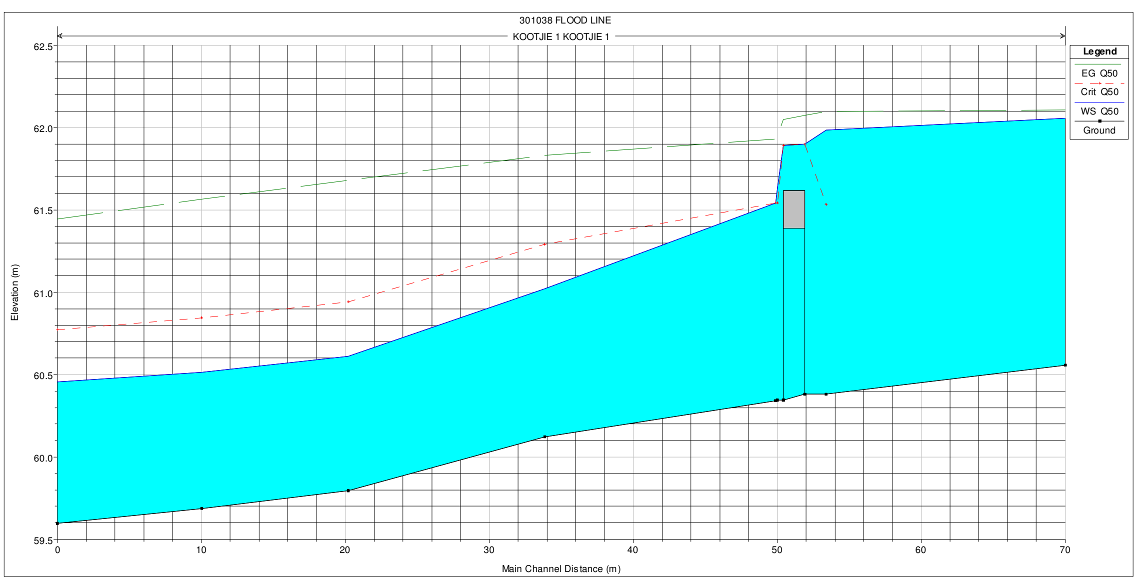


The change in flow profile is indicated in the Figure 5 above. A hydraulic jump occurs before these structures, meaning a change in flow characteristics between super critical and subcritical. Erosion normally occurs in the vicinity of such hydraulic jumps.

- Foot bridge at HecRas station no 51, Refer to Figures 6 and 7**.**

Figure 6 : Footbridge over Kootjieskloof channel

Figure 7 : HecRas results indicating the overtopping of the footbridge, at Kootjieskloof channel



As a result of these obstructions, the flow capacity of the channel is exceeded during the 1:20 year flood peak and higher flood peaks. The exceedance of capacity subsequently causes the channel to overflow its banks, but does not affect the proposed development. The excess flows flow overland adjacent to the channel and joins the channel flow downstream of the obstructions. The risk of this bank overflows is that severe erosion can be expected as a result of two occurrences, namely:

- The obstructions cause damming up of flows. The super-critical flow conditions suddenly change to sub-critical flow conditions. This results in hydraulic jumps occurring with turbulence conditions causing erosion of the side slopes and possible undermining of the concrete section of the channel;

- The bank overflows could erode the side slopes and overbank downstream thereof.

Solutions to these risks are discussed in Section 4: Hydraulic Characteristics.

4. HYDRAULIC CHARACTERISTICS

Although the current floodlines have no effect on the proposed development, the following issues should be addressed to improve the flow conditions and mitigate possible erosion.

- The difference in the flow velocities between the concrete section and the earth section of the channel under investigation in general is approximately 4m/s. Erosion could thus occur during larger storm events. Additional concrete erosion block protection adjacent to the concrete channel section on both sides should be considered to prevent possible erosion.

- The existing sewer crossing at Station 267 currently obstructs high flows with magnitude similar to the 1:20 year peak flood and higher. The problem is that the clearance between the channel invert level and the soffit level of the sewer crossing is too small. This leads to a hydraulic jump with subsequent overflow and erosion. Two possible solutions to this problem must be investigated, namely:
  - Divert and relay part of the sewer line.
  - Implement adjustments to the channel alignment and cross section to create sufficient clearance, e.g. a 3000 x 900mm box culvert can be installed to support the sewer line with two transitions between the channel and the culvert

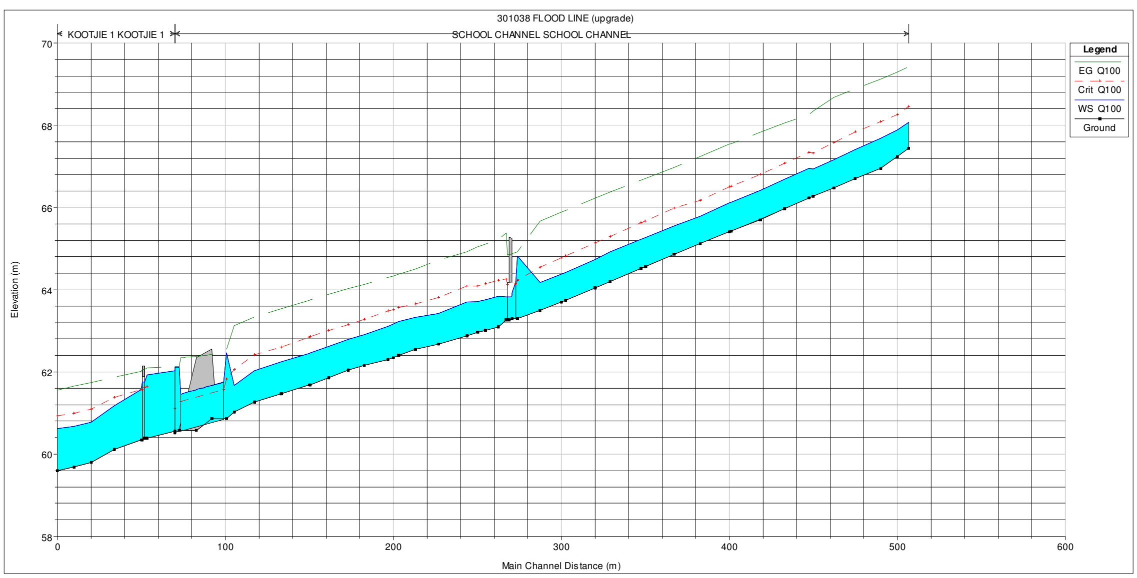
- The capacity of the existing 1 / 2100 x 900mm box culvert underneath Kootjieskloof Street does not have adequate capacity to accommodate larger return period floods. This again leads to a hydraulic jump with subsequent overflow and erosion. The existing culvert should be upgraded to a 2 / 2100 x 900mm box culvert, as recommended in the previous stormwater masterplans.

- The footbridge at Station no 51 was also constructed at a too low level and does not have enough clearance to accommodate larger return period flows. This again will cause damming up, leading to a hydraulic jump with subsequent overflowing of the channel and the risk of erosion. The footbridge should be demolished and reconstructed at a higher level to have at least 0.5m more clearance than at present, or alternatively the possibility of adjustments to the existing channel alignment and cross section should be investigated.

- Erosion protection on both sides of the Kootjieskloof Channel downstream of the confluence of the two channels should be investigated, as the analysis indicates that turbulence can be expected in the vicinity of the confluence during high interval peak floods (1:20 year peak flood and larger flows).

  Figure 8 graphically indicates the effect on the floodlines should the proposed remedial work, as mentioned above, be implemented.

Figure 8 : Revised 1:100 Year flood line after implementation of remedial proposal.



5. SUMMARY AND RECOMMENDATIONS

The floodlines represent the most severe conditions possible during a 1:50 and 1:100 year return period flood, as it is assumed that the storm will occur over the full catchment and that the stream will convey a peak flood.

According to the survey the low point on Maclon Street is approximately 25m north of the start of the channel. To ensure that the maximum peak flow reaches the existing channel, an open drain or a berm is recommended to divert the overland flow towards the channel. Refer to Drawing 301038-00-SW-DAL-0002-001 in Appendix 2 for position of the drain.

It is recommended that the proposed development be constructed above the expected 1:50 and 1:100 year flood levels and that the floor levels specifically be above the expected 1:100 year flood peak. As a result of the rather steep gradients of the existing channel and the stream vegetation, high flow velocities, above 1.5 m/s, can be expected. This will result in the 1:50 year and 1:100 year floodlines to be quite close to one another. It is thus proposed that the 1:100 year floodlines be used for planning purposes. As a result of the high flow velocities during large interval flood events, erosion on the unlined channel side slopes above the concrete section can be expected. For this reason it is proposed that these unlined side slopes be protected against erosion by the placing of concrete erosion blocks on geotextile to mitigate this possibility.

It is further recommended that any disturbance of vegetation or soil, below the 1:50 and 1:100 year floodline, during the construction works, be re-vegetated and protected against possible erosion.

6. CONCLUSION

Any enquiries with regards to flood levels can be referred directly to iX engineers.

We trust that the investigation and recommendations contained in this report will be to the satisfaction of the Saldanha Bay Municipality.

We thank you for the opportunity to submit this report.

7. REFERENCES

1. City of Cape Town, Floodplain and River Corridor Management Policy, 2009

2. City of Cape Town, Management of Urban Stormwater Impacts Policy , 2009

3. Drainage Manual. The South African National Roads Agency SOC Ltd: 6th Edition (2013).

4. Policy and Guidelines for Developments within Floodlines, Department of Water Affairs, March 2007

5. Google et al. (2018): Figure 1, Source: Google Earth Pro, AfriGIS (Pty) Ltd., Image DigitalGlobe (Imagery Date: 29/10/2017

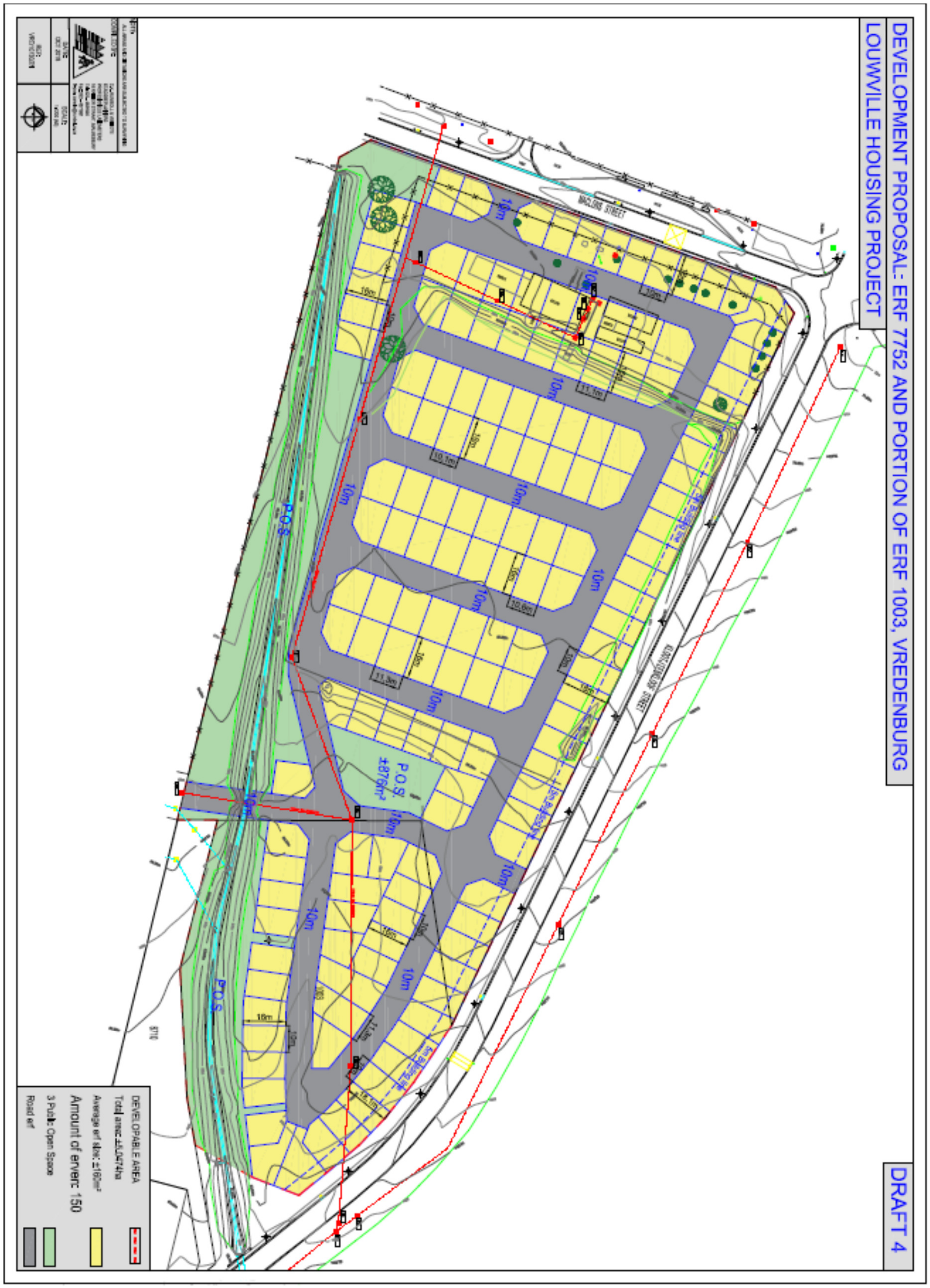
6. HEC-RAS, River Analysis System-(version 5.0.3) Software, U.S. Army Corps of Engineers, Hydrologic Engineering Centre.

7. Nadeson Consulting Services, Louwville Basin Stormwater Masterplan, June 2012.

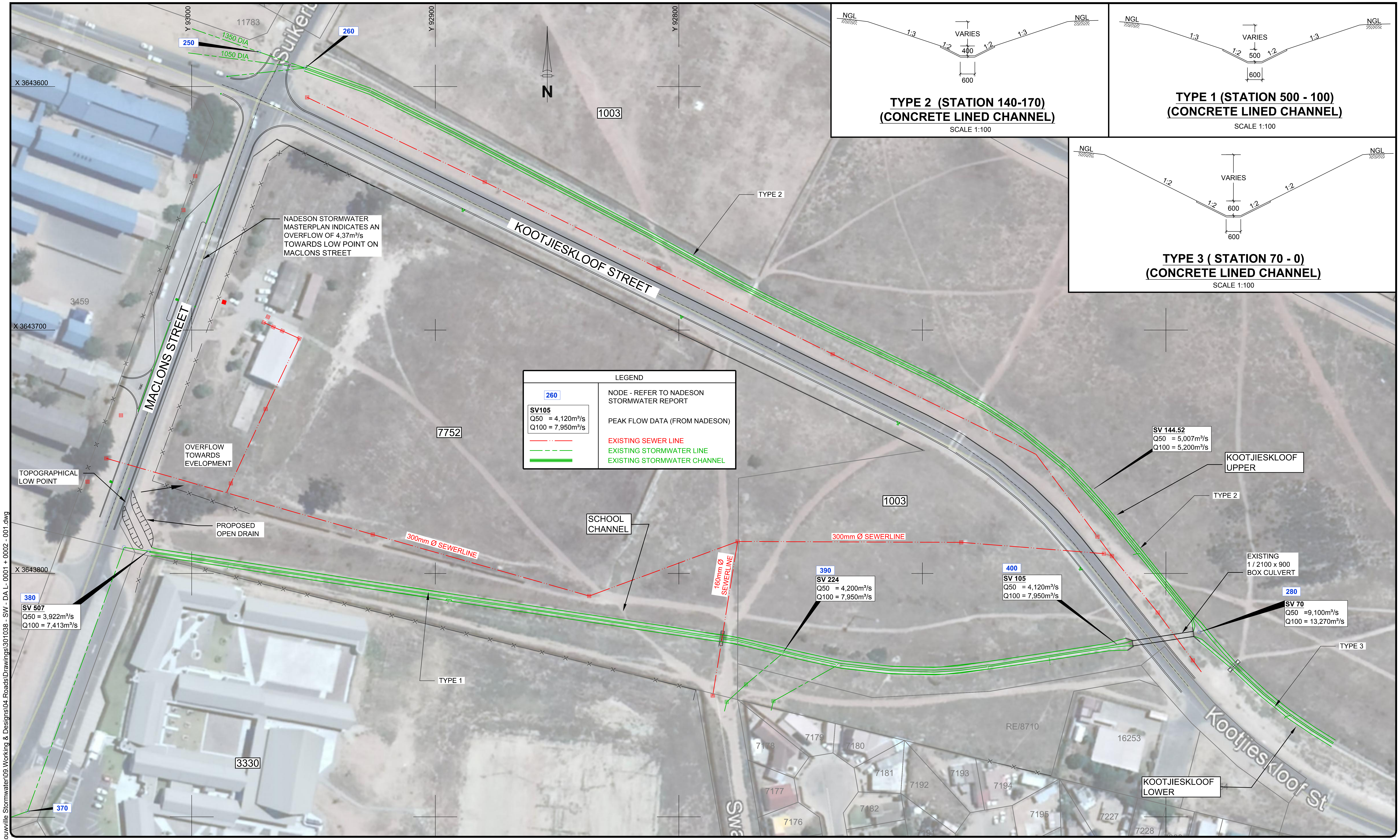
8. Nadeson Consulting Services, Louwville High School Stormwater Catchment Assessment Report, May 2012.

9. Wouter Engelbrecht Raadgewende Ingenieurs, Stormwater Meesterplan – Louwville, Vredenburg, Augustus 1997.

Appendix 1: Preliminary Erf Layout


DEVELOPMENT PROPOSAL: ERF 7752 AND PORTION OF ERF 1003, VREDENBURG
LOUWVILLE HOUSING PROJECT
DRAFT 4
P.O.S.
P.O.S. ±876m²
10m
DEVELOPABLE AREA
Amount of erven: 150
3 Public Open Space
Road erf

Appendix 2: Layout Drawing : 301038-00-SW-DAL-0001-001, Location of the 1:50 and 1:100 Year Peak flows



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CLIENT
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PROJECT
DEVELOPMENT OF 200 ERVEN IN LOUWVILLE

DRAWING DESCRIPTION
EXISTING STORMWATER SYSTEM - FLOW DATA

SCALE FOR REDUCED PLAN
0 5 10 20 30 40 50
50mm ON ORIGINAL PLAN

DATE	SCALE	ORIGINAL SIZE
2017/01/01	AS SHOWN	A2

DRAWING NUMBER	REV
301038-00-SW-DAL-0001-001	00

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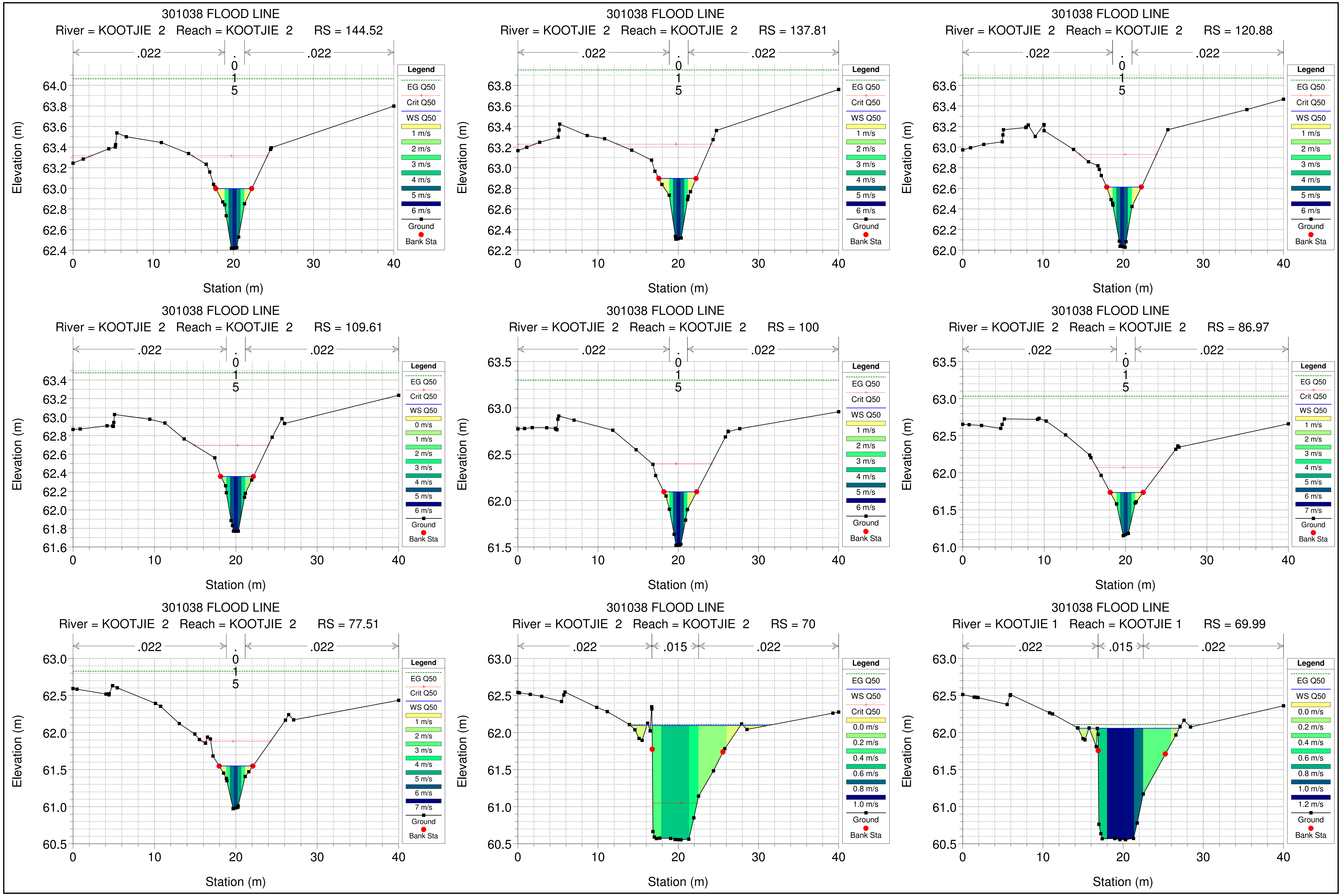
Appendix 3: Cross-sections of the Existing Channel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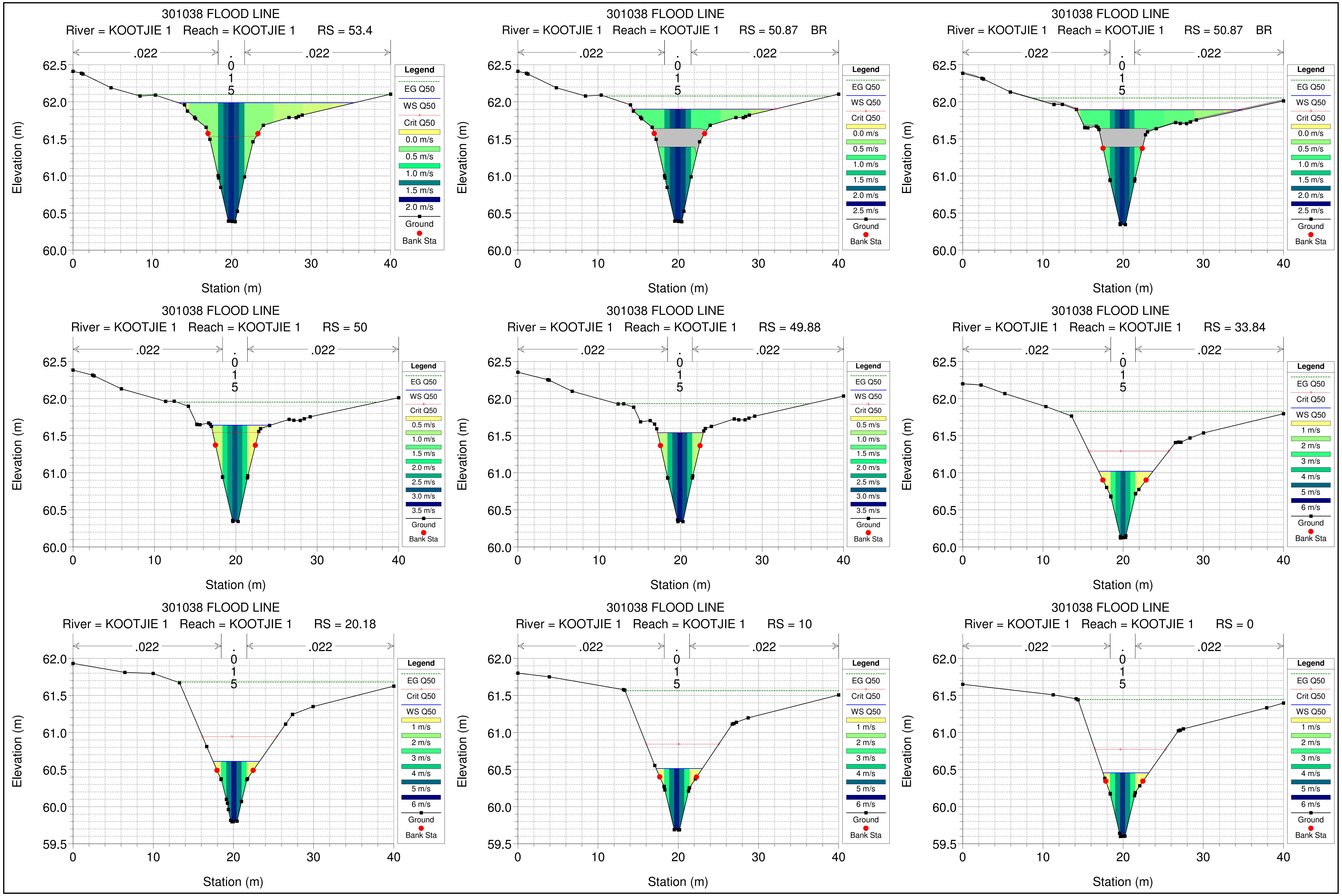

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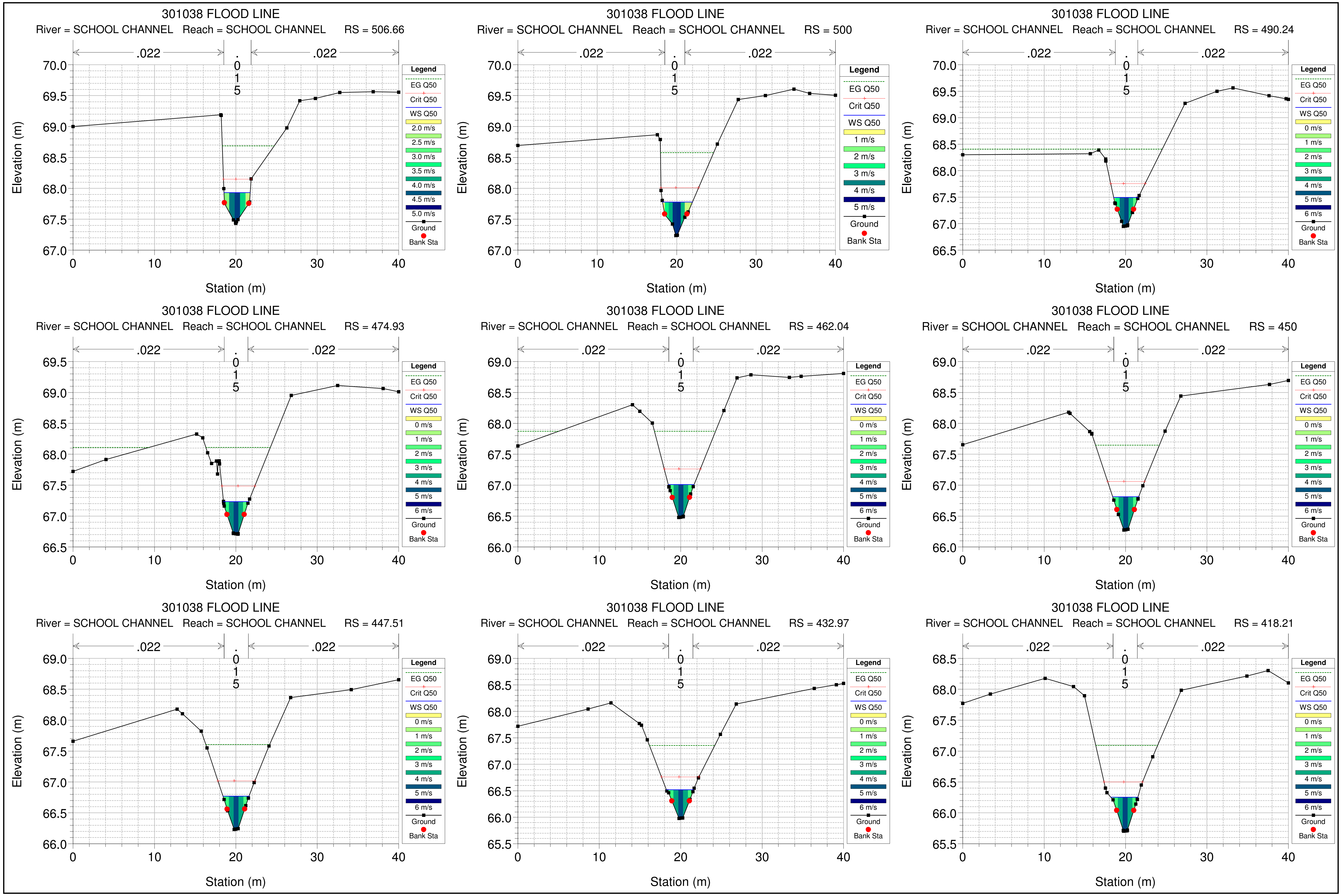
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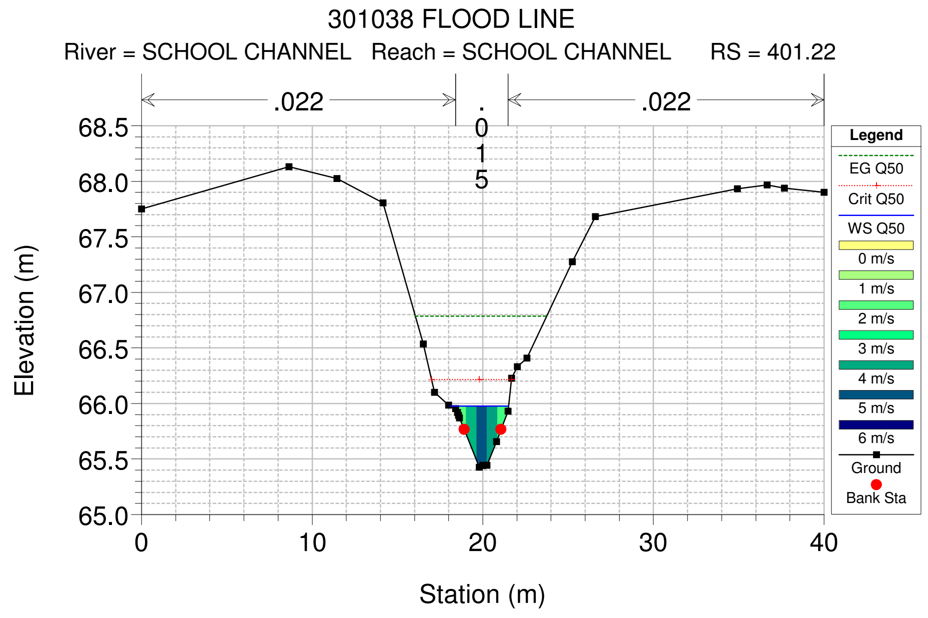
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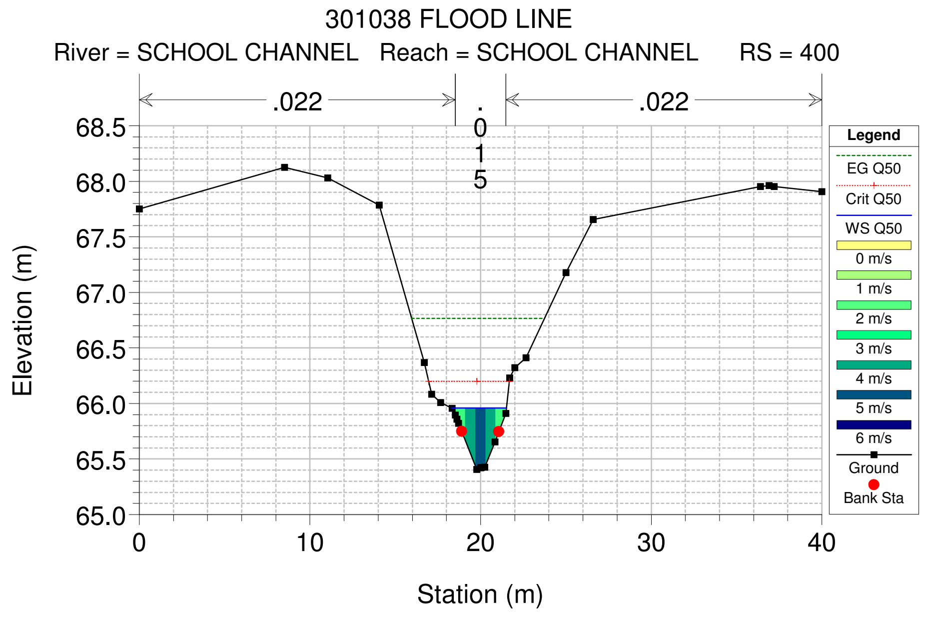
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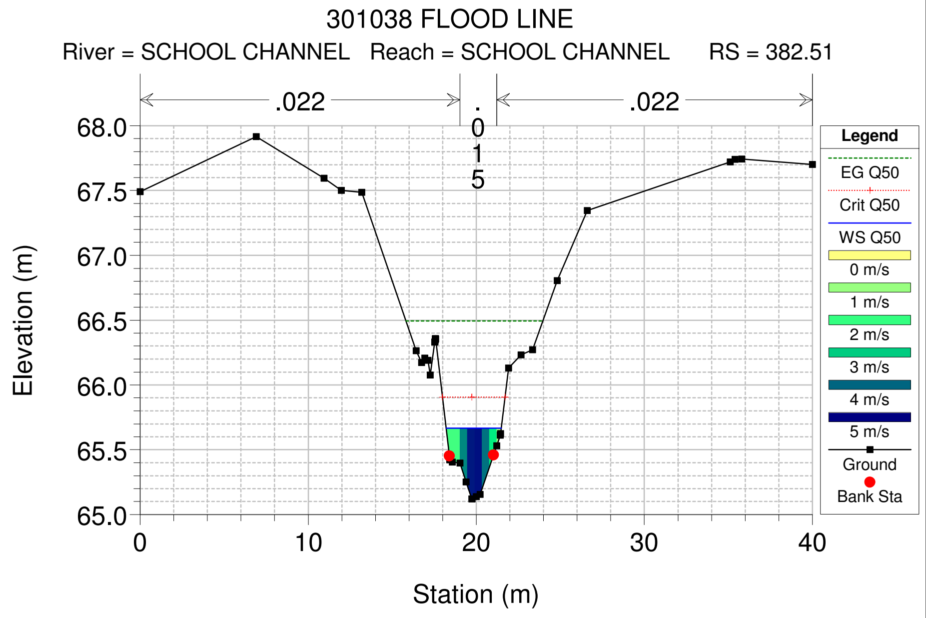
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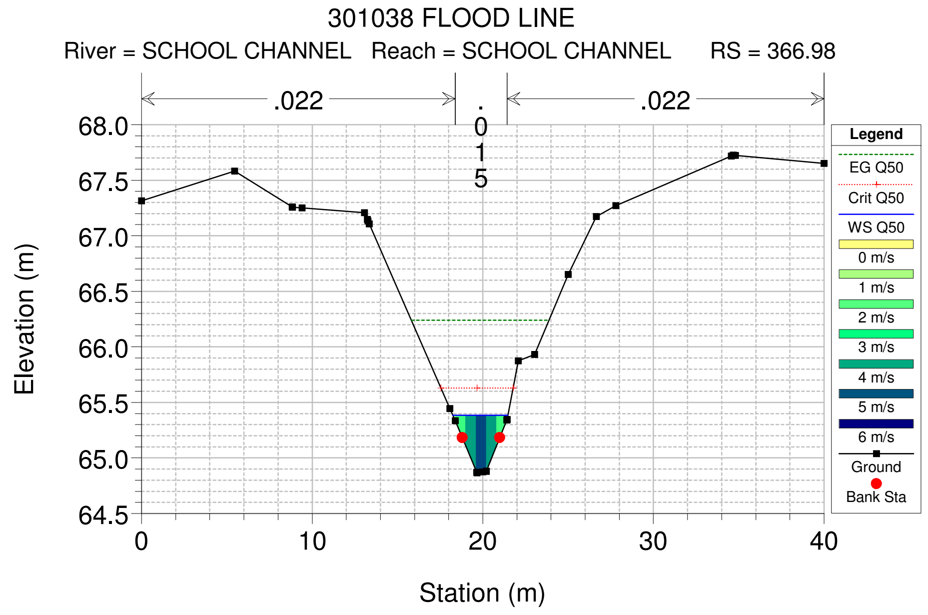
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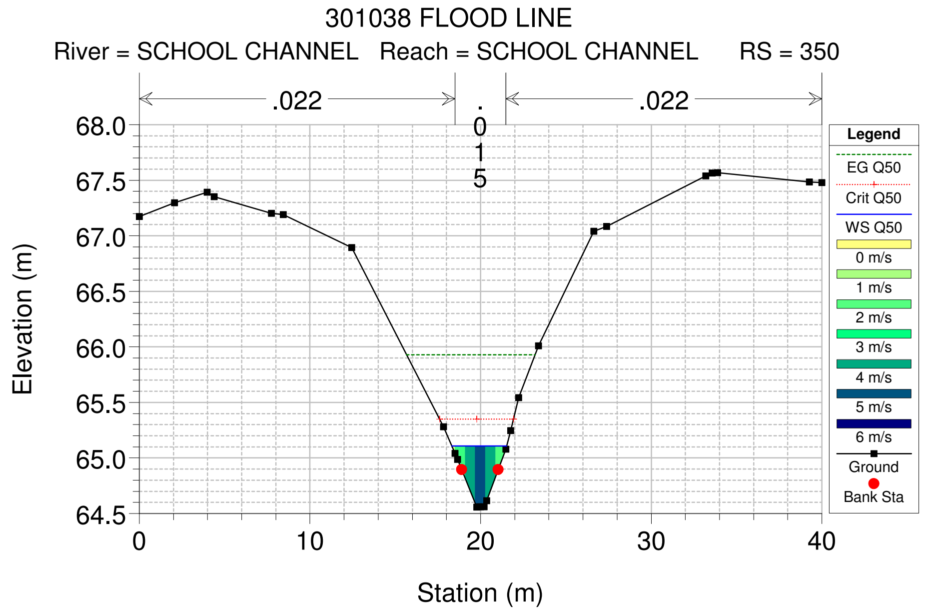
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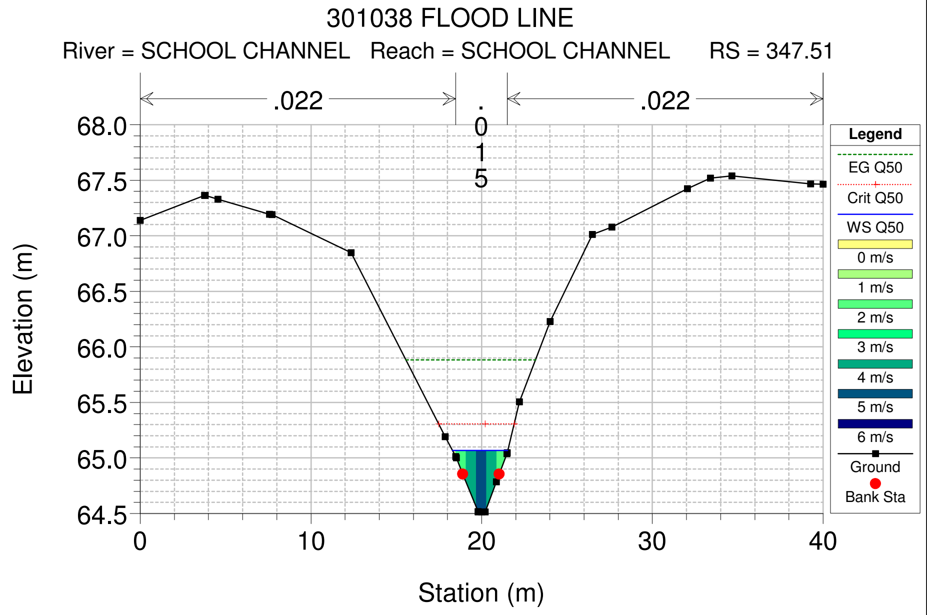
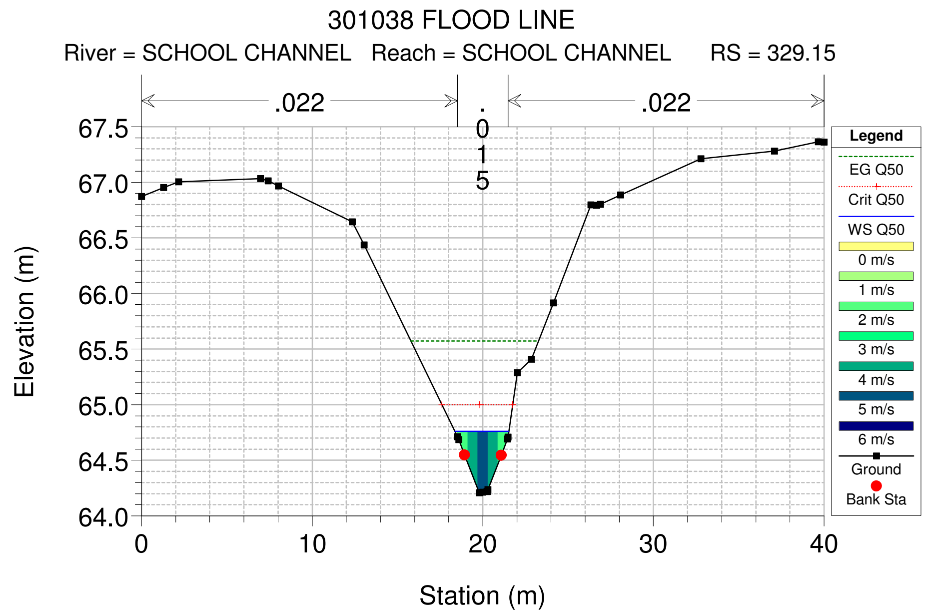
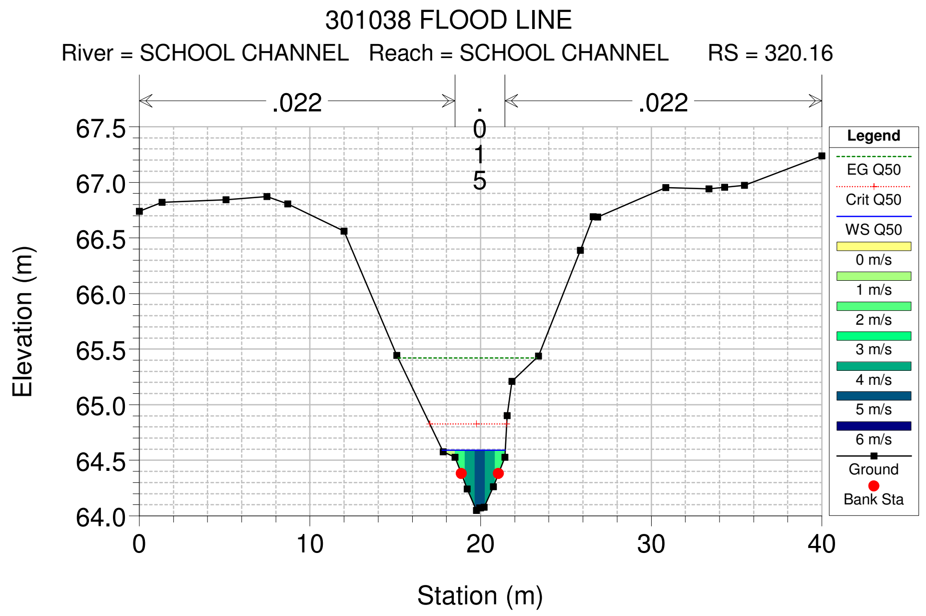
4 m/s
5 m/s
6 m/s
Ground
Bank Sta


301038 FLOOD LINE
River = SCHOOL CHANNEL Reach = SCHOOL CHANNEL RS = 347.51
.022
.022
Elevation (m)
Station (m)
Legend
EG Q50
Crit Q50
WS Q50
0 m/s
1 m/s
2 m/s
3 m/s
4 m/s
5 m/s
6 m/s
Ground
Bank Sta


301038 FLOOD LINE
River = SCHOOL CHANNEL Reach = SCHOOL CHANNEL RS = 329.15
.022
.022
Elevation (m)
Station (m)
Legend
EG Q50
Crit Q50
WS Q50
0 m/s
1 m/s
2 m/s
3 m/s
4 m/s
5 m/s
6 m/s
Ground
Bank Sta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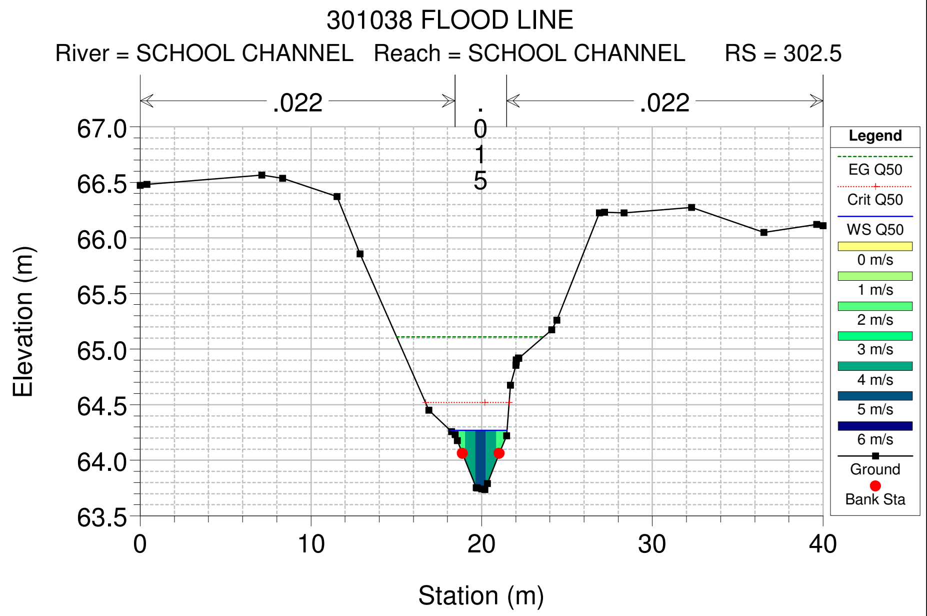
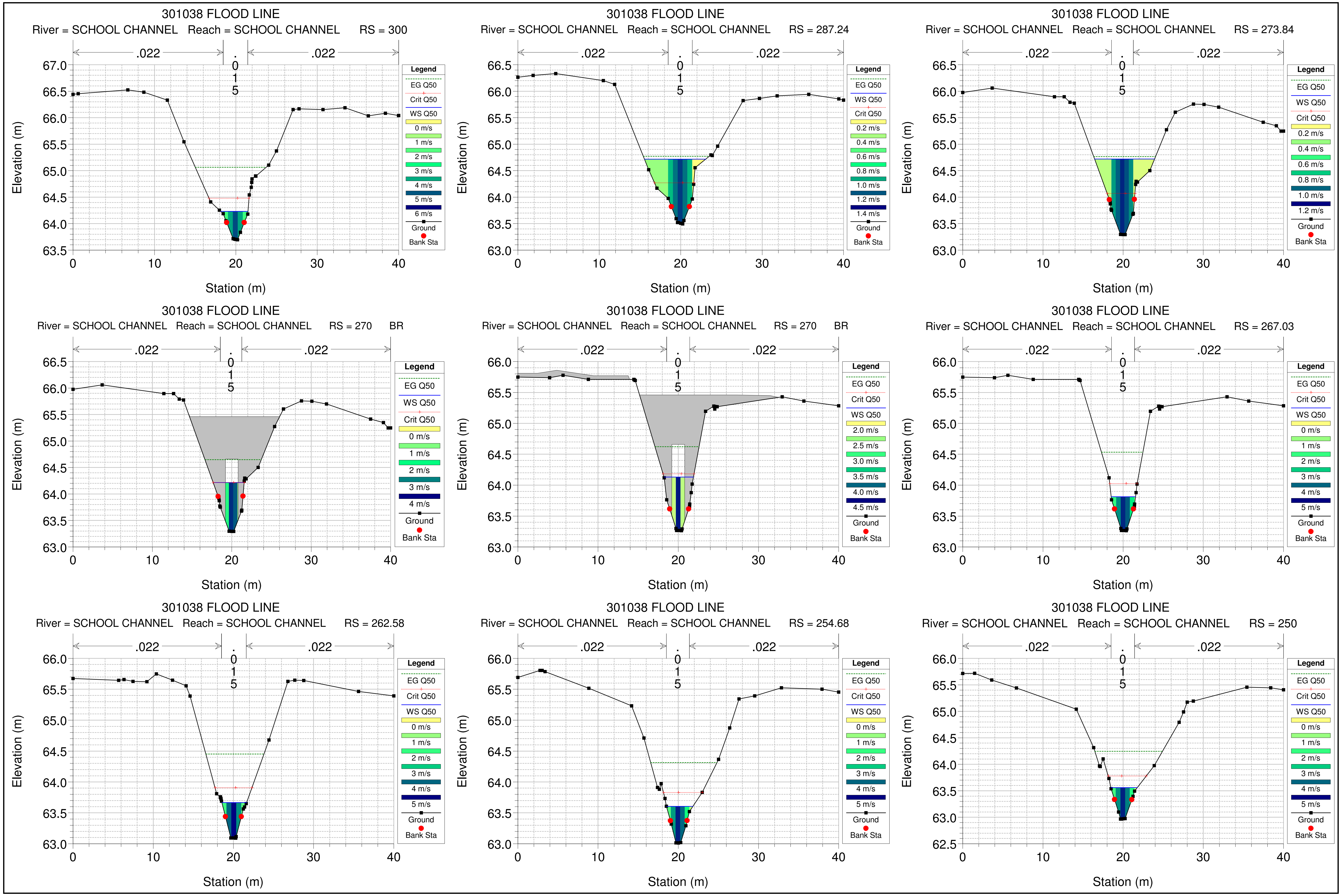
River = SCHOOL CHANNEL Reach = SCHOOL CHANNEL RS = 320.16
.022
.022
Elevation (m)
Station (m)
Legend
EG Q50
Crit Q50
WS Q50
0 m/s
1 m/s
2 m/s
3 m/s
4 m/s
5 m/s
6 m/s
Ground
Bank Sta


301038 FLOOD LINE
River = SCHOOL CHANNEL Reach = SCHOOL CHANNEL RS = 302.5
.022
.022
Elevation (m)
Station (m)
Legend
EG Q50
Crit Q50
WS Q50
0 m/s
1 m/s
2 m/s
3 m/s
4 m/s
5 m/s
6 m/s
Ground
Bank Sta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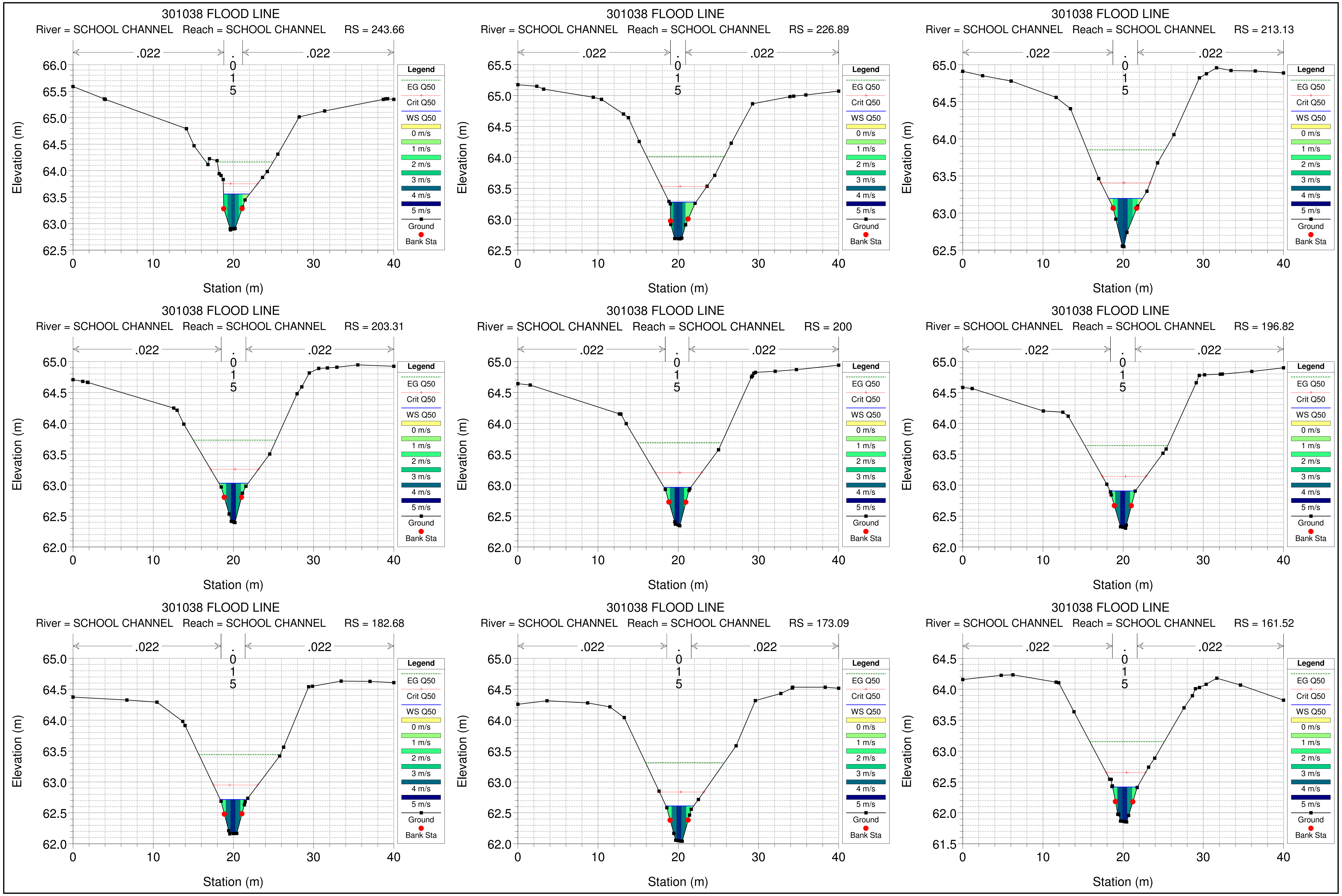
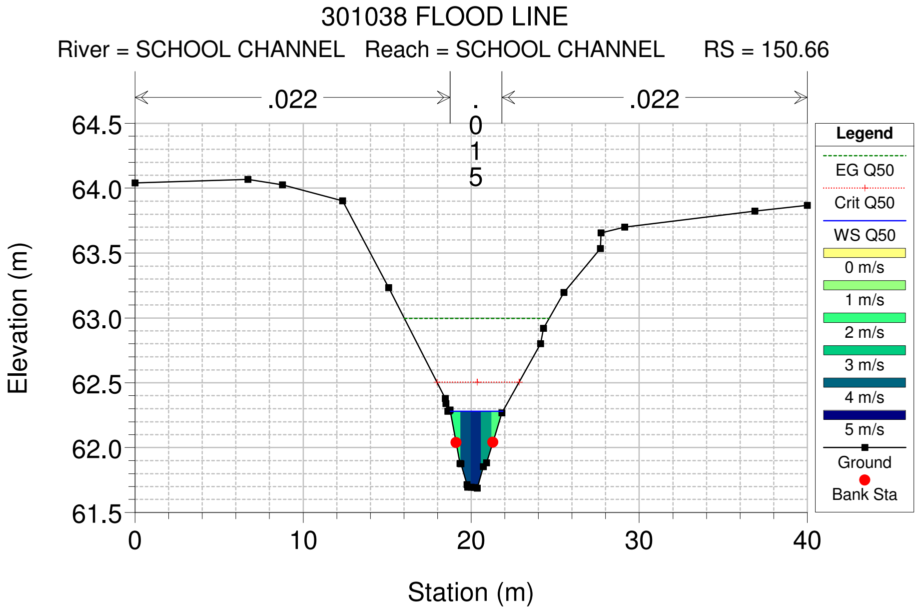
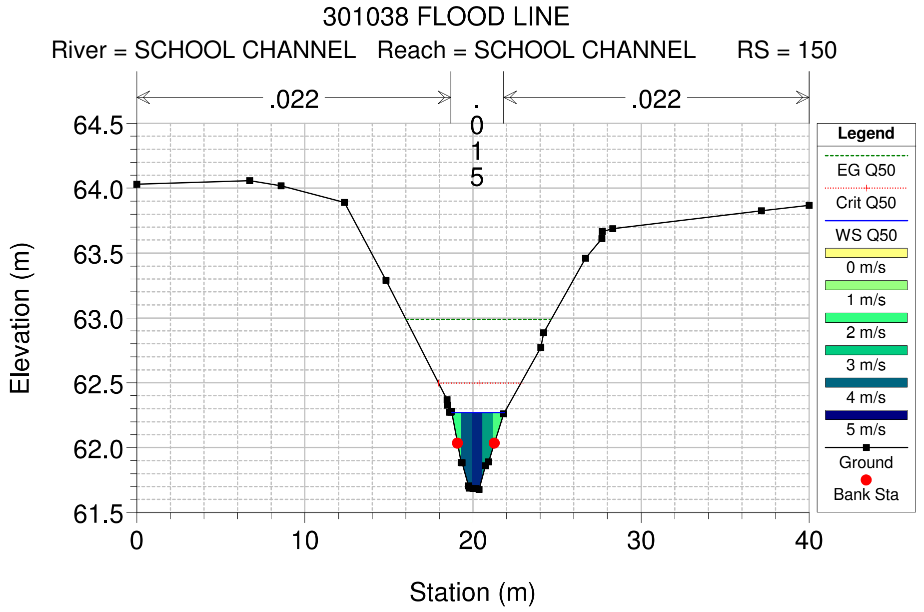
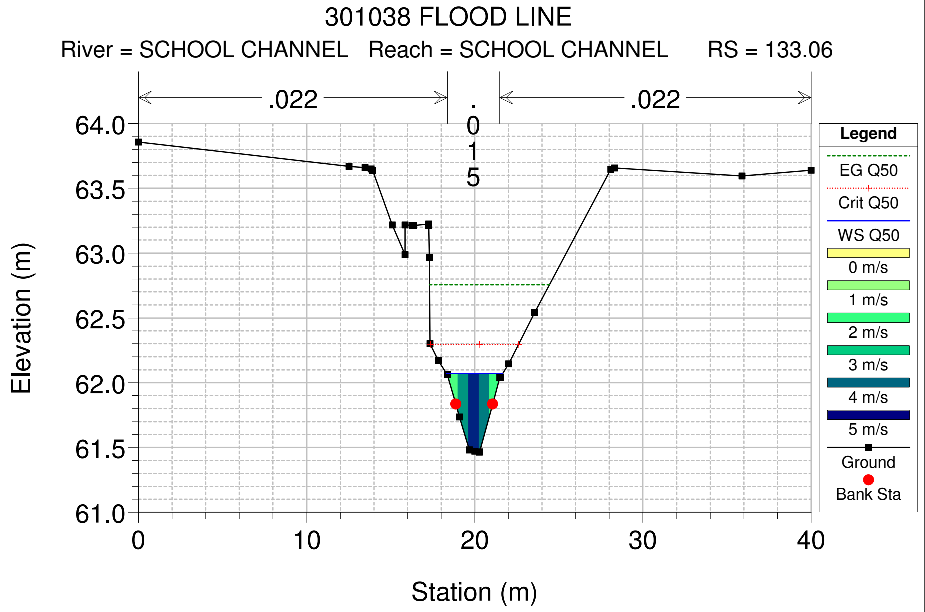
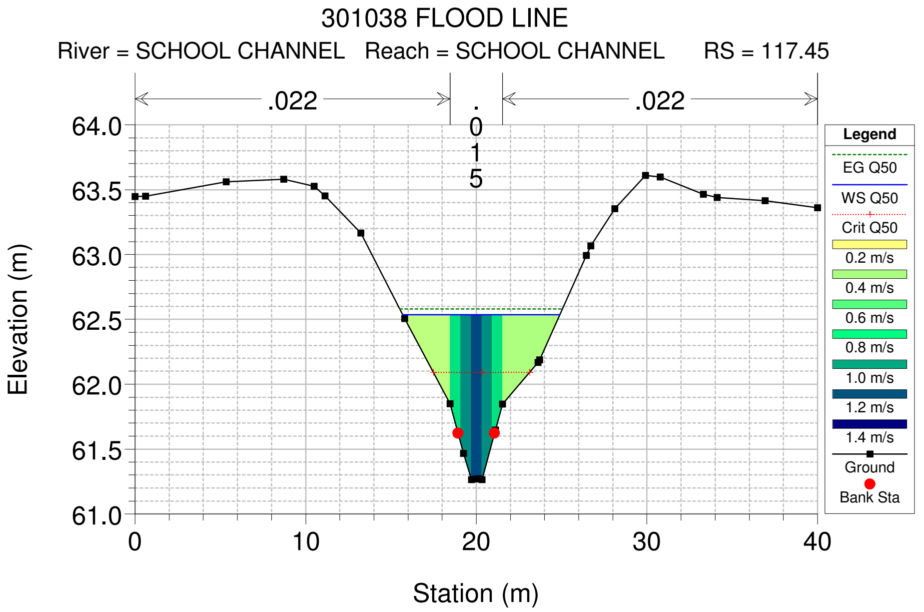
River = SCHOOL CHANNEL Reach = SCHOOL CHANNEL RS = 300
301038 FLOOD LINE
River = SCHOOL CHANNEL Reach = SCHOOL CHANNEL RS = 287.24
301038 FLOOD LINE
River = SCHOOL CHANNEL Reach = SCHOOL CHANNEL RS = 273.84
301038 FLOOD LINE
River = SCHOOL CHANNEL Reach = SCHOOL CHANNEL RS = 270 BR
301038 FLOOD LINE
River = SCHOOL CHANNEL Reach = SCHOOL CHANNEL RS = 270 BR
301038 FLOOD LINE
River = SCHOOL CHANNEL Reach = SCHOOL CHANNEL RS = 267.03
301038 FLOOD LINE
River = SCHOOL CHANNEL Reach = SCHOOL CHANNEL RS = 262.58
301038 FLOOD LINE
River = SCHOOL CHANNEL Reach = SCHOOL CHANNEL RS = 254.68
301038 FLOOD LINE
River = SCHOOL CHANNEL Reach = SCHOOL CHANNEL RS = 250
.022
.015
Elevation (m)
Station (m)
Legend
EG Q50
WS Q50
Crit Q50
Ground
Bank Sta

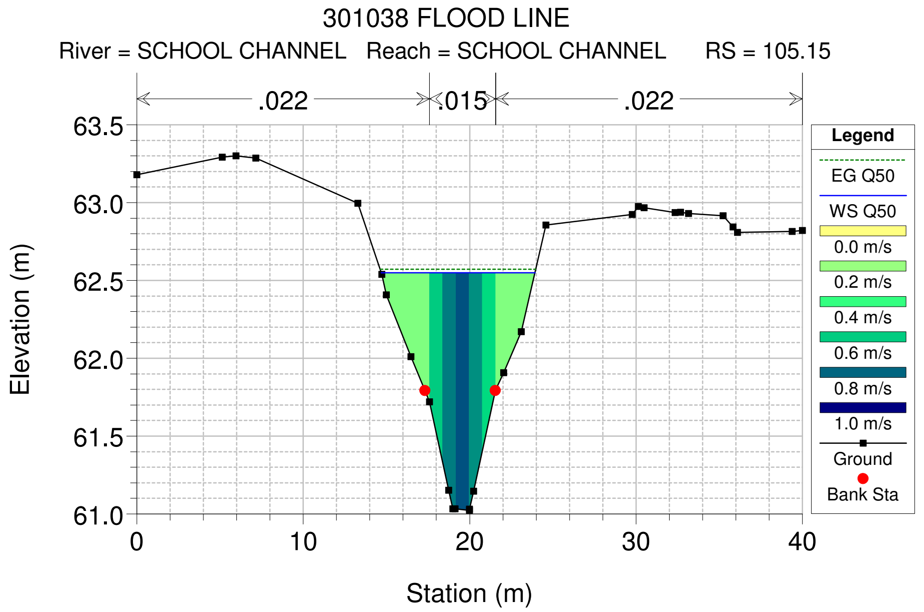

301038 FLOOD LINE
River = SCHOOL CHANNEL Reach = SCHOOL CHANNEL RS = 243.66
301038 FLOOD LINE
River = SCHOOL CHANNEL Reach = SCHOOL CHANNEL RS = 226.89
301038 FLOOD LINE
River = SCHOOL CHANNEL Reach = SCHOOL CHANNEL RS = 213.13
301038 FLOOD LINE
River = SCHOOL CHANNEL Reach = SCHOOL CHANNEL RS = 203.31
301038 FLOOD LINE
River = SCHOOL CHANNEL Reach = SCHOOL CHANNEL RS = 200
301038 FLOOD LINE
River = SCHOOL CHANNEL Reach = SCHOOL CHANNEL RS = 196.82
301038 FLOOD LINE
River = SCHOOL CHANNEL Reach = SCHOOL CHANNEL RS = 182.68
301038 FLOOD LINE
River = SCHOOL CHANNEL Reach = SCHOOL CHANNEL RS = 173.09
301038 FLOOD LINE
River = SCHOOL CHANNEL Reach = SCHOOL CHANNEL RS = 161.52
.022
.015
.022
Elevation (m)
Station (m)
Legend
EG Q50
Crit Q50
WS Q50
0 m/s
1 m/s
2 m/s
3 m/s
4 m/s
5 m/s
Ground
Bank Sta

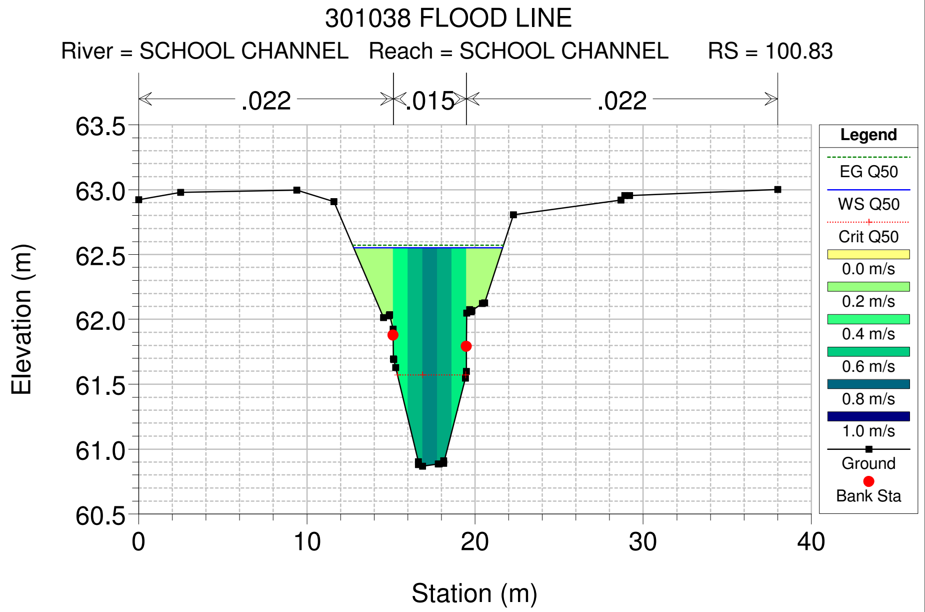

301038 FLOOD LINE
River = SCHOOL CHANNEL Reach = SCHOOL CHANNEL RS = 150.66
.022
.015
.022
Elevation (m)
Station (m)
Legend
EG Q50
Crit Q50
WS Q50
0 m/s
1 m/s
2 m/s
3 m/s
4 m/s
5 m/s
Ground
Bank Sta

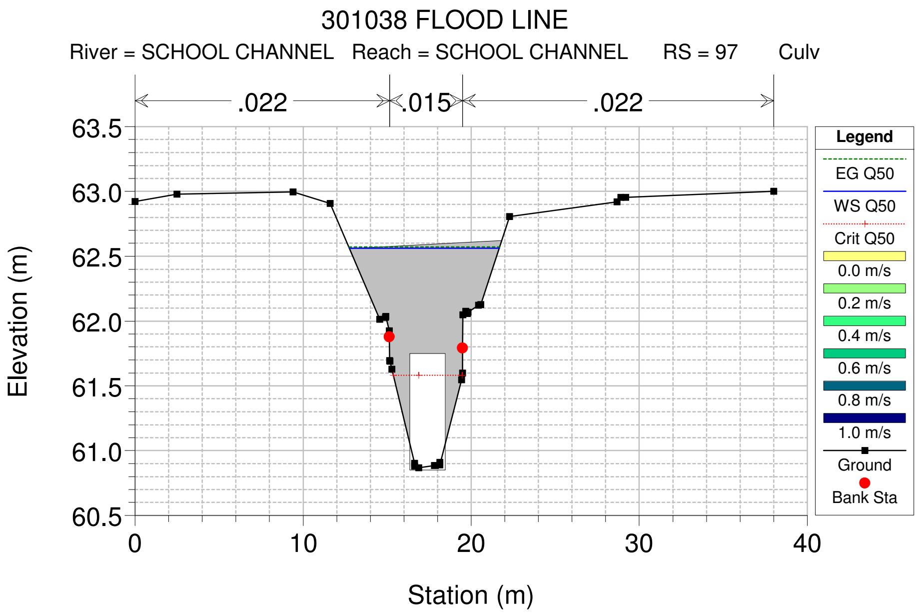

301038 FLOOD LINE
River = SCHOOL CHANNEL Reach = SCHOOL CHANNEL RS = 150
.022
.015
.022
Elevation (m)
Station (m)
Legend
EG Q50
Crit Q50
WS Q50
0 m/s
1 m/s
2 m/s
3 m/s
4 m/s
5 m/s
Ground
Bank Sta

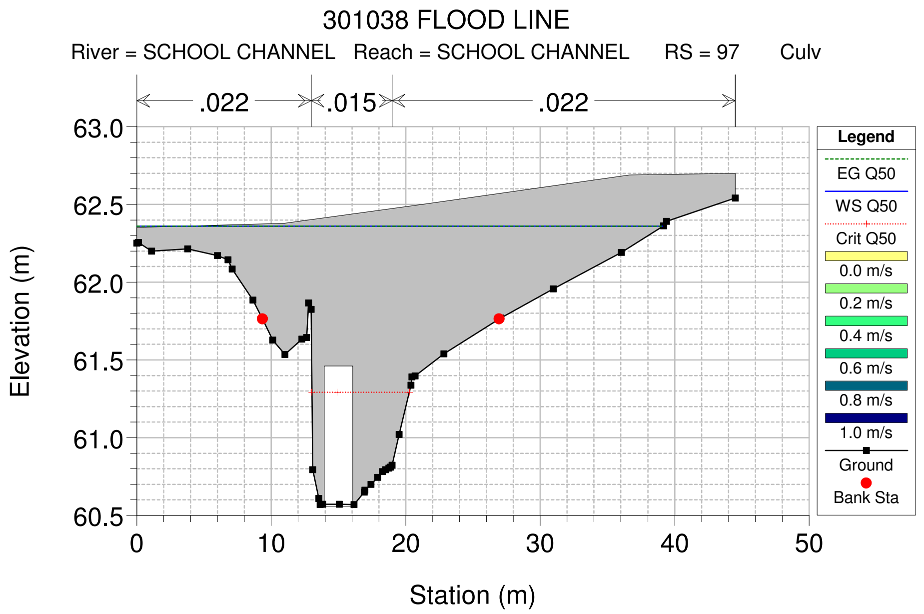

301038 FLOOD LINE
River = SCHOOL CHANNEL Reach = SCHOOL CHANNEL RS = 133.06
.022
.015
.022
Elevation (m)
Station (m)
Legend
EG Q50
Crit Q50
WS Q50
0 m/s
1 m/s
2 m/s
3 m/s
4 m/s
5 m/s
Ground
Bank Sta

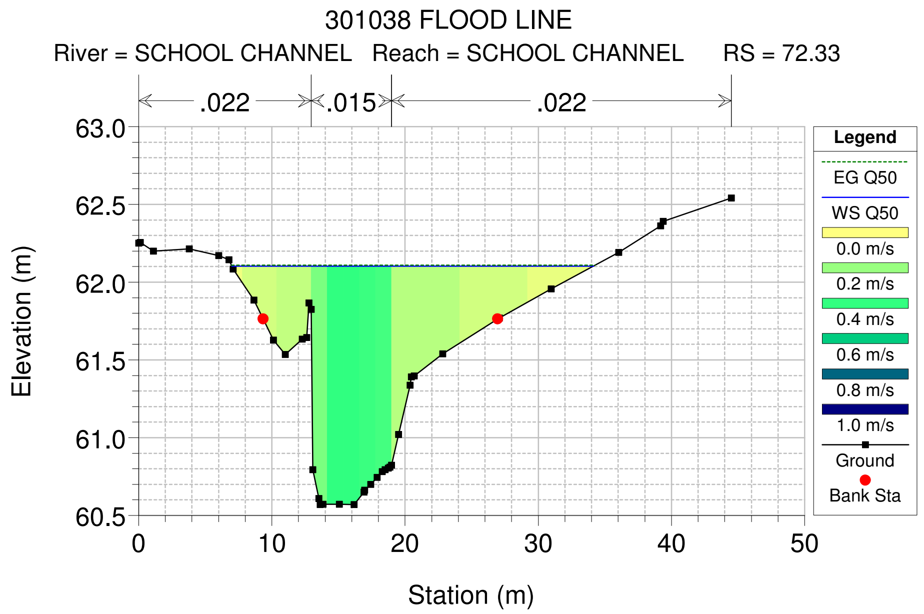

301038 FLOOD LINE
River = SCHOOL CHANNEL Reach = SCHOOL CHANNEL RS = 117.45
.022
.015
.022
Elevation (m)
Station (m)
Legend
EG Q50
WS Q50
Crit Q50
0.2 m/s
0.4 m/s
0.6 m/s
0.8 m/s
1.0 m/s
1.2 m/s
1.4 m/s
Ground
Bank Sta

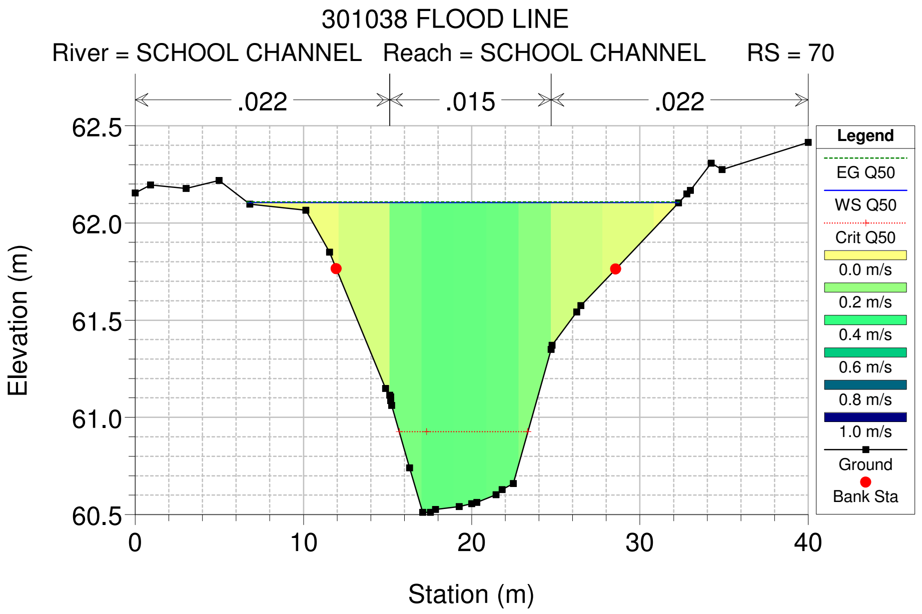

301038 FLOOD LINE
River = SCHOOL CHANNEL Reach = SCHOOL CHANNEL RS = 105.15
.022
.015
.022
Elevation (m)
Station (m)
Legend
EG Q50
WS Q50
0.0 m/s
0.2 m/s
0.4 m/s
0.6 m/s
0.8 m/s
1.0 m/s
Ground
Bank Sta


301038 FLOOD LINE
River = SCHOOL CHANNEL Reach = SCHOOL CHANNEL RS = 100.83
.022
.015
.022
Elevation (m)
Station (m)
Legend
EG Q50
WS Q50
Crit Q50
0.0 m/s
0.2 m/s
0.4 m/s
0.6 m/s
0.8 m/s
1.0 m/s
Ground
Bank Sta

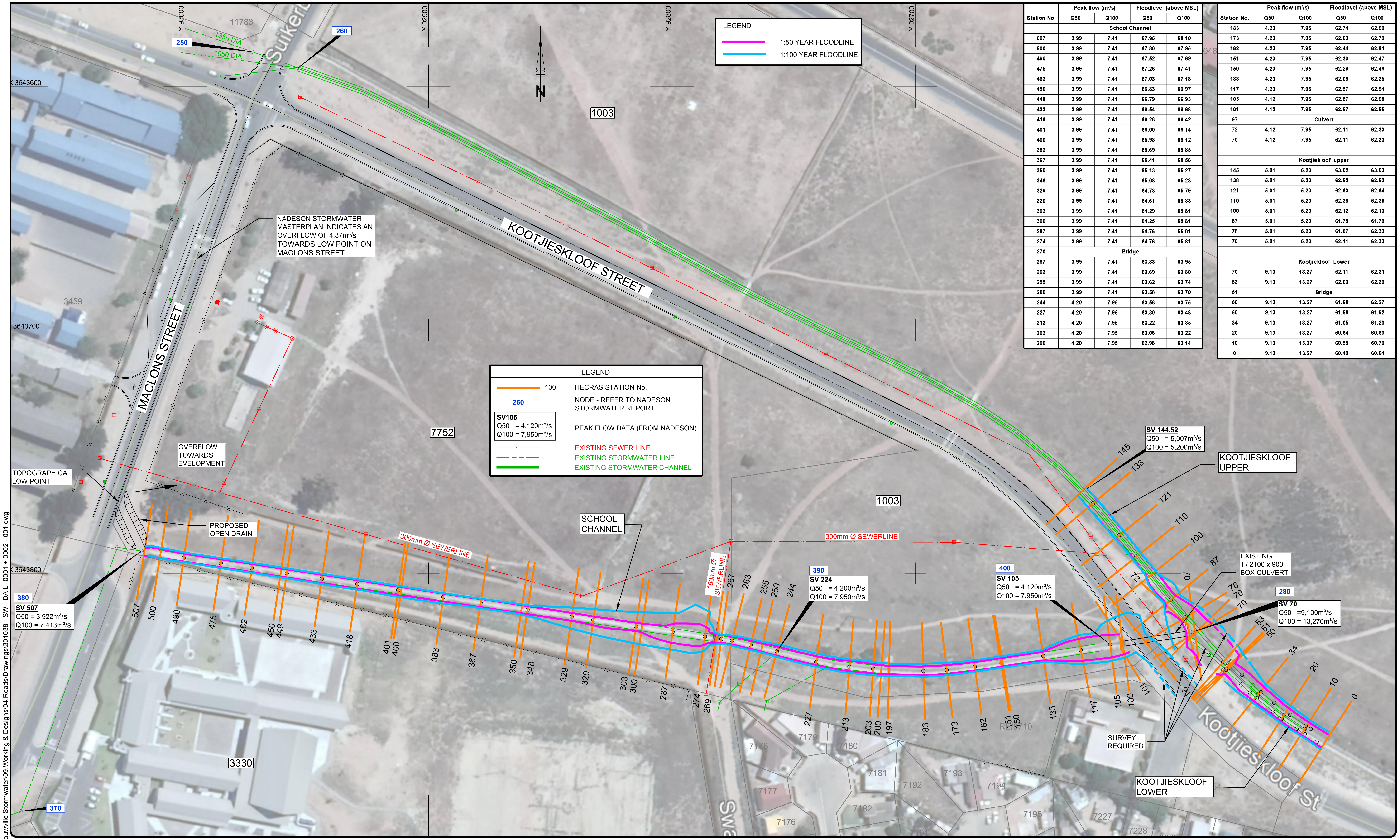

301038 FLOOD LINE
River = SCHOOL CHANNEL Reach = SCHOOL CHANNEL RS = 97 Culv
.022
.015
.022
Elevation (m)
Station (m)
Legend
EG Q50
WS Q50
Crit Q50
0.0 m/s
0.2 m/s
0.4 m/s
0.6 m/s
0.8 m/s
1.0 m/s
Ground
Bank Sta


301038 FLOOD LINE
River = SCHOOL CHANNEL Reach = SCHOOL CHANNEL RS = 97 Culv
.022
.015
.022
Elevation (m)
Station (m)
Legend
EG Q50
WS Q50
Crit Q50
0.0 m/s
0.2 m/s
0.4 m/s
0.6 m/s
0.8 m/s
1.0 m/s
Ground
Bank Sta


301038 FLOOD LINE
River = SCHOOL CHANNEL Reach = SCHOOL CHANNEL RS = 72.33
.022
.015
.022
Elevation (m)
Station (m)
Legend
EG Q50
WS Q50
0.0 m/s
0.2 m/s
0.4 m/s
0.6 m/s
0.8 m/s
1.0 m/s
Ground
Bank Sta


301038 FLOOD LINE
River = SCHOOL CHANNEL Reach = SCHOOL CHANNEL RS = 70
.022
.015
.022
Legend
EG Q50
WS Q50
Crit Q50
0.0 m/s
0.2 m/s
0.4 m/s
0.6 m/s
0.8 m/s
1.0 m/s
Ground
Bank Sta
Elevation (m)
62.5
62.0
61.5
61.0
60.5
0
10
20
30
40
Station (m)

Appendix 4: Layout Drawing: 301038-00-SW-DAL-0002-01 1:50 Year and 1:100 Year Floodlines of the existing channel between Maclon Street and Kootjieskloof Street



Station No.	Peak flow (m³/s) Q50	Peak flow (m³/s) Q100	Floodlevel (above MSL) Q50	Floodlevel (above MSL) Q100
	School Channel			
507	3.99	7.41	67.95	68.10
500	3.99	7.41	67.80	67.95
490	3.99	7.41	67.52	67.69
475	3.99	7.41	67.26	67.41
462	3.99	7.41	67.03	67.18
450	3.99	7.41	66.83	66.97
448	3.99	7.41	66.79	66.93
433	3.99	7.41	66.54	66.68
418	3.99	7.41	66.28	66.42
401	3.99	7.41	66.00	66.14
400	3.99	7.41	65.98	66.12
383	3.99	7.41	65.69	65.85
367	3.99	7.41	65.41	65.56
350	3.99	7.41	65.13	65.27
348	3.99	7.41	65.08	65.23
329	3.99	7.41	64.78	65.79
320	3.99	7.41	64.61	65.83
303	3.99	7.41	64.29	65.81
300	3.99	7.41	64.25	65.81
287	3.99	7.41	64.76	65.81
274	3.99	7.41	64.76	65.81
270	Bridge			
267	3.99	7.41	63.83	63.95
263	3.99	7.41	63.69	63.80
255	3.99	7.41	63.62	63.74
250	3.99	7.41	63.58	63.70
244	4.20	7.95	63.58	63.75
227	4.20	7.95	63.30	63.48
213	4.20	7.95	63.22	63.35
203	4.20	7.95	63.06	63.22
200	4.20	7.95	62.98	63.14

Station No.	Peak flow (m³/s) Q50	Peak flow (m³/s) Q100	Floodlevel (above MSL) Q50	Floodlevel (above MSL) Q100
183	4.20	7.95	62.74	62.90
173	4.20	7.95	62.63	62.79
162	4.20	7.95	62.44	62.61
151	4.20	7.95	62.30	62.47
150	4.20	7.95	62.29	62.46
133	4.20	7.95	62.09	62.25
117	4.20	7.95	62.57	62.94
105	4.12	7.95	62.57	62.95
101	4.12	7.95	62.57	62.95
97	Culvert			
72	4.12	7.95	62.11	62.33
70	4.12	7.95	62.11	62.33
	Kootjiekloof upper			
145	5.01	5.20	63.02	63.03
138	5.01	5.20	62.92	62.93
121	5.01	5.20	62.63	62.64
110	5.01	5.20	62.38	62.39
100	5.01	5.20	62.12	62.13
87	5.01	5.20	61.75	61.76
78	5.01	5.20	61.57	62.33
70	5.01	5.20	62.11	62.33
	Kootjiekloof Lower			
70	9.10	13.27	62.11	62.31
53	9.10	13.27	62.03	62.30
51	Bridge			
50	9.10	13.27	61.68	62.27
50	9.10	13.27	61.58	61.92
34	9.10	13.27	61.05	61.20
20	9.10	13.27	60.64	60.80
10	9.10	13.27	60.55	60.70
0	9.10	13.27	60.49	60.64

FOR INFORMATION

All dimensions must be verified on site before the works commence. Refer any discrepancies to the Engineer.

REVISION SCHEDULE

No	DATE	DESCRIPTION	DRW	CHK

CONSULTING ENGINEER

SIGNATURE | PR No | DATE

CLIENT

SIGNATURE | DATE

DESIGNED | DRAWN | CHECKED

CONSULTANT

iX engineers
Infrastructure Excellence
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Tel: +27 (0) 21 912 3000 | Fax: +27 (0) 21 912 322
www.ixengineers.co.za

CLIENT

SALDANHA BAAI BAY
MUNISIPALITEIT | MUNICIPALITY | uMASIPALA

PROJECT

DEVELOPMENT OF 200 ERVEN IN LOUWVILLE

DRAWING DESCRIPTION

FLOODLINES

SCALE FOR REDUCED PLAN
0 5 10 20 30 40 50
50mm ON ORIGINAL PLAN

DATE	SCALE	ORIGINAL SIZE
2017/01/01	AS SHOWN	A2

DRAWING NUMBER	REV
301038-00-SW-DAL-0002-001	00

P:\ iX Projects\301038_Vredenburg - Louwville Stormwater\09 Working & Designs\04 Roads\Drawings\301038 - SW - DAL - 0001 + 0002 - 001.dwg

09/11/2018 2:29:52 Printed By: Elize Louw (Cape Town)

Appendix 5: HecRas Results

River Station	Profile	Q Total	Min Ch El	Max Chl Dpth	W.S. Elev	Crit W.S.	Freebroad . Elev	E.G. Slope	Vel Left	Vel Right	Vel Chnl	Top Width	Froude # Chl
		(m^3/s)	(m)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m/s)	(m/s)	(m)	
						SCHOOL CHANNEL							
507	Q20	1.23	67.43	0.32	67.76	67.85	67.76	0.0170			2.54	2.99	2.02
507	Q50	3.99	67.43	0.50	67.93	68.15	67.95	0.0170			3.85	3.23	2.17
507	Q100	7.41	67.43	0.65	68.09	68.44	68.10	0.0170	0.31		4.80	3.35	2.25
500	Q20	1.23	67.24	0.35	67.59	67.70	67.60	0.0176	0.18	0.53	2.74	2.80	2.07
500	Q50	3.99	67.24	0.54	67.78	68.01	67.80	0.0147	1.05	1.41	4.06	3.77	2.13
500	Q100	7.41	67.24	0.69	67.93	68.27	67.95	0.0149	1.55	1.93	5.13	4.42	2.27
490	Q20	1.23	66.95	0.32	67.27	67.42	67.28	0.0207			3.12	1.99	2.24
490	Q50	3.99	66.95	0.55	67.49	67.76	67.52	0.0185	0.94	0.25	4.24	3.01	2.31
490	Q100	7.41	66.95	0.72	67.66	68.04	67.69	0.0160	1.48	1.15	5.16	3.80	2.30
475	Q20	1.23	66.71	0.32	67.03	67.16	67.04	0.0176			2.90	2.13	2.08
475	Q50	3.99	66.71	0.53	67.23	67.49	67.26	0.0184	0.61	0.33	4.15	3.08	2.30
475	Q100	7.41	66.71	0.68	67.39	67.79	67.41	0.0170	1.17	1.16	5.17	3.68	2.36
462	Q20	1.23	66.48	0.33	66.80	66.93	66.82	0.0175			2.90	2.12	2.08
462	Q50	3.99	66.48	0.53	67.01	67.26	67.03	0.0184	0.39	0.40	4.11	3.16	2.30
462	Q100	7.41	66.48	0.68	67.16	67.54	67.18	0.0178	1.14	1.19	5.19	3.90	2.41
450	Q20	1.23	66.27	0.33	66.60	66.73	66.61	0.0168			2.85	2.15	2.04
450	Q50	3.99	66.27	0.54	66.81	67.06	66.83	0.0174	0.51	0.39	4.05	3.21	2.24
450	Q100	7.41	66.27	0.68	66.96	67.34	66.97	0.0175	1.23	1.16	5.16	3.98	2.39
448	Q20	1.23	66.23	0.33	66.56	66.69	66.57	0.0170			2.86	2.16	2.04
448	Q50	3.99	66.23	0.54	66.77	67.02	66.79	0.0174	0.53	0.36	4.05	3.21	2.25
448	Q100	7.41	66.23	0.68	66.92	67.29	66.93	0.0175	1.24	1.14	5.15	3.98	2.39
433	Q20	1.23	65.98	0.33	66.31	66.44	66.32	0.0172			2.87	2.17	2.06
433	Q50	3.99	65.98	0.54	66.52	66.76	66.54	0.0175	0.62	0.38	4.05	3.34	2.25
433	Q100	7.41	65.98	0.68	66.66	67.04	66.68	0.0177	1.40	1.11	5.17	4.06	2.40
418	Q20	1.23	65.71	0.34	66.04	66.17	66.06	0.0175			2.91	2.10	2.07
418	Q50	3.99	65.71	0.55	66.25	66.50	66.28	0.0177	0.46	0.37	4.06	3.32	2.26
418	Q100	7.41	65.71	0.69	66.39	66.76	66.42	0.0180	1.36	1.11	5.18	4.26	2.41
401	Q20	1.23	65.43	0.34	65.77	65.89	65.78	0.0166			2.83	2.17	2.02
401	Q50	3.99	65.43	0.55	65.98	66.21	66.00	0.0172	0.32	0.34	3.98	3.42	2.23
401	Q100	7.41	65.43	0.69	66.11	66.47	66.14	0.0177	1.25	0.86	5.10	4.46	2.39
400	Q20	1.23	65.41	0.34	65.75	65.87	65.76	0.0166			2.83	2.17	2.02
400	Q50	3.99	65.41	0.55	65.96	66.20	65.98	0.0163	0.51	0.35	3.98	3.22	2.18
400	Q100	7.41	65.41	0.69	66.10	66.46	66.12	0.0169	1.25	0.86	5.10	4.51	2.35
383	Q20	1.23	65.12	0.34	65.46	65.58	65.47	0.0160	0.78		2.88	2.62	2.00
383	Q50	3.99	65.12	0.55	65.67	65.91	65.69	0.0145	1.86	0.94	4.19	3.27	2.12
383	Q100	7.41	65.12	0.71	65.83	66.21	65.85	0.0146	2.40	1.54	5.29	3.58	2.25
367	Q20	1.23	64.87	0.32	65.18	65.31	65.20	0.0179			2.89	2.20	2.10
367	Q50	3.99	64.87	0.52	65.39	65.63	65.41	0.0183	0.52	0.41	4.09	3.23	2.30
367	Q100	7.41	64.87	0.67	65.53	65.87	65.56	0.0174	1.24	1.07	5.14	3.83	2.39
350	Q20	1.23	64.56	0.34	64.89	65.02	64.91	0.0168			2.86	2.13	2.03
350	Q50	3.99	64.56	0.55	65.11	65.35	65.13	0.0171	0.58	0.32	4.02	3.21	2.22
350	Q100	7.41	64.56	0.69	65.25	65.63	65.27	0.0169	1.27	1.07	5.11	3.88	2.35
348	Q20	1.23	64.51	0.34	64.85	64.98	64.86	0.0168			2.86	2.13	2.03
348	Q50	3.99	64.51	0.55	65.07	65.31	65.08	0.0173	0.52	0.25	4.01	3.23	2.23
348	Q100	7.41	64.51	0.70	65.21	65.58	65.23	0.0173	1.24	1.01	5.11	3.95	2.37
329	Q20	1.23	64.21	0.34	64.54	64.67	64.56	0.0168			2.86	2.14	2.03
329	Q50	3.99	64.21	0.55	64.76	65.00	64.78	0.0165	0.48	0.39	3.99	3.16	2.19
329	Q100	7.41	64.21	1.53	65.74	65.27	65.79	0.0004	0.57	0.45	1.56	8.44	0.43
320	Q20	1.23	64.05	0.33	64.38	64.51	64.39	0.0178			2.89	2.18	2.09
320	Q50	3.99	64.05	0.54	64.59	64.83	64.61	0.0170	0.65	0.28	4.04	3.69	2.23
320	Q100	7.41	64.05	1.72	65.77		65.83	0.0002	0.51	0.33	1.24	10.04	0.32
303	Q20	1.23	63.73	0.33	64.06	64.19	64.07	0.0180			2.91	2.17	2.10
303	Q50	3.99	63.73	0.54	64.27	64.52	64.29	0.0179	0.44	0.31	4.06	3.33	2.27
303	Q100	7.41	63.73	2.05	65.79		65.81	0.0001	0.37	0.28	0.88	12.70	0.21
300	Q20	1.23	63.69	0.33	64.02	64.15	64.03	0.0175			2.88	2.17	2.07
300	Q50	3.99	63.69	0.54	64.23	64.48	64.25	0.0176	0.45	0.31	4.04	3.34	2.26
300	Q100	7.41	63.69	2.09	65.79		65.81	0.0001	0.36	0.28	0.84	13.07	0.19
287	Q20	1.23	63.50	0.32	63.82	63.95	63.83	0.0165			2.82	2.19	2.01
287	Q50	3.99	63.50	1.22	64.72	64.27	64.76	0.0003	0.44	0.20	1.10	7.52	0.35
287	Q100	7.41	63.50	2.30	65.79		65.81	0.0000	0.31	0.25	0.71	14.80	0.16
274	Q20	1.23	63.29	0.66	63.95	63.74	63.97	0.0005	0.18	0.16	0.92	3.13	0.42
274	Q50	3.99	63.29	1.43	64.72	64.07	64.76	0.0002	0.33	0.27	1.01	7.46	0.29
274	Q100	7.41	63.29	2.50	65.79	64.40	65.81	0.0000	0.27	0.17	0.76	26.57	0.16

River Station	Profile	Q Total	Min Ch El	Max Chl Dpth	W.S. Elev	Crit W.S.	Freebroad . Elev	E.G. Slope	Vel Left	Vel Right	Vel Chnl	Top Width	Froude # Chl
		(m^3/s)	(m)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m/s)	(m/s)	(m)	
270	Bridge												
267	Q20	1.23	63.26	0.35	63.62	63.70	63.62	0.0100			2.35	2.38	1.60
267	Q50	3.99	63.26	0.55	63.81	64.03	63.83	0.0131	0.33	0.63	3.76	3.03	1.98
267	Q100	7.41	63.26	0.67	63.93	64.33	63.95	0.0179	0.87	1.16	5.29	3.23	2.42
263	Q20	1.23	63.09	0.35	63.44	63.56	63.45	0.0134			2.73	1.98	1.82
263	Q50	3.99	63.09	0.58	63.67	63.91	63.69	0.0165		0.25	3.92	3.08	2.16
263	Q100	7.41	63.09	0.69	63.78	64.17	63.80	0.0212	0.63	1.05	5.37	3.86	2.56
255	Q20	1.23	63.01	0.36	63.37	63.48	63.38	0.0115			2.56	2.09	1.70
255	Q50	3.99	63.01	0.59	63.60	63.83	63.62	0.0131		0.62	3.73	3.30	1.95
255	Q100	7.41	63.01	0.71	63.72	64.10	63.74	0.0173	0.78	1.28	5.16	4.07	2.35
250	Q20	1.23	62.97	0.37	63.33	63.43	63.35	0.0110			2.50	2.16	1.67
250	Q50	3.99	62.97	0.59	63.56	63.78	63.58	0.0126	0.22	0.52	3.67	3.30	1.92
250	Q100	7.41	62.97	0.71	63.68	64.05	63.70	0.0164	0.87	1.19	5.05	4.08	2.30
244	Q20	1.33	62.88	0.40	63.29	63.37	63.29	0.0096			2.41	2.27	1.56
244	Q50	4.20	62.88	0.68	63.56	63.75	63.58	0.0074	0.29	0.80	3.47	3.25	1.55
244	Q100	7.95	62.88	0.84	63.72	64.09	63.75	0.0096	0.46	1.36	4.79	4.12	1.86
227	Q20	1.33	62.68	0.32	63.00	63.12	63.01	0.0118	0.07	0.62	2.78	2.19	1.76
227	Q50	4.20	62.68	0.60	63.28	63.53	63.30	0.0089	0.30	1.33	3.94	3.33	1.73
227	Q100	7.95	62.68	0.78	63.46	63.83	63.48	0.0104	0.92	1.78	5.17	5.00	1.96
213	Q20	1.33	62.55	0.52	63.06	63.08	63.09	0.0049			1.78	2.94	1.13
213	Q50	4.20	62.55	0.65	63.20	63.41	63.22	0.0118	0.73	0.68	3.60	4.21	1.88
213	Q100	7.95	62.55	0.78	63.33	63.66	63.35	0.0144	1.33	1.33	4.86	5.48	2.19
203	Q20	1.33	62.40	0.41	62.80	62.91	62.82	0.0110			2.57	2.14	1.67
203	Q50	4.20	62.40	0.64	63.03	63.26	63.06	0.0129	0.50	0.43	3.70	3.64	1.95
203	Q100	7.95	62.40	0.79	63.18	63.53	63.22	0.0140	1.18	1.14	4.83	5.18	2.14
200	Q20	1.33	62.34	0.38	62.73	62.84	62.73	0.0127			2.70	2.11	1.79
200	Q50	4.20	62.34	0.62	62.97	63.20	62.98	0.0129	0.33	0.41	3.75	3.34	1.95
200	Q100	7.95	62.34	0.78	63.13	63.48	63.14	0.0134	1.10	1.13	4.84	5.00	2.10
197	Q20	1.33	62.30	0.36	62.67	62.79	62.67	0.0135			2.75	2.12	1.84
197	Q50	4.20	62.30	0.60	62.91	63.14	62.92	0.0141	0.20	0.07	3.79	3.15	2.02
197	Q100	7.95	62.30	0.77	63.07	63.42	63.09	0.0140	1.02	1.01	4.85	4.72	2.14
183	Q20	1.33	62.16	0.32	62.48	62.60	62.49	0.0134			2.72	2.19	1.84
183	Q50	4.20	62.16	0.56	62.72	62.95	62.74	0.0134	0.30	0.36	3.77	3.32	1.98
183	Q100	7.95	62.16	0.72	62.88	63.23	62.90	0.0136	1.08	1.12	4.85	4.85	2.12
173	Q20	1.33	62.04	0.34	62.38	62.49	62.39	0.0120			2.61	2.24	1.75
173	Q50	4.20	62.04	0.57	62.61	62.84	62.63	0.0127	0.29	0.45	3.70	3.44	1.94
173	Q100	7.95	62.04	0.73	62.77	63.11	62.79	0.0133	1.05	1.16	4.80	4.89	2.10
162	Q20	1.33	61.85	0.33	62.18	62.30	62.19	0.0142			2.78	2.16	1.88
162	Q50	4.20	61.85	0.57	62.42	62.65	62.44	0.0141		0.14	3.79	3.10	2.01
162	Q100	7.95	61.85	0.74	62.59	62.95	62.61	0.0137	0.78	1.05	4.81	4.38	2.11
151	Q20	1.33	61.69	0.35	62.04	62.16	62.05	0.0136			2.73	2.18	1.85
151	Q50	4.20	61.69	0.59	62.28	62.51	62.30	0.0137		0.15	3.75	3.12	1.99
151	Q100	7.95	61.69	0.76	62.44	62.81	62.47	0.0137	1.01	1.03	4.81	4.38	2.11
150	Q20	1.33	61.68	0.35	62.03	62.15	62.04	0.0136			2.72	2.19	1.84
150	Q50	4.20	61.68	0.59	62.27	62.50	62.29	0.0137		0.16	3.75	3.12	1.99
150	Q100	7.95	61.68	0.76	62.44	62.80	62.46	0.0139	0.95	1.04	4.80	4.38	2.13
133	Q20	1.33	61.46	0.37	61.83	61.95	61.84	0.0120			2.63	2.19	1.74
133	Q50	4.20	61.46	0.61	62.07	62.29	62.09	0.0128	0.16	0.33	3.66	3.35	1.93
133	Q100	7.95	61.46	0.77	62.23	62.56	62.25	0.0133	1.02	1.12	4.75	4.73	2.10
117	Q20	1.33	61.26	0.36	61.62	61.74	61.63	0.0127			2.69	2.14	1.79
117	Q50	4.20	61.26	1.27	62.54	62.09	62.57	0.0003	0.35	0.39	1.04	9.20	0.33
117	Q100	7.95	61.26	1.63	62.89	62.37	62.94	0.0003	0.47	0.52	1.28	11.81	0.34
105	Q20	1.35	61.02	0.77	61.79	61.45	61.81	0.0003	0.09		0.69	4.24	0.32
105	Q50	4.12	61.02	1.53	62.55		62.57	0.0001	0.25	0.25	0.71	9.23	0.20
105	Q100	7.95	61.02	1.88	62.90		62.95	0.0001	0.38	0.22	1.01	19.33	0.26
101	Q20	1.35	60.87	0.93	61.80	61.25	61.81	0.0001	0.01	0.01	0.47	4.36	0.18
101	Q50	4.12	60.87	1.68	62.55	61.57	62.57	0.0001	0.16	0.15	0.63	8.86	0.17
101	Q100	7.95	60.87	2.04	62.91	61.83	62.95	0.0001	0.28	0.16	0.93	16.27	0.22
97		Culvert											
72	Q20	1.35	60.57	1.19	61.76		61.76	0.0000	0.04	0.05	0.18	17.35	0.06
72	Q50	4.12	60.57	1.53	62.10		62.11	0.0000	0.11	0.12	0.37	27.14	0.10
72	Q100	7.95	60.57	1.75	62.32		62.33	0.0000	0.14	0.19	0.55	38.43	0.14
70	Q20	1.35	60.51	1.25	61.76	60.74	61.76	0.0000	0.04	0.03	0.13	16.61	0.04
70	Q50	4.12	60.51	1.59	62.10	60.93	62.11	0.0000	0.07	0.08	0.28	25.63	0.08

River Station	Profile	Q Total	Min Ch El	Max Chl Dpth	W.S. Elev	Crit W.S.	Freebroad . Elev	E.G. Slope	Vel Left	Vel Right	Vel Chnl	Top Width	Froude # Chl
		(m^3/s)	(m)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m/s)	(m/s)	(m)	
70	Q100	7.95	60.51	1.81	62.32	61.10	62.33	0.0000	0.11	0.12	0.44	36.69	0.11
KOOTJIE 2													
145	Q20	4.99	62.42	0.58	63.00	63.31	63.02	0.0170	1.11	1.02	4.64	4.46	2.29
145	Q50	5.01	62.42	0.58	63.00	63.32	63.02	0.0170	1.11	1.03	4.65	4.47	2.29
145	Q100	5.20	62.42	0.59	63.01	63.34	63.03	0.0170	1.15	1.07	4.71	4.58	2.30
138	Q20	4.99	62.31	0.59	62.89	63.23	62.92	0.0164	1.13	1.14	4.64	4.64	2.25
138	Q50	5.01	62.31	0.59	62.90	63.23	62.92	0.0164	1.13	1.15	4.65	4.65	2.25
138	Q100	5.20	62.31	0.60	62.90	63.24	62.93	0.0164	1.17	1.19	4.71	4.75	2.26
121	Q20	4.99	62.03	0.58	62.61	62.93	62.63	0.0165	1.08	1.19	4.64	4.32	2.26
121	Q50	5.01	62.03	0.58	62.61	62.93	62.63	0.0165	1.08	1.20	4.64	4.33	2.26
121	Q100	5.20	62.03	0.59	62.62	62.94	62.64	0.0165	1.12	1.24	4.71	4.43	2.27
110	Q20	4.99	61.77	0.59	62.36	62.69	62.38	0.0167	0.90	1.18	4.74	4.04	2.28
110	Q50	5.01	61.77	0.59	62.36	62.70	62.38	0.0167	0.90	1.18	4.75	4.05	2.28
110	Q100	5.20	61.77	0.60	62.37	62.71	62.39	0.0167	0.96	1.22	4.81	4.13	2.29
100	Q20	4.99	61.52	0.58	62.09	62.39	62.12	0.0187	1.12	1.28	4.95	4.07	2.41
100	Q50	5.01	61.52	0.58	62.09	62.40	62.12	0.0187	1.12	1.29	4.96	4.08	2.41
100	Q100	5.20	61.52	0.59	62.10	62.42	62.13	0.0186	1.15	1.33	5.02	4.20	2.41
87	Q20	4.99	61.15	0.58	61.73	62.07	61.75	0.0214	1.18	1.14	5.11	4.03	2.54
87	Q50	5.01	61.15	0.58	61.73	62.07	61.75	0.0214	1.19	1.14	5.12	4.04	2.54
87	Q100	5.20	61.15	0.59	61.74	62.08	61.76	0.0213	1.23	1.19	5.18	4.15	2.54
78	Q20	4.99	60.97	0.58	61.55	61.88	61.57	0.0211	1.20	1.13	5.08	4.13	2.53
78	Q50	5.01	60.97	0.58	61.55	61.88	61.57	0.0210	1.21	1.13	5.09	4.14	2.53
78	Q100	5.20	60.97	1.32	62.30	61.89	62.33	0.0003	0.39	0.30	1.19	22.04	0.35
70	Q20	4.99	60.55	1.18	61.74	61.05	61.76	0.0001		0.24	0.75	8.82	0.23
70	Q50	5.01	60.55	1.54	62.10	61.05	62.11	0.0001	0.07	0.19	0.54	16.47	0.14
70	Q100	5.20	60.55	1.77	62.32	61.06	62.33	0.0000	0.08	0.12	0.45	29.77	0.11
KOOTJIE 1													
70	Q20	6.46	60.56	1.15	61.71		61.75	0.0003		0.31	1.04	8.38	0.32
70	Q50	9.10	60.56	1.50	62.06		62.11	0.0002	0.13	0.38	1.05	12.59	0.28
70	Q100	13.27	60.56	1.70	62.25		62.31	0.0003	0.23	0.32	1.31	24.61	0.33
53	Q20	6.46	60.38	1.19	61.57	61.35	61.61	0.0010	0.55	0.52	1.90	6.28	0.62
53	Q50	9.10	60.38	1.60	61.99	61.53	62.03	0.0004	0.42	0.34	1.62	22.20	0.44
53	Q100	13.27	60.38	1.86	62.24	61.91	62.30	0.0003	0.35	0.44	1.57	36.26	0.39
51	Bridge												
50	Q20	6.46	60.34	1.03	61.37	61.36	61.40	0.0023	0.71	0.73	2.55	4.89	0.92
50	Q50	9.10	60.34	1.30	61.64	61.54	61.68	0.0015	0.81	0.61	2.57	7.35	0.80
50	Q100	13.27	60.34	1.87	62.21	61.90	62.27	0.0003	0.37	0.47	1.56	35.59	0.39
50	Q20	6.46	60.34	1.02	61.36	61.36	61.39	0.0023	0.73	0.74	2.58	4.85	0.93
50	Q50	9.10	60.34	1.20	61.54	61.54	61.58	0.0022	0.89	0.90	2.87	5.61	0.93
50	Q100	13.27	60.34	1.53	61.87	61.87	61.92	0.0014	0.75	0.56	2.80	19.23	0.79
34	Q20	6.46	60.12	0.78	60.90	61.14	60.92	0.0078	0.89	0.82	3.73	5.39	1.61
34	Q50	9.10	60.12	0.90	61.02	61.29	61.05	0.0073	1.16	1.10	4.13	6.79	1.62
34	Q100	13.27	60.12	1.05	61.17	61.48	61.20	0.0069	1.44	1.40	4.58	8.55	1.62
20	Q20	6.46	59.80	0.69	60.49	60.79	60.51	0.0129	0.81	0.81	4.32	4.52	2.02
20	Q50	9.10	59.80	0.81	60.61	60.94	60.64	0.0111	1.17	1.18	4.67	5.78	1.95
20	Q100	13.27	59.80	0.97	60.76	61.15	60.80	0.0097	1.51	1.52	5.09	7.39	1.89
10	Q20	6.46	59.69	0.71	60.40	60.69	60.42	0.0117	0.78	0.84	4.21	4.59	1.94
10	Q50	9.10	59.69	0.83	60.51	60.84	60.55	0.0107	1.14	1.19	4.63	5.78	1.92
10	Q100	13.27	59.69	0.98	60.67	61.05	60.70	0.0095	1.50	1.53	5.09	7.29	1.88
0	Q20	6.46	59.60	0.75	60.34	60.61	60.37	0.0101	0.84	0.81	4.03	4.63	1.81
0	Q50	9.10	59.60	0.86	60.46	60.77	60.49	0.0096	1.16	1.14	4.49	5.72	1.83
0	Q100	13.27	59.60	1.01	60.61	60.97	60.64	0.0089	1.49	1.48	4.99	7.17	1.82

Appendix 6: Copy of Report on Stormwater Catchment Assessment at Louwville High School, Vredenburg by Nadeson Consulting Services, May 2014

LOUWVILLE HIGH SCHOOL

STORMWATER CATCHMENT ASSESSMENT REPORT

MAY 2014

Prepared for:

WORLEYPARSONS RSA

31 Allen Drive
Loevenstein
7530

Prepared by:

NADESON CONSULTING SERVICES

15TH floor Triangle House
22 Riebeek Street
Cape Town, 8000

REVISION SUMMARY

Project Name: *LOUWVILLE HIGH SCHOOL STORMWATER CATCHMENT ASSESSMENT REPORT*

Contract No: VR032/09

Document No: VR032/09/OD/001

This document has gone through a line of checking procedure, which forms part of our Quality Management System.

………..
Signature of Project Leader

………..
Signature of Head of Department

REV	DATE	BY	DESCRIPTION OF REVISION
00	12 June 2014	CS	Issued to Client

TABLE OF CONTENTS

1 INTRODUCTION

1.1 Brief

Nadeson Consulting Services was appointed by WorleyParsons RSA on behalf of the Department of Public works to assess the impact of extreme rainfall events on the proposed Louwville High School.

The assessment will inform recommendations aimed at mitigating negative impacts through the introduction of stormwater controls.

1.2 Objectives

The Objectives for the Stormwater Investigation are as follows:

- Determine the catchment area draining to the site
- Analyse the cut-off drains for the 1:50 year and 1:100 year rainfall events and assessing if the infrastructure will contain these events.
- Analyse the existing closed networks for the 1:50 year and 1:100 year rainfall events and determining impacts of the overflow
- Analyse the 1:50 year and 1:100 year rainfall events assuming that the existing infrastructure has failed and all flows are overland
- Determining the floodplain elevation and extents on the site, along Maclon Street, Duif Street, and the existing concrete lined channel north of the site
- Recommendations for the Finished Floor Elevation of the proposed school
- Recommendations for upgrading the existing infrastructure

1.3 Site Description and Proposed Improvements

The Proposed Louwville High School is located on Erf 3300, off Maclon Street in Louwville, Vredenburg, Western Cape. It is situated on the east side of Maclon Street, south of Kootjieskloof Street. To the north, the site it is bound by an open concrete lined channel, and to the south it is bound by Duif Street.

Currently the site has temporary classroom structures located on the eastern half of the site. The remainder of the site consists of an open field with sparse vegetation.

The topography of the site is relatively flat, with gradients on average of 1.76% but varying between 1.14% and 7.40%.

The proposed development will consist of new school buildings, a parking lot, drop off area, and related underground infrastructure improvements.

2 ANALYSIS

2.1 Standard Reference Documents, Codes of Practice, Policies and Guidelines

This report references the master planning for the Vredenburg/Louwville Basin that was originally done first by Wouter Engelbrecht Engineers in August 1997, and then later by Nadeson Consulting Services in July 2012.

As part of the Stormwater Master Plan that was compiled for the Vredenburg/Louwville Basin, the guidelines that are being referenced include the following:

- Guidelines for Human Settlement Planning and Design (Published by CSIR Building and Construction Technology, 2000, Boutek Report No. BOU/E2001 (known as "Red Book")
- SANRAL Road Drainage Manual
- Minimum Standards for Civil Engineering Services in Townships Version 1, July 2013 by the City of Cape Town

Using the references, the following minimum parameters were established:

- Major Systems will be designed for the 1:50 year peak rainfall event
  - Runoff to be no more than 150mm above the road crown
- Minor Systems will be designed for the 1:2 year peak rainfall event
  - The stormwater system within the school will need to be designed for the 1:5 year peak rainfall event since it is classified as an institution
- 1:100 year peak event to be accommodated in the freeboard of stormwater structures.

2.2 Stormwater Model

An overall stormwater system model has been developed to determine the peak flows and flood levels for the existing and proposed infrastructure. This model was utilised to run the 50 year and 100 year rainfall events to determine the impacts on the school site.

Please refer to Annexure B for a print out of the results for both the 1:50 year and 1:100 year rainfall events

2.2.1 Modeling Software

Two software packages were selected to model the Vredenburg/Louwville Basic; Civil Designer "Storm" was used to simulate the surface runoff incorporating the interconnected system of hydrologic and hydraulic components. The Illudas Time-Area method is used for estimation of runoff from a uniformly distributed design storm.

HEC-RAS, river analysis system software, performs a one-dimensional steady flow calculation which is used to generate water surface profiles needed for the 1:50 year and 1:100 year return period flood lines.

2.2.2 Model Parameters

Parameters used in the model are based on accepted norms and sound engineering judgement. Where possible a desk-top study has been conducted to ascertain the accuracy of the values asserted.

The following parameters were used in the model:

- Storm duration of 328 minutes for the major storm, based on Manning and Kerby equations
- Ratio of the time to peak vs storm duration of 0.38
- Land use in terms of paved, supplementary and grassed are based on land use representative calculations based on the future Spatial Development Plan for Vredenburg
- A "coastal" climate region in accordance with the SCS storm distribution area map. The type 1 distribution applies to coastal areas with winter rainfall or rainfall through the year
- Rainfall station Verdenburg (Pol), SAWB number 0060864 W is the closest station to our catchment. A Mean Annual Precipitation (MAP) value of 275mm and the 2-year return period rainfall of 34.6mm are extracted from the rainfall station information

2.2.3 Description of Model

Delineation of the catchment area was accomplished using topographical countour mapping data and a substantial database of topographical information procured from previous Saldanha Bay Municipality contracts.

In addition to this, the survey performed by Neil Woodin Surveys in October 2013 for the proposed school site was used in the model as well.

GIS information and as-built drawings were obtained and used in the development of the system network.

2.3 Catchment

The Vredenburg / Louwville basin is approximately 1050 hectares. As highlighted by the Stormwater Master Plan, there are various different drainage routes that act as cut-off drains thereby reducing the concentration that would otherwise occur without these drainage systems in place.

The area that ultimately drains to the school site is approximately 112.49 hectares. This consists of a mixture of residential, institutional and commercial land uses. Please refer to Figure 1: Overall Catchment Plan.

2.4 Cut-Off Drain Analysis

The cut-off drains can be defined as follows:

- Witteklip Stormwater Channel
- Ruthfirst Stormwater Channel
- Kootjieskloof Collector System

2.4.1 Witteklip Stormwater Channel

The Witteklip Stormwater Channel is located just south of Vink Street and runs parallel to the railway line. It is an open earth channel that starts at the Ruthfirst Pond's outlet structure and terminates at Southern Bypass Street. It acts as a cut-off drain for the area from Witteklip that drains north in to the channel.

The analysis was performed for both the 1:50 year and 1:100 year rain fall events and the runoff was contained within the channel. The runoff values obtained for these rainfall events were 1.50m^3/s and 1.84m^3/s respectively, the capacity of the channel is 9.74m^3/s.

Please refer to Figure 3: Typical Road and Channel Cross Sections for the typical cross sections of the channel.

2.4.2 Ruthfirst Stormwater Channel

The Ruthfirst Stormwater Channel is located west of Bergsig Street and runs south towards the Ruthfirst Pond. It is an open grass-block lined channel that starts south of Fairbairn Street and runs south in to the Ruthfirst Pond. It acts as a cut-off drain for the area west of the Louwville Basin.

The 1:50 year and 1:100 year rainfall events were analysed and the runoff from both these events was contained within the channel. The runoff values obtained for these rainfall events were 2.77m^3/s and 3.34m^3/s respectively, with the capacity of the channel being 3.92m^3/s

Please refer to Figure 3: Typical Road and Channel Cross Sections for the typical cross sections of the channel.

2.4.3 Kootjieskloof Collector System

The Kootjieskloof Collector System consists of a 1350mm diameter concrete pipe with an overflow channel or depression above the pipe.

For both the 1:50 year and 1:100 year rainfall events, the pipe surcharges at node 200 just before Erica Street and then again at node 250 just before Suikerbos Avenue. In both of these incidents the system is designed that the overflow enters the 1350mm diameter concrete pipe at the next node downstream, which are nodes 210 and 260 respectively.

In the event that the overflows do not re-enter the drainage system, a portion of the flows will drain south towards Kootjieskloof Street. The road prism will act as a secondary open channel until the overflow either re-enters the underground drainage system or continues overland to Maclon Street. From Maclon Street the overflow will then flow south to the open concrete lined channel north of the school site.

2.5 Maclon Street

Maclon Street falls from Bokmakierie Street, passing the proposed school site, and then towards the open stormwater channel. This can be referred to as the western drainage portion of Maclon Street. It also falls down from Kootjieskloof Street to the same open stormwater channel, and this section can be referred to as the northern drainage portion of Maclon Street.

The ridge separating the western and northern drainage points is located at the bell mouth of the southern entrance to the Louwville Primary School. The lowest point within the road is located at the catchpit just north of the open stormwater channel.

The underground drainage system has adequate capacity to convey both the 1:50 year and 1:100 year rainfall events as long as there are no blockages within the system. In the event of a blockage, Maclon Street will then act as a secondary drainage channel to convey the runoff down to the open stormwater channel.

2.6 Drainage Channel North of School Site

The open stormwater channel located directly north of the proposed school site is the lowest point within the catchment area. It continues in an easterly direction until it converges with the Ongegund Channel as illustrated in Figure 3: Typical Road and Channel Cross Sections.

It has a concrete lining for the more frequent, lower intensity rainfall events, and grass covered banks to contain the larger rainfall events.

An analysis was performed for the 1:50 year and 1:100 year rainfall events, assuming the inclusion of the overflow from the Kootjieskloof Collector System. These results show the channel was able to convey these larger rainfall events with flows of 3.92m^3/s and 7.41m^3/s respectively. The capacity of the channel is 39m^3/s. Please refer to the HEC-RAS cross section in Annexure B for a graphical representation of these results.

Please refer to the typical cross sections located in Figure 3: Typical Road and Channel Cross Sections for the typical cross sections of the channel.

2.7 Duif Street

Duif Street is located on the south side of the proposed school site. During the catchment analysis, it was noted that there is a small portion that can potentially drain down Duif Street.

There is a 300mm diameter stormwater pipe that starts approximately midway down Duif Street and connects to the 750mm diameter stormwater pipe system located in Swavel Street. In the event that the 300mm diameter pipe blocks, Duif Street will then act as a secondary channel, conveying the runoff to the next drainage structure located at the intersection of Swavel Street

The 1:50 year and 1:100 year rainfall events were analysed for the catchment draining to Duif Street, and the runoff was contained within the road reserve up until approximately 150m from the Swavel Street intersection where the flow then overtopped in to the school site.

Please refer to Figure 3: Typical Road and Channel Cross Sections for the typical cross section for Duif Street.

2.8 Worst Case Scenario

In the event that the underground drainage system fails, and the capacity of the pipes are reduced, the runoff will then overflow in to the roads until it enters back in to the system at a further downstream structure.

Since it is unlikely that the system will fail completely, and all at once, a worst case scenario where the underground system is running at 50% capacity and the remainder as overflow was modeled for both the 1:50 year and 1:100 year rainfall events along Maclon Street. In both cases, the runoff overtopped the kerb and went on to the school site.

3 RECOMMENDATIONS

3.1 Maclon Street

In order to ensure that the overflow from the northern catchment of Maclon Street flows easily in to the open stormwater channel, it is recommended to remove a portion of the kerb and replace it with a dropped kerb (Item 3.1).

The existing catchpit across from the proposed drop-off exit is not adequate to accept the amount of runoff that could potentially come down Maclon Street from the Bokmakierie side. Therefore additional catchpit structures should be constructed adjacent to the existing structure to increase the inlet capacity in that area (Item 3.2).

Please refer to Figure 2: Stormwater Layout for the location of the proposed recommendations.

3.2 School Site

The design of the proposed drop-off area should be designed to act as a berm or levee between Maclon Street and the school building. The highest elevation of this berm should be at least equal to the 100 year water level assuming that the closed system is at half the capacity. This elevation is 70.23, refer to the HEC-RAS cross section in Annexure B for a graphical representation of the results. Furthermore, the profile of the berm will need to extend from the southernmost point of the property all the way along up until the open stormwater channel (Item 3.3).

With the berm protecting the school from any overflows, the finished floor elevation for the school can remain at 69.85 provided the internal drainage of the school and parking is not connected to the stormwater system within Maclon Street.

The underground drainage system for the drop-off area should be separate from the remainder of the onsite drainage system. This is to avoid surcharging in areas on the eastern side of berm. The drainage in the drop-off area should be upsized to accommodate the 100-year rainfall event (Item 3.4).

As additional precaution for ensuring that there is a clear path for the runoff to flow into the open stormwater channel from the drop off area, dropped kerbs should be introduced along the northern edge to create an overflow path (Item 3.5).

The design of the internal drainage for the site will be done by WorleyParsons RSA.

Please refer to Figure 2: Stormwater Layout for the location of the proposed recommendations.

3.3 Duif Street

During the analysis it was highlighted that a portion of the runoff starts overtopping the road in to the school site. To prevent this from occurring and contain the runoff within the road, it is recommended to create an earth berm along the southern side of the school site. The berm can be a landscaped feature of approximately 500mm high (Item 3.6).

Please refer to Figure 2: Stormwater Layout for the location of the proposed recommendations.

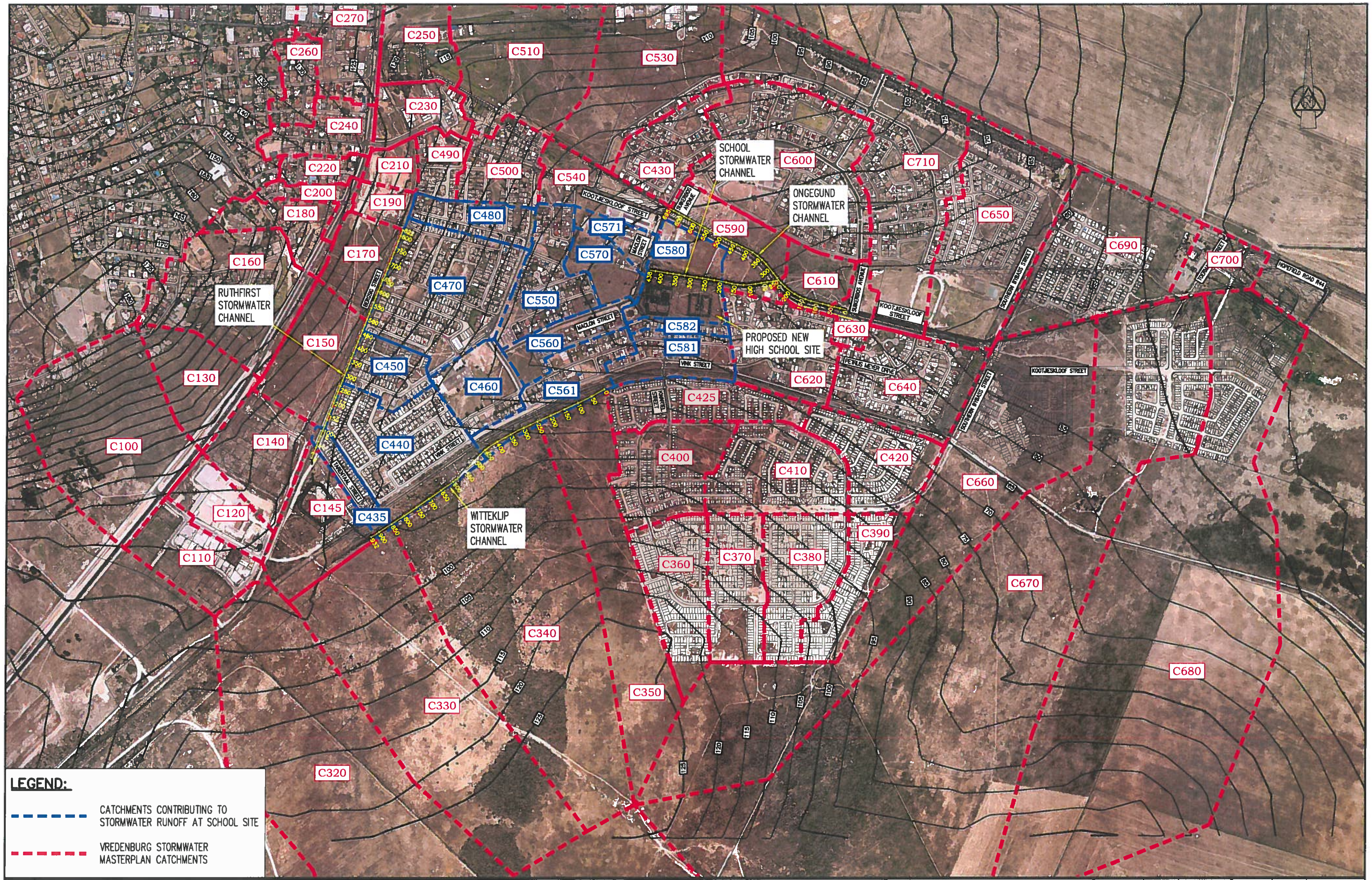
4 CONCLUSIONS

- In conclusion the analysis was performed to determine the catchment area draining to the school site and verifying that the cut-off drains were able to convey the 1:50 year and 1:100 year rainfall events.
- In instances where the cut-off drains were found to be inadequate, further investigation was performed to determine where the runoff from the breaches would flow to and how it could potentially affect the school site.
- The existing infrastructure was analysed for the 50 year and 100 year rainfall events to determine if they were able to convey the runoff from these rainfall events.
- A further investigation was performed assuming that the infrastructure had failed and what the effect of the runoff would be on the school site.
- The flood elevations were determined for Maclon Street, the school site, and Duif Street, with recommendations given on what the finished floor elevation should be for the proposed school building.
- Further recommendations were provided on changing the existing infrastructure to ensure that the proposed school site will be further protected from potential flooding.

ANNEXURES

ANNEXURE A

FIGURE 1: OVERALL CATCHMENT PLAN
FIGURE 2: STORMWATER LAYOUT
FIGURE 3: TYPICAL ROAD AND CHANNEL CROSS SECTIONS
FIGURE 4: TYPICAL CROSS SECTION OF MACLON STREET AND PROPOSED SCHOOL ROAD



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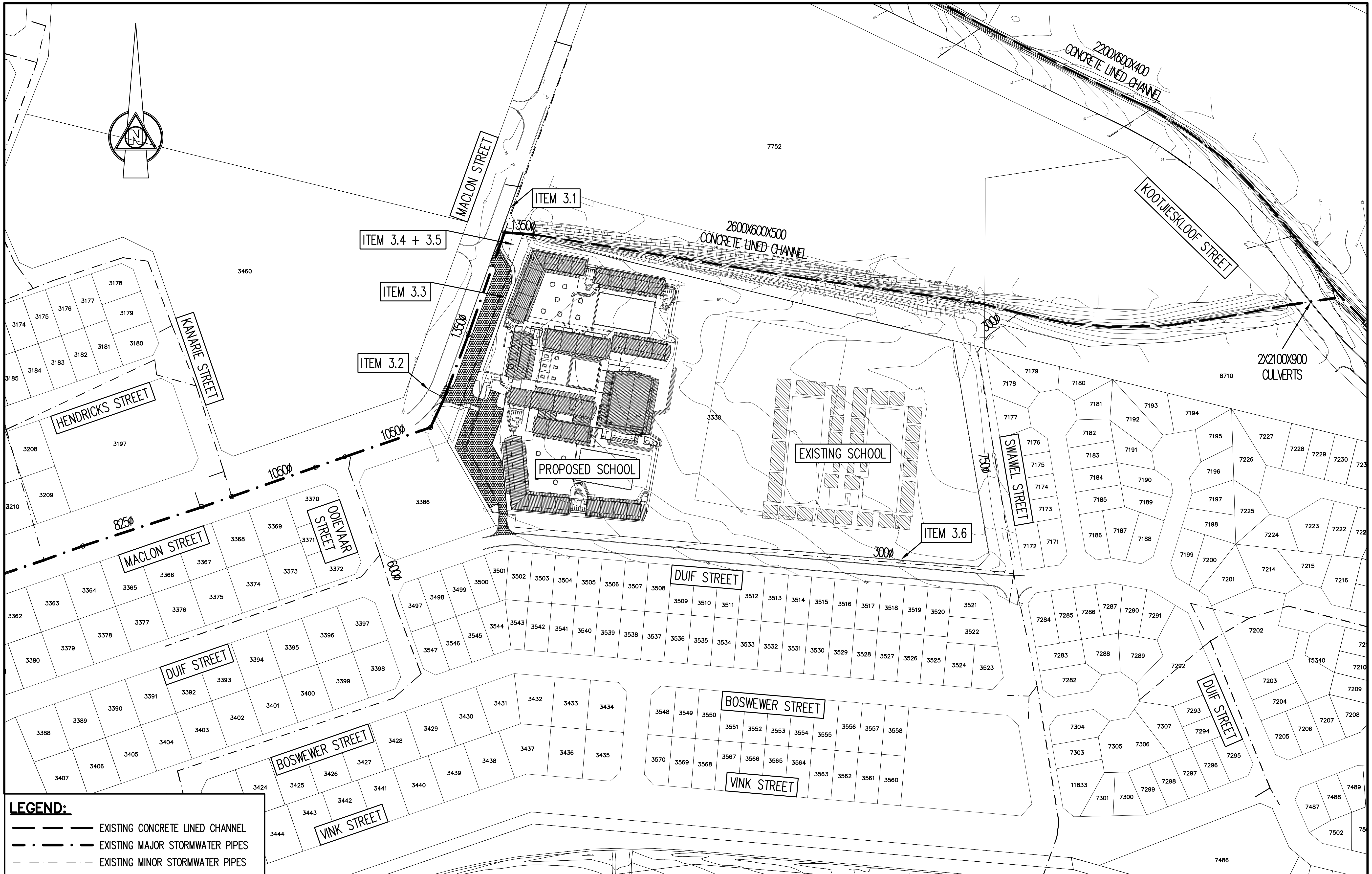
DRAWING TITLE
FIGURE 1: OVERALL CATCHMENT PLAN

PROJECT
LOUWVILLE HIGH SCHOOL

	INITIAL	DATE		INITIAL	DATE
DESIGNED			DRAWN	M.E.D.	05-06-2014
CHECKED	L.C.	05-06-2014	CHECKED	A.D.	05-06-2014

PROJECT NO	DRAWING NO	REVISION
VR032/09	FIG. 1	0A



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DRAWING TITLE
FIGURE 2: STORMWATER LAYOUT

PROJECT
LOUWVILLE HIGH SCHOOL

	INITIAL	DATE		INITIAL	DATE
DESIGNED			DRAWN	M.E.D.	05-06-2014
CHECKED	L.C.	05-06-2014	CHECKED	A.D.	05-06-2014

PROJECT NO	DRAWING NO	REVISION
VR032/09	FIG. 2	0A

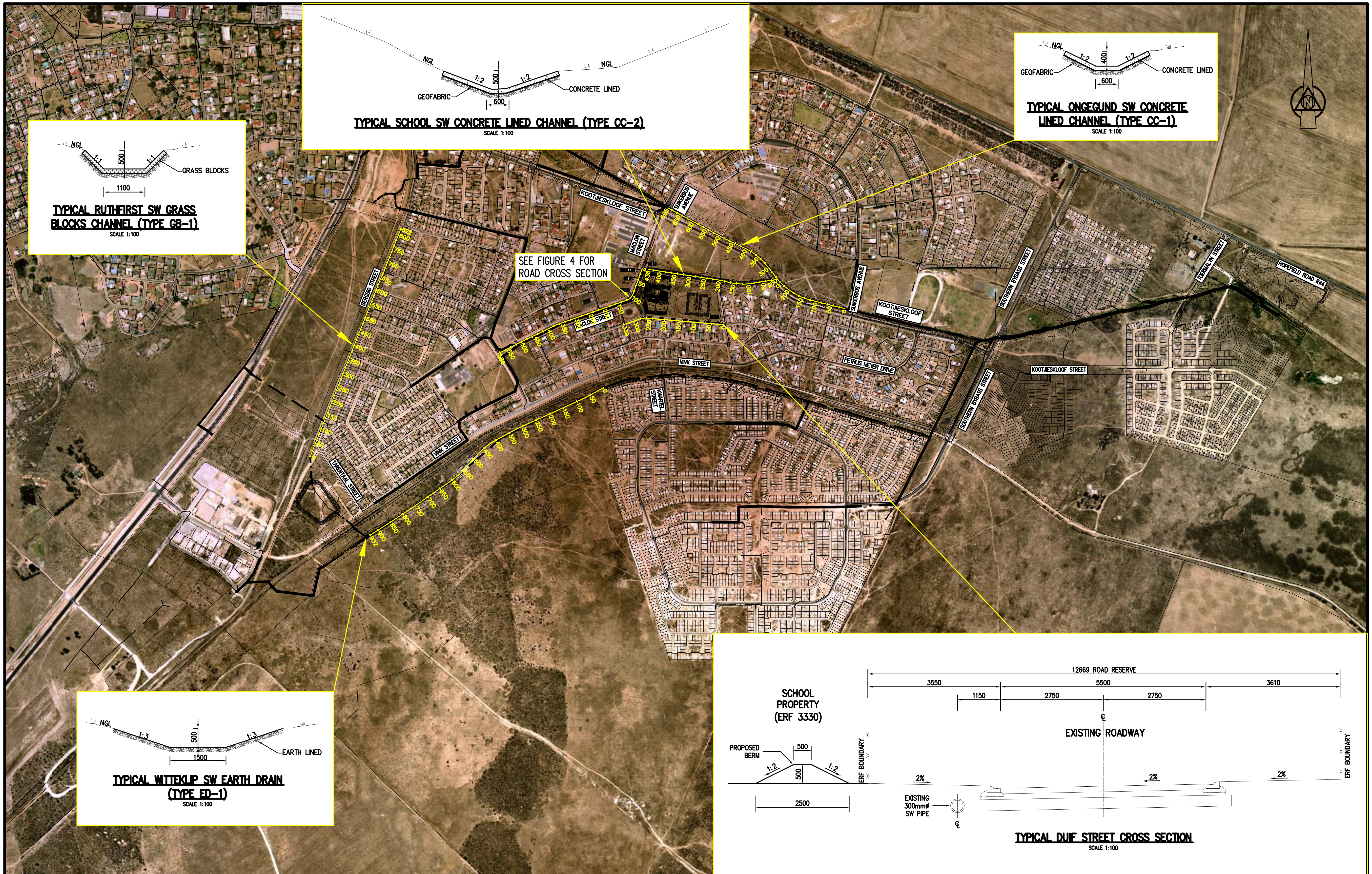

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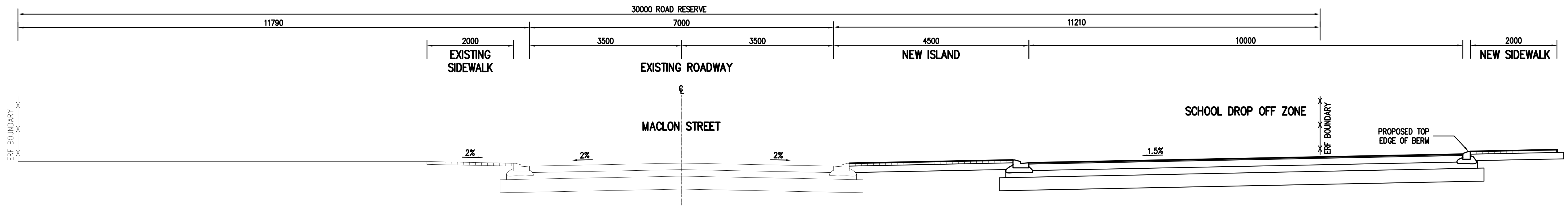
FIGURE 3: TYPICAL ROAD AND CHANNEL CROSS SECTIONS

PROJECT

LOUWVILLE HIGH SCHOOL

	INITIAL	DATE		INITIAL	DATE
DESIGNED			DRAWN	M.E.D.	05-06-2014
CHECKED	L.C.	05-06-2014	CHECKED	A.D.	05-06-2014

PROJECT NO	DRAWING NO	REVISION
VR032/09	FIG. 3	0A



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DRAWING TITLE
FIGURE 4: TYPICAL CROSS SECTION OF MACLON STREET AND PROPOSED SCHOOL ROAD

PROJECT
LOUWVILLE HIGH SCHOOL

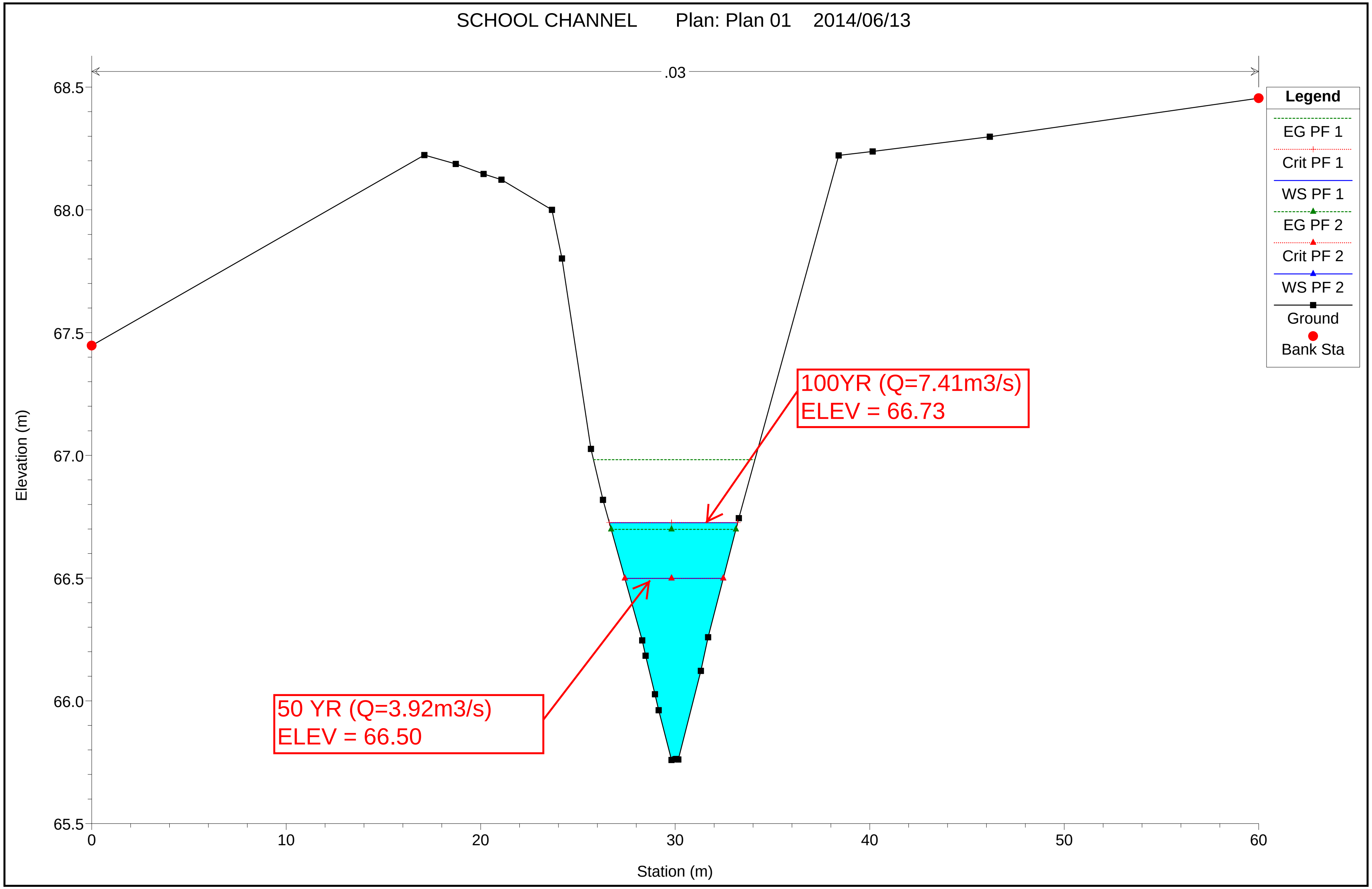
	INITIAL	DATE		INITIAL	DATE
DESIGNED			DRAWN	M.E.D.	05-06-2014
CHECKED	L.C.	05-06-2014	CHECKED	A.D.	05-06-2014

PROJECT NO	DRAWING NO	REVISION
VR032/09	FIG. 4	0A

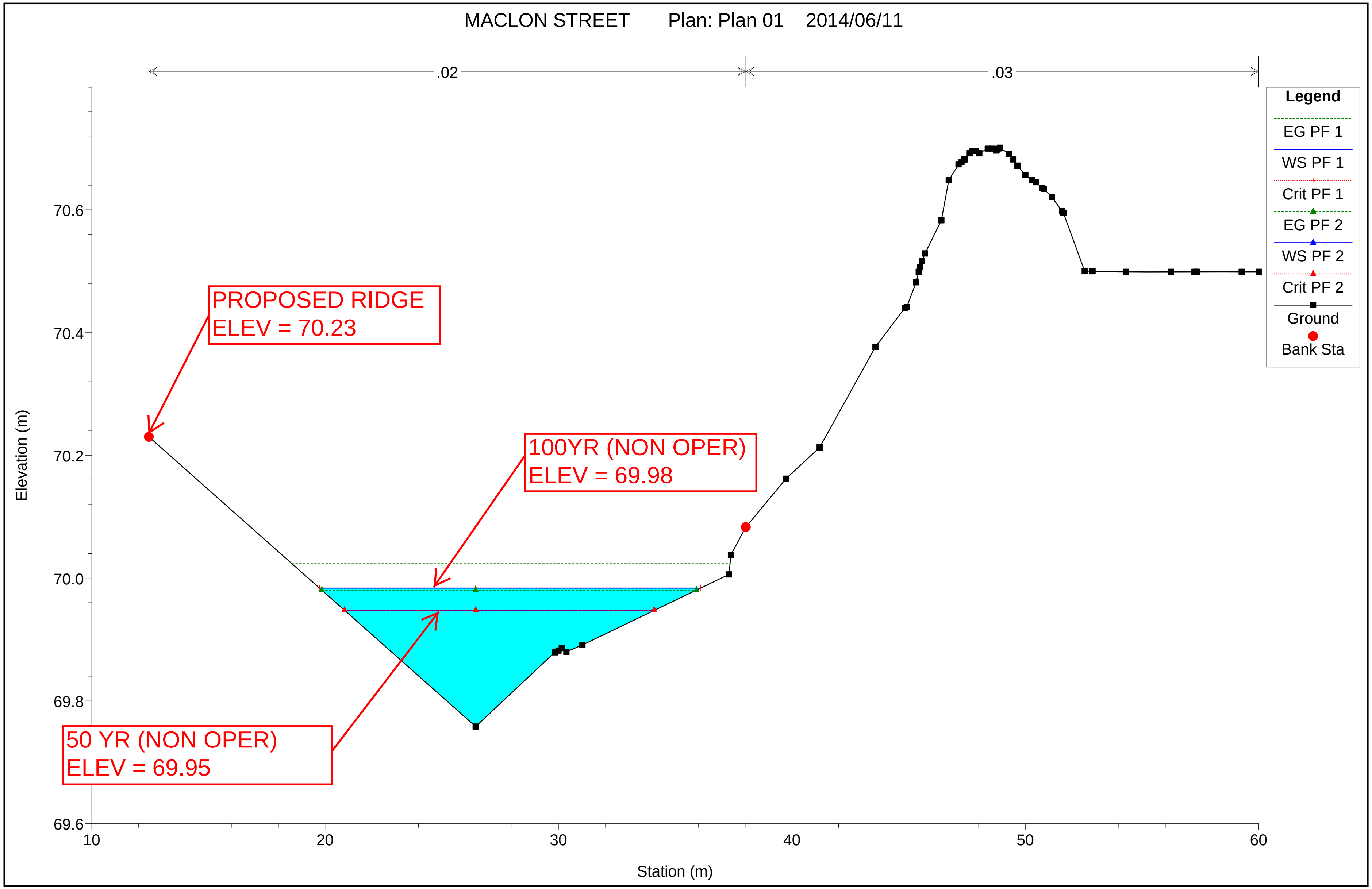
ANNEXURE B

HECRAS CROSS SECTIONS ANALYSIS RESULTS

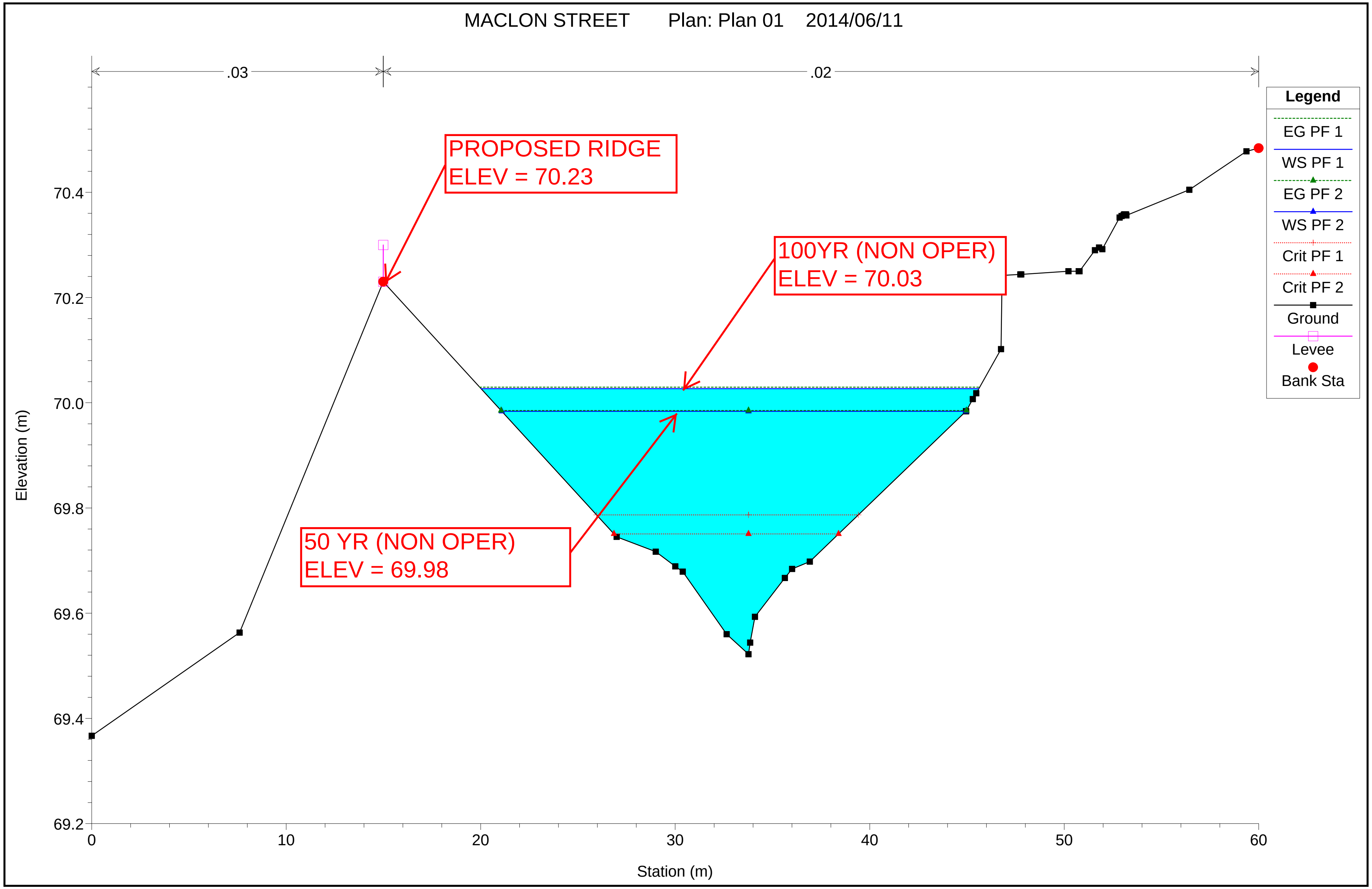
VR032-09 LOUWVILLE HIGH SCHOOL - HECRAS RESULTS - SCHOOL CHANNEL - STATION 350



VR032-09 LOUWVILLE HIGH SCHOOL - HECRAS RESULTS - MACLON STREET - STATION 20



VR032-09 LOUWVILLE HIGH SCHOOL - HECRAS RESULTS - MACLON STREET - STATION 90



Results Summary

File Name: R:\VR032\Stormwater\Master Plan\Base Drawing Civil Designer\Louwville Stormwater MP.stw

Inflow Calculation Method	= Illudas	
Number of Nodes analyzed	= 148	

Subnetwork 1

Outfall Data

Outfall Node	= OUT		
Outlet Level	=	41.232	m
Design Flow	=	0.982	m3/s

Storm Data

File Name: R:\VR032\Stormwater\Master Plan\Vredenberg 50 year - MAP 275 - 328min.stm

Chicago Storm Coastal Region

MAP 275 50yr 328min

Mean Annual Precipitation	=	275	mm
Return Period	=	50	years
Duration	=	328	min
Time Step	=	18	min
Ratio of Peak to Duration	=	0.38	

Factors:

A = 677   B = 12.0   C = 0.750

Total Depth	=	47.2	mm

Antecedant Moisture Condition	= Rather Wet (3)
Routing Method	= Continuity

Accuracy Check

Volume of inflow	=	93758.2	m3
Volume at outfall	=	93363.9	m3
Percentage Error	=	0.42	%

Illudas Runoff Analysis

Node Name	Next Node Name	Runoff m3/s	Surface Inflow m3/s	Paved Area Volume m3	Grass Area Volume m3	Total Volume m3
10	20	0.9156	0.9156	2716.417	798.194	3514.6
100	110	0.2259	0.2259	748.497	0.000	748.5
1000	1010	0.0000	0.0000	0.000	0.000	0.0
1010	OUT	0.0000	0.0000	0.000	0.000	0.0
110	180	0.1552	0.1552	664.837	0.000	664.8
120	100	0.1039	0.1039	216.453	92.547	309.0
130	100	0.0886	0.0886	275.204	13.417	288.6
140	290	0.0994	0.0994	207.176	88.581	295.8
150	130	0.2576	0.2576	656.410	165.484	821.9
160	170	1.9834	1.9834	6512.882	1913.749	8426.6
170	110	0.0000	0.0000	0.000	0.000	0.0
180	190	0.0000	0.0000	0.000	0.000	0.0
190	200	0.0000	0.0000	0.000	0.000	0.0
20	30	0.9752	0.9752	2893.313	850.173	3743.5
200	210	0.0000	0.0000	0.000	0.000	0.0
210	250	0.1983	0.1983	849.626	0.000	849.6
220	230	0.3116	0.3116	924.354	271.613	1196.0
230	240	0.0000	0.0000	0.000	0.000	0.0
240	210	0.0000	0.0000	0.000	0.000	0.0
250	260	0.1765	0.1765	633.246	30.872	664.1
260	280	0.1963	0.1963	753.041	0.000	753.0
270	260	0.1538	0.1538	551.791	26.901	578.7
280	470	0.0746	0.0746	285.927	0.000	285.9
290	300	0.2411	0.2411	641.547	154.885	796.4
30	50	0.2482	0.2482	645.560	189.692	835.3
300	310	0.1614	0.1614	378.873	113.039	491.9
310	320	0.0000	0.0000	0.000	0.000	0.0
320	330	0.0000	0.0000	0.000	0.000	0.0
330	340	0.0000	0.0000	0.000	0.000	0.0
340	342	0.3921	0.3921	1406.454	68.567	1475.0
342	343	0.0000	0.0000	0.000	0.000	0.0
343	344	0.0000	0.0000	0.000	0.000	0.0
344	350	0.0000	0.0000	0.000	0.000	0.0
350	360	0.1886	0.1886	676.536	32.982	709.5
360	370	0.1162	0.1162	335.957	16.379	352.3
365	360	0.2562	0.2562	755.029	36.809	791.8
370	375	0.0474	0.0474	63.889	110.195	174.1
375	380	0.0688	2.1441	84.854	197.914	282.8
380	382	0.0000	0.0000	0.000	0.000	0.0
382	384	0.0000	0.0000	0.000	0.000	0.0
384	390	0.0000	0.0000	0.000	0.000	0.0
390	395	0.1963	0.1963	359.895	414.841	774.7

Vredenburg Masterplan 50 yr 05-06-2014

Node Name	Next Node Name	Runoff m3/s	Surface Inflow m3/s	Paved Area Volume m3	Grass Area Volume m3	Total Volume m3
391	392	0.1397	0.1397	407.248	19.854	427.1
392	394	0.0613	0.0613	176.848	8.622	185.5
394	390	0.0000	0.0000	0.000	0.000	0.0
395	400	0.0000	0.0000	0.000	0.000	0.0
40	50	0.1537	0.1537	320.203	136.907	457.1
400	280	0.0000	0.0000	0.000	0.000	0.0
410	420	0.1098	0.1098	393.927	19.205	413.1
420	340	0.0000	0.0000	0.000	0.000	0.0
430	440	0.0667	0.0667	207.257	10.104	217.4
440	450	0.3270	0.3270	1173.076	57.190	1230.3
450	460	0.0337	0.0337	314.480	226.119	540.6
460	343	0.0000	0.0000	0.000	0.000	0.0
470	480	0.3257	0.3257	877.203	261.719	1138.9
480	513	0.0898	0.0898	127.168	123.437	250.6
490	500	0.5046	0.5046	2021.309	98.543	2119.9
50	60	0.0000	0.0000	0.000	0.000	0.0
500	510	0.0500	0.0500	191.905	0.000	191.9
510	511	0.0000	0.0000	0.000	0.000	0.0
511	480	0.0000	0.0000	0.000	0.000	0.0
513	516	0.0000	0.0000	0.000	0.000	0.0
516	520	0.1339	0.1339	480.183	23.410	503.6
520	523	0.8936	0.8936	2684.663	800.987	3485.7
523	525	0.0000	0.0000	0.000	0.000	0.0
525	530	0.0000	0.0000	0.000	0.000	0.0
530	860	0.4767	0.4767	1909.340	93.084	2002.4
540	545	0.2412	0.2412	514.098	289.298	803.4
545	550	0.5419	0.5419	1587.590	400.239	1987.8
550	570	0.9060	0.9060	2654.121	669.117	3323.2
560	565	1.0670	1.0670	2422.886	886.747	3309.6
565	565A	0.0000	0.0000	0.000	0.000	0.0
565A	565B	0.0000	0.0000	0.000	0.000	0.0
565B	550	0.0000	0.0000	0.000	0.000	0.0
570	580	0.0000	0.0000	0.000	0.000	0.0
580	585	0.0000	0.0000	0.000	0.000	0.0
585	590	0.0000	0.0000	0.000	0.000	0.0
590	600	0.6921	0.6921	2145.087	358.442	2503.5
60	65	0.9216	0.9216	2734.455	803.494	3537.9
600	610	0.0000	0.0000	0.000	0.000	0.0
610	620	0.0000	0.0000	0.000	0.000	0.0
620	630	0.0000	0.0000	0.000	0.000	0.0
630	640	0.0609	0.0609	233.496	0.000	233.5
640	650	0.1800	0.1800	771.020	0.000	771.0
65	67	0.0000	0.0000	0.000	0.000	0.0
650	660	0.2325	0.2325	996.026	0.000	996.0

Vredenburg Masterplan 50 yr 05-06-2014

Node Name	Next Node Name	Runoff m3/s	Surface Inflow m3/s	Paved Area Volume m3	Grass Area Volume m3	Total Volume m3
660	664	0.0951	0.0951	407.481	0.000	407.5
664	670	0.0000	0.0000	0.000	0.000	0.0
67	68	0.0000	0.0000	0.000	0.000	0.0
670	680	0.0000	0.0000	0.000	0.000	0.0
68	70	0.0000	0.0000	0.000	0.000	0.0
680	684	0.0000	0.0000	0.000	0.000	0.0
684	685	0.0000	0.0000	0.000	0.000	0.0
685	686	0.0000	0.0000	0.000	0.000	0.0
686	690	0.0000	0.0000	0.000	0.000	0.0
690	692	0.1237	0.1237	474.460	0.000	474.5
692	693	0.0000	0.0000	0.000	0.000	0.0
693	695	0.0000	0.0000	0.000	0.000	0.0
695	697	0.0000	0.0000	0.000	0.000	0.0
697	698	0.0000	0.0000	0.000	0.000	0.0
698	699	0.0000	0.0000	0.000	0.000	0.0
699	700	0.0000	0.0000	0.000	0.000	0.0
70	80	0.0000	0.0000	0.000	0.000	0.0
700	701	0.1336	0.1336	512.488	0.000	512.5
700A	700	2.0156	2.0156	1353.926	4055.772	5409.7
701	702	0.0000	0.0000	0.000	0.000	0.0
702	704	0.0000	0.0000	0.000	0.000	0.0
704	706	0.0000	0.0000	0.000	0.000	0.0
706	708	0.0000	0.0000	0.000	0.000	0.0
708	525	0.0000	0.0000	0.000	0.000	0.0
710	530	0.1269	0.1269	455.120	22.188	477.3
720	730	0.7606	0.7606	1609.561	1129.325	2738.9
730	760	1.5340	1.5340	4698.848	1402.230	6101.1
740	750	0.4516	0.4516	1207.849	369.082	1576.9
750	752	0.0000	0.0000	0.000	0.000	0.0
752	752A	0.0000	0.0000	0.000	0.000	0.0
752A	752B	0.0000	0.0000	0.000	0.000	0.0
752B	754	0.0000	0.0000	0.000	0.000	0.0
754	756	0.0000	0.0000	0.000	0.000	0.0
756	590	0.0000	0.0000	0.000	0.000	0.0
760	750	0.2175	0.2175	532.361	212.418	744.8
770	775	0.0000	0.0000	0.000	0.000	0.0
775	780	0.3312	0.3312	1270.145	0.000	1270.1
780	790	0.0000	0.0000	0.000	0.000	0.0
790	630	0.0000	0.0000	0.000	0.000	0.0
80	110	0.3117	0.3117	947.455	174.668	1122.1
800	810	0.1541	0.1541	591.203	0.000	591.2
810	690	0.1741	0.1741	667.748	0.000	667.7
820	830	0.1501	0.1501	575.742	0.000	575.7
830	840	0.1312	0.1312	503.320	0.000	503.3

Node Name	Next Node Name	Runoff m3/s	Surface Inflow m3/s	Paved Area Volume m3	Grass Area Volume m3	Total Volume m3
840	850	0.1517	0.1517	581.818	0.000	581.8
850	700	0.1043	0.1043	400.085	0.000	400.1
860	862	0.0000	0.0000	0.000	0.000	0.0
862	866	0.0000	0.0000	0.000	0.000	0.0
866	870	0.0000	0.0000	0.000	0.000	0.0
870	873	0.2609	0.2609	804.083	0.000	804.1
873	876	0.0000	0.0000	0.000	0.000	0.0
876	880	0.0000	0.0000	0.000	0.000	0.0
880	890	0.2650	0.2650	1135.156	0.000	1135.2
890	900	0.0000	0.0000	0.000	0.000	0.0
90	95	0.2147	0.2147	447.390	191.287	638.7
900	910	0.6223	0.6223	3706.249	0.000	3706.2
910	920	0.0339	0.0339	112.340	0.000	112.3
920	930	0.0000	0.0000	0.000	0.000	0.0
930	940	0.4620	0.4620	2751.661	0.000	2751.7
940	1000	0.0000	0.0000	0.000	0.000	0.0
95	130	0.0000	0.0000	0.000	0.000	0.0
OUT		0.0000	0.0000	0.000	0.000	0.0

Flow Analysis

Link Name	Next Link Name	Number of Links	Link Type	Calculated Size	Flow m3/s	Capacity m3/s	Velocity m/s	Flow Depth %
10	20	1	100D Concrete	675	0.6040	0.6040	2.008	100.000
100	110	1	100D Concrete	525	0.8771	1.0555	5.675	68.000
1000	1010	1	WEIR 1	5000 x 800	0.9822	27.9730	4.451	12.000
1010	OUT	1	MP SW CH	Overland wide	0.9822	1.2213	0.706	89.000
110	180	1	100D Concrete	1350	6.3948	6.7117	6.096	76.000
120	100	1	100D Concrete	375	0.1039	0.5117	3.741	30.000
130	100	1	50D Concrete	525	0.5504	1.2940	5.541	45.000
140	290	1	MP SW CH	Overland Ch	0.0994	1.7116	1.082	22.000
150	130	1	50D Concrete	450	0.2576	0.6412	3.876	43.000
160	170	1	50D Concrete	825	1.9834	3.5312	6.703	53.000
170	110	1	MP SW CH	TYPE CC-1	1.9671	3.8611	5.748	71.000
180	190	1	100D Concrete	1350	6.2932	9.5210	8.126	59.000
190	200	1	100D Concrete	1350	6.2693	7.7205	6.862	67.000
20	30	1	100D Concrete	675	1.4886	1.4886	4.949	100.000
200	210	1	100D Concrete	1350	5.2450	5.2450	4.755	100.000
210	250	1	100D Concrete	1350	6.6780	9.3089	8.066	62.000
220	230	1	100D Concrete	450	0.3116	0.4726	3.211	57.000
230	240	1	100D Concrete	600	0.2972	0.4396	1.722	56.000
240	210	1	100D Concrete	600	0.2720	1.6384	4.512	27.000

Link Name	Next Link Name	Number of Links	Link Type	Calculated Size	Flow m3/s	Capacity m3/s	Velocity m/s	Flow Depth %
250	260	1	100D Concrete	1350	4.6758	4.6758	4.239	100.000
260	280	1	100D Concrete	1350	5.0077	7.2791	6.273	60.000
270	260	1	100D Concrete	1050	0.1538	3.7924	2.383	12.000
280	470	1	100D Concrete	1350	5.8551	5.8551	5.309	100.000
290	300	1	100D Concrete	300	0.2599	0.2599	4.247	79.000
30	50	1	100D Concrete	675	1.4413	1.4413	4.792	100.000
300	310	1	100D Concrete	375	0.2897	0.2897	3.072	100.000
310	320	1	100D Concrete	450	0.4700	0.4700	3.427	100.000
320	330	1	100D Concrete	525	0.4255	0.4255	2.336	79.000
330	340	1	100D Concrete	750	0.4808	0.7935	1.980	55.000
340	342	1	100D Concrete	825	0.9683	2.1949	4.354	46.000
342	343	1	75D Concrete	825	0.9613	1.7310	3.635	52.000
343	344	1	75D Concrete	825	1.3181	1.5145	3.484	70.000
344	350	1	75D Concrete	825	1.2848	1.7382	3.879	62.000
350	360	1	100D Concrete	1050	1.4401	2.4340	3.310	54.000
360	370	1	100D Concrete	1200	1.7905	3.2767	3.351	52.000
365	360	1	100D Concrete	600	0.2562	1.3283	3.809	29.000
370	375	1	100D Concrete	1350	1.8209	3.9535	3.079	47.000
375	380	1	75D Concrete	1350	3.3571	3.3571	2.904	100.000
380	382	1	MP SW CH	TYPE CC-2	1.5207	1.5207	1.890	100.000
382	384	1	MP SW CH	TYPE CC-2	1.5207	1.5207	1.892	100.000
384	390	1	MP SW CH	TYPE CC-2	1.5207	1.5207	1.886	100.000
390	395	1	MP SW CH	TYPE CC-2	1.5207	1.5207	1.896	100.000
391	392	1	75D Concrete	750	0.1397	1.8493	2.607	18.000
392	394	1	75D Concrete	750	0.1986	0.8802	1.678	31.000
394	390	1	100D Concrete	375	0.1287	0.1287	1.364	100.000
395	400	1	MP SW CH	TYPE CC-2	2.6809	2.6809	3.333	100.000
40	50	1	50D Concrete	375	0.1537	0.2661	2.569	54.000
400	280	1	Box Culvert	2100 x 900	4.1258	11.4662	4.829	44.000
410	420	1	100D Concrete	525	0.1098	0.7450	2.536	25.000
420	340	1	100D Concrete	600	0.1046	1.0856	2.540	20.000
430	440	1	100D Concrete	450	0.0667	0.3863	1.791	26.000
440	450	1	100D Concrete	525	0.3851	0.4041	2.198	73.000
450	460	1	100D Concrete	600	0.3820	0.5184	2.096	62.000
460	343	1	100D Concrete	600	0.3710	0.7669	2.821	48.000
470	480	1	Portal Culvert	2100 x 1200	9.4273	21.3432	9.022	40.000
480	513	1	100D Concrete	1350	3.6632	3.6632	3.323	100.000
490	500	1	100D Concrete	825	0.5046	0.8673	1.831	53.000
50	60	1	100D Concrete	750	1.2272	1.2272	3.325	100.000
500	510	1	100D Concrete	825	0.5381	0.9729	2.041	52.000
510	511	1	MP SW CH	TYPE CC-1	0.5334	0.9409	1.441	75.000
511	480	1	100D Concrete	750	0.5228	0.7935	2.023	59.000
513	516	1	100D Concrete	1350	7.4654	7.4654	6.769	100.000
516	520	1	100D Concrete	1350	7.1486	7.1486	6.481	100.000

Link Name	Next Link Name	Number of Links	Link Type	Calculated Size	Flow m3/s	Capacity m3/s	Velocity m/s	Flow Depth %
520	523	1	100D Concrete	1350	5.0731	5.0731	4.600	100.000
523	525	1	100D Concrete	1350	3.9303	3.9303	3.568	100.000
525	530	1	Box Culvert	1800 x 900	5.7556	5.7556	3.553	100.000
530	860	2	Box Culvert	2 x 2100 x 900	15.8734	35.9198	7.977	52.000
540	545	1	MP SW CH	Overland Ch	0.2412	1.7218	1.413	36.000
545	550	1	100D Concrete	525	0.5263	0.5263	2.876	100.000
550	570	1	100D Concrete	1050	2.7702	3.9158	5.556	61.000
560	565	1	75D Concrete	900	1.0670	3.0865	4.734	40.000
565	565A	1	75D Concrete	900	1.0710	4.3553	6.094	33.000
565A	565B	1	75D Concrete	900	1.0780	3.8993	5.634	36.000
565B	550	1	75D Concrete	900	1.0847	3.9252	5.670	36.000
570	580	1	100D Concrete	1050	2.3385	2.3385	3.473	100.000
580	585	1	75D Concrete	1200	2.5012	2.5012	2.698	100.000
585	590	1	Drains	Sheet flow	2.7605	9.1638	2.260	63.000
590	600	1	Reservoir	Ruthfirst Pond	6.4100	1.6330	0.000	0.000
60	65	1	100D Concrete	825	2.4810	2.4810	5.769	100.000
600	610	1	100D Concrete	600	0.7519	0.7519	3.173	100.000
610	620	1	100D Concrete	1050	0.7519	1.3096	1.776	54.000
620	630	1	100D Concrete	600	0.3093	0.3093	1.305	100.000
630	640	1	MP SW CH	TYPE CC-N1A	1.0968	7.1600	1.449	43.000
640	650	1	MP SW CH	TYPE CC-N1A	1.2533	9.6576	1.889	41.000
65	67	1	100D Concrete	900	1.2616	1.2616	2.412	100.000
650	660	1	MP SW CH	TYPE CC-N2A	1.4953	9.7366	1.586	43.000
660	664	1	100D Concrete	825	1.4836	1.4836	3.450	100.000
664	670	1	100D Concrete	825	1.6125	1.7198	4.007	77.000
67	68	1	100D Concrete	900	1.2641	1.2641	2.417	100.000
670	680	1	100D Concrete	825	1.6184	2.0251	4.612	67.000
68	70	1	100D Concrete	900	3.2122	4.8307	8.710	59.000
680	684	1	100D Concrete	825	1.6191	1.8274	4.233	73.000
684	685	1	100D Concrete	825	1.5305	1.5305	3.559	100.000
685	686	1	100D Concrete	825	1.5035	1.5035	3.496	100.000
686	690	1	100D Concrete	825	1.1589	1.1589	2.705	100.000
690	692	1	100D Concrete	825	1.9595	2.0751	4.838	77.000
692	693	1	100D Concrete	825	1.2197	1.2197	2.836	100.000
693	695	1	100D Concrete	825	0.9729	0.9729	2.273	100.000
695	697	1	100D Concrete	825	1.3536	1.3536	3.148	100.000
697	698	1	100D Concrete	825	1.5945	1.5945	3.708	100.000
698	699	1	100D Concrete	825	1.9274	1.9274	4.482	100.000
699	700	1	100D Concrete	825	1.4930	1.4930	3.484	100.000
70	80	1	100D Concrete	1050	3.2042	6.5777	8.543	48.000
700	701	1	100D Concrete	825	3.4039	3.4039	7.946	100.000
700A	700	1	100D Concrete	525	0.3114	0.3114	1.709	100.000
701	702	1	100D Concrete	825	2.9616	2.9616	6.887	100.000
702	704	1	100D Concrete	825	3.0504	3.0504	7.094	100.000

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Link Name	Next Link Name	Number of Links	Link Type	Calculated Size	Flow m3/s	Capacity m3/s	Velocity m/s	Flow Depth %
704	706	1	100D Concrete	825	2.3711	2.3711	5.514	100.000
706	708	1	100D Concrete	900	1.2152	1.2152	2.335	100.000
708	525	1	100D Concrete	825	3.7685	3.7685	8.764	100.000
710	530	1	100D Concrete	450	0.1269	0.7766	3.689	27.000
720	730	1	MP SW CH	Overland Ch	0.4202	0.4202	0.600	100.000
730	760	1	MP SW CH	Overland Ch	1.1553	1.1553	1.650	100.000
740	750	1	75D Concrete	900	0.4516	1.0433	1.690	45.000
750	752	1	100D Concrete	1050	1.7689	1.7689	2.627	100.000
752	752A	1	75D Concrete	900	0.7964	0.7964	1.527	100.000
752A	752B	1	75D Concrete	900	0.7964	0.7964	1.527	100.000
752B	754	1	75D Concrete	900	0.7954	0.7954	1.525	100.000
754	756	1	50D Concrete	1350	2.4549	2.4549	2.017	100.000
756	590	1	Drains	Sheet flow	2.9575	4.6382	1.365	83.000
760	750	1	75D Concrete	900	1.1659	1.1659	2.229	100.000
770	775	1	75D Concrete	1200	0.0000	2.0028	0.000	0.000
775	780	1	75D Concrete	1200	0.3312	1.7009	1.228	28.000
780	790	1	100D Concrete	1200	0.3061	1.8084	1.333	26.000
790	630	1	MP SW CH	TYPE ED-1	0.2902	1.7493	0.713	40.000
80	110	1	100D Concrete	1050	3.4892	5.9506	8.079	54.000
800	810	1	100D Concrete	375	0.1541	0.3114	2.858	47.000
810	690	1	100D Concrete	600	0.3184	1.1319	3.596	35.000
820	830	1	100D Concrete	300	0.1501	0.2074	3.221	61.000
830	840	1	100D Concrete	450	0.2772	0.3343	2.351	63.000
840	850	1	100D Concrete	450	0.2611	0.2611	1.910	100.000
850	700	1	100D Concrete	525	0.4910	0.8145	4.057	54.000
860	862	1	Box Culvert	1500 x 1200	14.4943	14.4943	8.046	99.000
862	866	1	Box Culvert	1500 x 1200	7.8016	7.8016	4.334	100.000
866	870	1	Box Culvert	1500 x 1200	11.2880	11.2880	6.267	100.000
870	873	1	Box Culvert	1500 x 1200	10.6493	10.6493	5.914	100.000
873	876	1	Portal Culvert	1500 x 1200	8.5785	8.5785	5.107	100.000
876	880	1	Portal Culvert	1500 x 1200	6.4126	6.4126	3.817	100.000
880	890	1	Box Culvert	1500 x 1200	5.4647	5.4647	3.036	100.000
890	900	2	Portal Culvert	2 x 1500 x 1200	14.9525	14.9525	4.451	99.000
90	95	1	100D Concrete	450	0.2147	0.6308	3.659	39.000
900	910	1	Box Culvert	1800 x 1500	9.4874	9.4874	3.510	100.000
910	920	2	Portal Culvert	2 x 1500 x 1200	16.7137	33.2991	9.911	46.000
920	930	1	MP SW CH	TYPE GBC -1	16.6993	24.1417	1.785	79.000
930	940	1	MP SW CH	TYPE GBC -1	16.2990	24.6440	1.831	80.000
940	1000	1	Reservoir	100 year pond	16.2990	10.0000	0.000	0.000
95	130	1	100D Concrete	450	0.2125	0.5746	3.411	41.000
OUT		1	MP SW CH	Overland wide	0.9822	1.2213	0.000	0.000

Illudas Overflow Analysis

Link Name	Next Link Name	Overflow Node	Inflow m3/s	Design Flow m3/s	Capacity m3/s	Overflow m3/s	Storage m3	Inflow Storage m3
10	20	20	0.9156	0.6040	0.6040	0.3116	0.0	0.0
100	110	110	0.8771	0.8771	1.0555	0.0000	0.0	0.0
1000	1010		0.9822	0.9822	27.9730	0.0000	0.0	0.0
1010	OUT		0.9822	0.9822	1.2213	0.0000	0.0	0.0
110	180	180	6.3948	6.3948	6.7117	0.0000	0.0	0.0
120	100	100	0.1039	0.1039	0.5117	0.0000	0.0	0.0
130	100	100	0.5504	0.5504	1.2940	0.0000	0.0	0.0
140	290	290	0.0994	0.0994	1.7116	0.0000	0.0	0.0
150	130	130	0.2576	0.2576	0.6412	0.0000	0.0	0.0
160	170	170	1.9834	1.9834	3.5312	0.0000	0.0	0.0
170	110	110	1.9671	1.9671	3.8611	0.0000	0.0	0.0
180	190	190	6.2932	6.2932	9.5210	0.0000	0.0	0.0
190	200	200	6.2693	6.2693	7.7205	0.0000	0.0	0.0
20	30	30	1.8908	1.4886	1.4886	0.4022	0.0	0.0
200	210	210	6.2113	5.2450	5.2450	0.9664	0.0	0.0
210	250	250	6.6780	6.6780	9.3089	0.0000	0.0	0.0
220	230	230	0.3116	0.3116	0.4726	0.0000	0.0	0.0
230	240	240	0.2972	0.2972	0.4396	0.0000	0.0	0.0
240	210	210	0.2720	0.2720	1.6384	0.0000	0.0	0.0
250	260	375	6.7511	4.6758	4.6758	2.0753	0.0	0.0
260	280	280	5.0077	5.0077	7.2791	0.0000	0.0	0.0
270	260	375	0.1538	0.1538	3.7924	0.0000	0.0	0.0
280	470	470	9.1016	5.8551	5.8551	3.2465	0.0	0.0
290	300	300	0.3381	0.2599	0.2599	0.0781	0.0	0.0
30	50	50	2.1390	1.4413	1.4413	0.6977	0.0	0.0
300	310	310	0.4933	0.2897	0.2897	0.2037	0.0	0.0
310	320	320	0.4933	0.4700	0.4700	0.0233	0.0	0.0
320	330	330	0.4933	0.4255	0.4255	0.0679	0.0	0.0
330	340	340	0.4808	0.4808	0.7935	0.0000	0.0	0.0
340	342	342	0.9683	0.9683	2.1949	0.0000	0.0	0.0
342	343	344	0.9613	0.9613	1.7310	0.0000	0.0	0.0
343	344	344	1.3181	1.3181	1.5145	0.0000	0.0	0.0
344	350	350	1.2848	1.2848	1.7382	0.0000	0.0	0.0
350	360	360	1.4401	1.4401	2.4340	0.0000	0.0	0.0
360	370	370	1.7905	1.7905	3.2767	0.0000	0.0	0.0
365	360	392	0.2562	0.2562	1.3283	0.0000	0.0	0.0
370	375	375	1.8209	1.8209	3.9535	0.0000	0.0	0.0
375	380	380	3.9229	3.3571	3.3571	0.5658	0.0	0.0
380	382	382	3.9229	1.5207	1.5207	2.4022	0.0	0.0
382	384	384	3.8878	1.5207	1.5207	2.3671	0.0	0.0
384	390	390	3.8609	1.5207	1.5207	2.3402	0.0	0.0
390	395	395	4.2000	1.5207	1.5207	2.6793	0.0	0.0

Vredenburg Masterplan 50 yr 05-06-2014

Link Name	Next Link Name	Overflow Node	Inflow m3/s	Design Flow m3/s	Capacity m3/s	Overflow m3/s	Storage m3	Inflow Storage m3
391	392	392	0.1397	0.1397	1.8493	0.0000	0.0	0.0
392	394	394	0.1986	0.1986	0.8802	0.0000	0.0	0.0
394	390	390	0.1890	0.1287	0.1287	0.0604	0.0	0.0
395	400	400	4.1839	2.6809	2.6809	1.5030	0.0	0.0
40	50	50	0.1537	0.1537	0.2661	0.0000	0.0	0.0
400	280	280	4.1258	4.1258	11.4662	0.0000	0.0	0.0
410	420	420	0.1098	0.1098	0.7450	0.0000	0.0	0.0
420	340	340	0.1046	0.1046	1.0856	0.0000	0.0	0.0
430	440	440	0.0667	0.0667	0.3863	0.0000	0.0	0.0
440	450	450	0.3851	0.3851	0.4041	0.0000	0.0	0.0
450	460	460	0.3820	0.3820	0.5184	0.0000	0.0	0.0
460	343	343	0.3710	0.3710	0.7669	0.0000	0.0	0.0
470	480	480	9.4273	9.4273	21.3432	0.0000	0.0	0.0
480	513	513	10.0152	3.6632	3.6632	6.3520	0.0	0.0
490	500	500	0.5046	0.5046	0.8673	0.0000	0.0	0.0
50	60	60	2.2906	1.2272	1.2272	1.0634	0.0	0.0
500	510	510	0.5381	0.5381	0.9729	0.0000	0.0	0.0
510	511	511	0.5334	0.5334	0.9409	0.0000	0.0	0.0
511	480	480	0.5228	0.5228	0.7935	0.0000	0.0	0.0
513	516	516	10.0152	7.4654	7.4654	2.5498	0.0	0.0
516	520	520	10.1491	7.1486	7.1486	3.0005	0.0	0.0
520	523	523	11.0427	5.0731	5.0731	5.9696	0.0	0.0
523	525	525	11.0427	3.9303	3.9303	7.1124	0.0	0.0
525	530	530	15.2702	5.7556	5.7556	9.5146	0.0	0.0
530	860	860	15.8734	15.8734	35.9198	0.0000	0.0	0.0
540	545	545	0.2412	0.2412	1.7218	0.0000	0.0	0.0
545	550	550	0.7734	0.5263	0.5263	0.2471	0.0	0.0
550	570	570	2.7702	2.7702	3.9158	0.0000	0.0	0.0
560	565	565	1.0670	1.0670	3.0865	0.0000	0.0	0.0
565	565A	565A	1.0710	1.0710	4.3553	0.0000	0.0	0.0
565A	565B	565B	1.0780	1.0780	3.8993	0.0000	0.0	0.0
565B	550	550	1.0847	1.0847	3.9252	0.0000	0.0	0.0
570	580	580	2.7605	2.3385	2.3385	0.4220	0.0	0.0
580	585	585	2.7605	2.5012	2.5012	0.2593	0.0	0.0
585	590	590	2.7605	2.7605	9.1638	0.0000	0.0	0.0
590	600		6.2837	6.4100	1.6330	0.0000	0.0	0.0
60	65	65	3.2122	2.4810	2.4810	0.7312	0.0	0.0
600	610		1.3844	0.7519	0.7519	0.6325	7009.5	0.0
610	620	620	0.7519	0.7519	1.3096	0.0000	0.0	0.0
620	630	630	0.7546	0.3093	0.3093	0.4453	0.0	0.0
630	640	640	1.0968	1.0968	7.1600	0.0000	0.0	0.0
640	650	650	1.2533	1.2533	9.6576	0.0000	0.0	0.0
65	67	67	3.2122	1.2616	1.2616	1.9506	0.0	0.0
650	660	660	1.4953	1.4953	9.7366	0.0000	0.0	0.0

Vredenburg Masterplan 50 yr 05-06-2014

Link Name	Next Link Name	Overflow Node	Inflow m3/s	Design Flow m3/s	Capacity m3/s	Overflow m3/s	Storage m3	Inflow Storage m3
660	664	664	1.6125	1.4836	1.4836	0.1288	0.0	0.0
664	670	670	1.6125	1.6125	1.7198	0.0000	0.0	0.0
67	68	68	3.2122	1.2641	1.2641	1.9481	0.0	0.0
670	680	680	1.6184	1.6184	2.0251	0.0000	0.0	0.0
68	70	70	3.2122	3.2122	4.8307	0.0000	0.0	0.0
680	684	684	1.6191	1.6191	1.8274	0.0000	0.0	0.0
684	685	685	1.6254	1.5305	1.5305	0.0948	0.0	0.0
685	686	686	1.6254	1.5035	1.5035	0.1219	0.0	0.0
686	690	690	1.6254	1.1589	1.1589	0.4665	0.0	0.0
690	692	692	1.9595	1.9595	2.0751	0.0000	0.0	0.0
692	693	693	1.9673	1.2197	1.2197	0.7476	0.0	0.0
693	695	695	1.9673	0.9729	0.9729	0.9944	0.0	0.0
695	697	697	1.9673	1.3536	1.3536	0.6137	0.0	0.0
697	698	698	1.9673	1.5945	1.5945	0.3728	0.0	0.0
698	699	699	1.9673	1.9274	1.9274	0.0399	0.0	0.0
699	700	700	1.9673	1.4930	1.4930	0.4743	0.0	0.0
70	80	80	3.2042	3.2042	6.5777	0.0000	0.0	0.0
700	701	701	4.2275	3.4039	3.4039	0.8236	0.0	0.0
700A	700	700	2.0156	0.3114	0.3114	1.7042	0.0	0.0
701	702	702	4.2275	2.9616	2.9616	1.2660	0.0	0.0
702	704	704	4.2275	3.0504	3.0504	1.1772	0.0	0.0
704	706	706	4.2275	2.3711	2.3711	1.8564	0.0	0.0
706	708	708	4.2275	1.2152	1.2152	3.0124	0.0	0.0
708	525	525	4.2275	3.7685	3.7685	0.4590	0.0	0.0
710	530	530	0.1269	0.1269	0.7766	0.0000	0.0	0.0
720	730	730	0.7606	0.4202	0.4202	0.3404	0.0	0.0
730	760	760	2.2946	1.1553	1.1553	1.1393	0.0	0.0
740	750	750	0.4516	0.4516	1.0433	0.0000	0.0	0.0
750	752	752	2.9575	1.7689	1.7689	1.1887	0.0	0.0
752	752A	752A	2.9575	0.7964	0.7964	2.1611	0.0	0.0
752A	752B	752B	2.9575	0.7964	0.7964	2.1611	0.0	0.0
752B	754	754	2.9575	0.7954	0.7954	2.1621	0.0	0.0
754	756	756	2.9575	2.4549	2.4549	0.5026	0.0	0.0
756	590	590	2.9575	2.9575	4.6382	0.0000	0.0	0.0
760	750	750	2.5121	1.1659	1.1659	1.3462	0.0	0.0
770	775	775	0.0000	0.0000	2.0028	0.0000	0.0	0.0
775	780	780	0.3312	0.3312	1.7009	0.0000	0.0	0.0
780	790	790	0.3061	0.3061	1.8084	0.0000	0.0	0.0
790	630	630	0.2902	0.2902	1.7493	0.0000	0.0	0.0
80	110	110	3.4892	3.4892	5.9506	0.0000	0.0	0.0
800	810	810	0.1541	0.1541	0.3114	0.0000	0.0	0.0
810	690	690	0.3184	0.3184	1.1319	0.0000	0.0	0.0
820	830	830	0.1501	0.1501	0.2074	0.0000	0.0	0.0
830	840	840	0.2772	0.2772	0.3343	0.0000	0.0	0.0

Vredenburg Masterplan 50 yr 05-06-2014

Link Name	Next Link Name	Overflow Node	Inflow m3/s	Design Flow m3/s	Capacity m3/s	Overflow m3/s	Storage m3	Inflow Storage m3
840	850	850	0.3981	0.2611	0.2611	0.1370	0.0	0.0
850	700	700	0.4910	0.4910	0.8145	0.0000	0.0	0.0
860	862	862	15.8524	14.4943	14.4943	1.3581	0.0	0.0
862	866	866	15.7929	7.8016	7.8016	7.9913	0.0	0.0
866	870	870	15.7929	11.2880	11.2880	4.5049	0.0	0.0
870	873	873	16.0108	10.6493	10.6493	5.3615	0.0	0.0
873	876	876	15.9904	8.5785	8.5785	7.4119	0.0	0.0
876	880	880	15.9904	6.4126	6.4126	9.5779	0.0	0.0
880	890	890	16.2554	5.4647	5.4647	10.7907	0.0	0.0
890	900	900	16.2554	14.9525	14.9525	1.3029	0.0	0.0
90	95	95	0.2147	0.2147	0.6308	0.0000	0.0	0.0
900	910	910	16.7333	9.4874	9.4874	7.2459	0.0	0.0
910	920	920	16.7137	16.7137	33.2991	0.0000	0.0	0.0
920	930	930	16.6993	16.6993	24.1417	0.0000	0.0	0.0
930	940	940	16.2990	16.2990	24.6440	0.0000	0.0	0.0
940	1000		16.4600	16.2990	10.0000	0.0000	0.0	0.0
95	130	130	0.2125	0.2125	0.5746	0.0000	0.0	0.0
OUT			0.9822	0.9822	1.2213	0.0000	0.0	0.0

Results Summary

File Name: R:\VR032\Stormwater\Master Plan\Base Drawing Civil Designer\Louwville Stormwater MP.stw

Inflow Calculation Method = Illudas
Number of Nodes analyzed = 148

Subnetwork 1

Outfall Data

Outfall Node	=	OUT	
Outlet Level	=	41.232	m
Design Flow	=	1.221	m3/s

Storm Data

File Name: R:\VR032\Stormwater\Master Plan\Vredenberg 100 year - MAP 275 - 328min Coast.stm
Chicago Storm Coastal Region
MAP 275 100yr 328min

Mean Annual Precipitation	=	275	mm
Return Period	=	100	years
Duration	=	328	min
Time Step	=	18	min
Ratio of Peak to Duration	=	0.38	

Factors:
A = 834   B = 12.0   C = 0.750

Total Depth	=	57.5	mm

Antecedant Moisture Condition = Rather Wet (3)
Routing Method = Continuity

Accuracy Check

Volume of inflow	=	134067.8	m3
Volume at outfall	=	133636.2	m3
Percentage Error	=	0.32	%

Illudas Runoff Analysis

Node Name	Next Node Name	Runoff m3/s	Surface Inflow m3/s	Paved Area Volume m3	Grass Area Volume m3	Total Volume m3
10	20	1.1578	1.1578	3336.783	1046.981	4383.8
100	110	0.2856	0.2856	919.437	119.668	1039.1
1000	1010	0.0000	0.0000	0.000	0.000	0.0
1010	OUT	0.0000	0.0000	0.000	0.000	0.0
110	180	0.2145	0.2145	816.670	45.954	862.6
120	100	0.1289	0.1289	265.885	203.561	469.4
130	100	0.1201	0.1201	338.054	104.386	442.4
140	290	0.1233	0.1233	254.490	194.837	449.3
150	130	0.2857	0.2857	806.319	242.001	1048.3
160	170	2.5380	2.5380	8000.272	2510.241	10510.5
170	110	0.0000	0.0000	0.000	0.000	0.0
180	190	0.0000	0.0000	0.000	0.000	0.0
190	200	0.0000	0.0000	0.000	0.000	0.0
20	30	1.2332	1.2332	3554.078	1115.161	4669.2
200	210	0.0000	0.0000	0.000	0.000	0.0
210	250	0.2920	0.2920	1043.661	112.605	1156.3
220	230	0.3940	0.3940	1135.455	356.271	1491.7
230	240	0.0000	0.0000	0.000	0.000	0.0
240	210	0.0000	0.0000	0.000	0.000	0.0
250	260	0.2875	0.2875	777.865	240.192	1018.1
260	280	0.2860	0.2860	925.018	97.127	1022.1
270	260	0.2505	0.2505	677.808	209.296	887.1
280	470	0.0977	0.0977	351.226	0.000	351.2
290	300	0.2674	0.2674	781.855	226.501	1008.4
30	50	0.2707	0.2707	792.991	248.816	1041.8
300	310	0.2078	0.2078	465.399	296.280	761.7
310	320	0.0000	0.0000	0.000	0.000	0.0
320	330	0.0000	0.0000	0.000	0.000	0.0
330	340	0.0000	0.0000	0.000	0.000	0.0
340	342	0.6385	0.6385	1727.655	533.471	2261.1
342	343	0.0000	0.0000	0.000	0.000	0.0
343	344	0.0000	0.0000	0.000	0.000	0.0
344	350	0.0000	0.0000	0.000	0.000	0.0
350	360	0.3071	0.3071	831.042	256.612	1087.7
360	370	0.1372	0.1372	412.682	127.429	540.1
365	360	0.3447	0.3447	927.460	286.384	1213.8
370	375	0.0836	0.0836	78.480	255.702	334.2
375	380	0.1127	4.4885	104.233	402.026	506.3
380	382	0.0000	0.0000	0.000	0.000	0.0
382	384	0.0000	0.0000	0.000	0.000	0.0
384	390	0.0000	0.0000	0.000	0.000	0.0
390	395	0.2817	0.2817	442.087	830.075	1272.2

Node Name	Next Node Name	Runoff m3/s	Surface Inflow m3/s	Paved Area Volume m3	Grass Area Volume m3	Total Volume m3
391	392	0.1836	0.1836	500.254	154.470	654.7
392	394	0.0732	0.0732	217.236	67.079	284.3
394	390	0.0000	0.0000	0.000	0.000	0.0
395	400	0.0000	0.0000	0.000	0.000	0.0
40	50	0.1906	0.1906	393.330	301.132	694.5
400	280	0.0000	0.0000	0.000	0.000	0.0
410	420	0.1788	0.1788	483.891	149.418	633.3
420	340	0.0000	0.0000	0.000	0.000	0.0
430	440	0.0905	0.0905	254.590	78.613	333.2
440	450	0.5325	0.5325	1440.979	444.950	1885.9
450	460	0.0505	0.0505	386.300	453.709	840.0
460	343	0.0000	0.0000	0.000	0.000	0.0
470	480	0.5074	0.5074	1077.535	685.974	1763.5
480	513	0.1175	0.1175	156.210	264.746	421.0
490	500	0.8610	0.8610	2482.929	766.687	3249.6
50	60	0.0000	0.0000	0.000	0.000	0.0
500	510	0.0656	0.0656	235.732	0.000	235.7
510	511	0.0000	0.0000	0.000	0.000	0.0
511	480	0.0000	0.0000	0.000	0.000	0.0
513	516	0.0000	0.0000	0.000	0.000	0.0
516	520	0.2180	0.2180	589.846	182.135	772.0
520	523	1.5040	1.5040	3297.778	2099.411	5397.2
523	525	0.0000	0.0000	0.000	0.000	0.0
525	530	0.0000	0.0000	0.000	0.000	0.0
530	860	0.8133	0.8133	2345.389	724.217	3069.6
540	545	0.3486	0.3486	631.505	563.476	1195.0
545	550	0.7045	0.7045	1950.159	585.302	2535.5
550	570	1.1777	1.1777	3260.261	978.503	4238.8
560	565	1.0994	1.0994	2976.217	1677.735	4654.0
565	565A	0.0000	0.0000	0.000	0.000	0.0
565A	565B	0.0000	0.0000	0.000	0.000	0.0
565B	550	0.0000	0.0000	0.000	0.000	0.0
570	580	0.0000	0.0000	0.000	0.000	0.0
580	585	0.0000	0.0000	0.000	0.000	0.0
585	590	0.0000	0.0000	0.000	0.000	0.0
590	600	0.9287	0.9287	2634.975	635.294	3270.3
60	65	1.1655	1.1655	3358.940	1053.933	4412.9
600	610	0.0000	0.0000	0.000	0.000	0.0
610	620	0.0000	0.0000	0.000	0.000	0.0
620	630	0.0000	0.0000	0.000	0.000	0.0
630	640	0.0798	0.0798	286.821	0.000	286.8
640	650	0.3036	0.3036	947.103	217.958	1165.1
65	67	0.0000	0.0000	0.000	0.000	0.0
650	660	0.3922	0.3922	1223.495	281.565	1505.1

Node Name	Next Node Name	Runoff m3/s	Surface Inflow m3/s	Paved Area Volume m3	Grass Area Volume m3	Total Volume m3
660	664	0.1605	0.1605	500.540	115.190	615.7
664	670	0.0000	0.0000	0.000	0.000	0.0
67	68	0.0000	0.0000	0.000	0.000	0.0
670	680	0.0000	0.0000	0.000	0.000	0.0
68	70	0.0000	0.0000	0.000	0.000	0.0
680	684	0.0000	0.0000	0.000	0.000	0.0
684	685	0.0000	0.0000	0.000	0.000	0.0
685	686	0.0000	0.0000	0.000	0.000	0.0
686	690	0.0000	0.0000	0.000	0.000	0.0
690	692	0.1964	0.1964	582.815	115.756	698.6
692	693	0.0000	0.0000	0.000	0.000	0.0
693	695	0.0000	0.0000	0.000	0.000	0.0
695	697	0.0000	0.0000	0.000	0.000	0.0
697	698	0.0000	0.0000	0.000	0.000	0.0
698	699	0.0000	0.0000	0.000	0.000	0.0
699	700	0.0000	0.0000	0.000	0.000	0.0
70	80	0.0000	0.0000	0.000	0.000	0.0
700	701	0.2121	0.2121	629.529	125.034	754.6
700A	700	2.6257	2.6257	1663.132	6635.844	8299.0
701	702	0.0000	0.0000	0.000	0.000	0.0
702	704	0.0000	0.0000	0.000	0.000	0.0
704	706	0.0000	0.0000	0.000	0.000	0.0
706	708	0.0000	0.0000	0.000	0.000	0.0
708	525	0.0000	0.0000	0.000	0.000	0.0
710	530	0.2066	0.2066	559.059	172.628	731.7
720	730	0.9691	0.9691	1977.147	1588.729	3565.9
730	760	2.1914	2.1914	5771.955	2498.964	8270.9
740	750	0.6392	0.6392	1483.694	733.689	2217.4
750	752	0.0000	0.0000	0.000	0.000	0.0
752	752A	0.0000	0.0000	0.000	0.000	0.0
752A	752B	0.0000	0.0000	0.000	0.000	0.0
752B	754	0.0000	0.0000	0.000	0.000	0.0
754	756	0.0000	0.0000	0.000	0.000	0.0
756	590	0.0000	0.0000	0.000	0.000	0.0
760	750	0.3208	0.3208	653.940	454.995	1108.9
770	775	0.0000	0.0000	0.000	0.000	0.0
775	780	0.4339	0.4339	1560.216	0.000	1560.2
780	790	0.0000	0.0000	0.000	0.000	0.0
790	630	0.0000	0.0000	0.000	0.000	0.0
80	110	0.4501	0.4501	1163.831	416.137	1580.0
800	810	0.2447	0.2447	726.220	144.239	870.5
810	690	0.2764	0.2764	820.246	162.914	983.2
820	830	0.2383	0.2383	707.228	140.467	847.7
830	840	0.2083	0.2083	618.267	122.797	741.1

Node Name	Next Node Name	Runoff m3/s	Surface Inflow m3/s	Paved Area Volume m3	Grass Area Volume m3	Total Volume m3
840	850	0.2408	0.2408	714.692	141.949	856.6
850	700	0.1656	0.1656	491.455	97.611	589.1
860	862	0.0000	0.0000	0.000	0.000	0.0
862	866	0.0000	0.0000	0.000	0.000	0.0
866	870	0.0000	0.0000	0.000	0.000	0.0
870	873	0.3948	0.3948	987.716	410.801	1398.5
873	876	0.0000	0.0000	0.000	0.000	0.0
876	880	0.0000	0.0000	0.000	0.000	0.0
880	890	0.4323	0.4323	1394.399	276.949	1671.3
890	900	0.0000	0.0000	0.000	0.000	0.0
90	95	0.2663	0.2663	549.563	420.744	970.3
900	910	1.2671	1.2671	4552.670	2484.750	7037.4
910	920	0.0409	0.0409	137.996	10.237	148.2
920	930	0.0000	0.0000	0.000	0.000	0.0
930	940	0.9407	0.9407	3380.076	1844.773	5224.8
940	1000	0.0000	0.0000	0.000	0.000	0.0
95	130	0.0000	0.0000	0.000	0.000	0.0
OUT		0.0000	0.0000	0.000	0.000	0.0

Flow Analysis

Link Name	Next Link Name	Number of Links	Link Type	Calculated Size	Flow m3/s	Capacity m3/s	Velocity m/s	Flow Depth %
10	20	1	100D Concrete	675	0.6040	0.6040	2.008	100.000
100	110	1	100D Concrete	525	1.0555	1.0555	5.769	100.000
1000	1010	1	WEIR 1	5000 x 800	2.5372	27.9730	5.804	20.000
1010	OUT	1	MP SW CH	Overland wide	1.2213	1.2213	0.752	100.000
110	180	1	100D Concrete	1350	6.7117	6.7117	6.085	100.000
120	100	1	100D Concrete	375	0.1289	0.5117	4.026	34.000
130	100	1	50D Concrete	525	0.6836	1.2940	5.859	51.000
140	290	1	MP SW CH	Overland Ch	0.1233	1.7116	1.181	26.000
150	130	1	50D Concrete	450	0.2857	0.6412	4.000	46.000
160	170	1	50D Concrete	825	2.5380	3.5312	7.094	62.000
170	110	1	MP SW CH	TYPE CC-1	2.5274	3.8611	6.156	81.000
180	190	1	100D Concrete	1350	8.2312	9.5210	8.560	71.000
190	200	1	100D Concrete	1350	7.7205	7.7205	7.000	100.000
20	30	1	100D Concrete	675	1.4886	1.4886	4.949	100.000
200	210	1	100D Concrete	1350	5.2450	5.2450	4.755	100.000
210	250	1	100D Concrete	1350	8.8588	9.3089	8.457	77.000
220	230	1	100D Concrete	450	0.3940	0.4726	3.382	68.000
230	240	1	100D Concrete	600	0.3823	0.4396	1.823	68.000
240	210	1	100D Concrete	600	0.3583	1.6384	4.876	31.000

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Link Name	Next Link Name	Number of Links	Link Type	Calculated Size	Flow m3/s	Capacity m3/s	Velocity m/s	Flow Depth %
250	260	1	100D Concrete	1350	4.6758	4.6758	4.239	100.000
260	280	1	100D Concrete	1350	5.2071	7.2791	6.336	62.000
270	260	1	100D Concrete	1050	0.2505	3.7924	2.819	17.000
280	470	1	100D Concrete	1350	5.8551	5.8551	5.309	100.000
290	300	1	100D Concrete	300	0.2599	0.2599	4.227	100.000
30	50	1	100D Concrete	675	1.4413	1.4413	4.792	100.000
300	310	1	100D Concrete	375	0.2897	0.2897	3.072	100.000
310	320	1	100D Concrete	450	0.4700	0.4700	3.427	100.000
320	330	1	100D Concrete	525	0.4255	0.4255	2.325	100.000
330	340	1	100D Concrete	750	0.6040	0.7935	2.086	65.000
340	342	1	100D Concrete	825	1.4203	2.1949	4.786	58.000
342	343	1	75D Concrete	825	1.4202	1.7310	3.960	68.000
343	344	1	75D Concrete	825	1.5145	1.5145	3.522	100.000
344	350	1	75D Concrete	825	1.7382	1.7382	4.042	100.000
350	360	1	100D Concrete	1050	2.3874	2.4340	3.633	79.000
360	370	1	100D Concrete	1200	2.8605	3.2767	3.699	72.000
365	360	1	100D Concrete	600	0.3447	1.3283	4.151	34.000
370	375	1	100D Concrete	1350	2.9386	3.9535	3.459	64.000
375	380	1	75D Concrete	1350	3.3571	3.3571	2.904	100.000
380	382	1	MP SW CH	TYPE CC-2	1.5207	1.5207	1.836	100.000
382	384	1	MP SW CH	TYPE CC-2	1.5207	1.5207	1.839	100.000
384	390	1	MP SW CH	TYPE CC-2	1.5207	1.5207	1.842	100.000
390	395	1	MP SW CH	TYPE CC-2	1.5207	1.5207	1.901	100.000
391	392	1	75D Concrete	750	0.1836	1.8493	2.833	21.000
392	394	1	75D Concrete	750	0.2572	0.8802	1.829	37.000
394	390	1	100D Concrete	375	0.1287	0.1287	1.364	100.000
395	400	1	MP SW CH	TYPE CC-2	2.6809	2.6809	2.958	100.000
40	50	1	50D Concrete	375	0.1906	0.2661	2.724	64.000
400	280	1	Box Culvert	2100 x 900	7.9526	11.4662	5.642	74.000
410	420	1	100D Concrete	525	0.1788	0.7450	2.955	33.000
420	340	1	100D Concrete	600	0.1786	1.0856	2.990	27.000
430	440	1	100D Concrete	450	0.0905	0.3863	2.026	32.000
440	450	1	100D Concrete	525	0.4041	0.4041	2.106	100.000
450	460	1	100D Concrete	600	0.5184	0.5184	2.187	100.000
460	343	1	100D Concrete	600	0.6634	0.7669	3.208	71.000
470	480	1	Portal Culvert	2100 x 1200	13.7851	21.3432	9.022	59.000
480	513	1	100D Concrete	1350	3.6632	3.6632	3.321	100.000
490	500	1	100D Concrete	825	0.8610	0.8673	2.017	100.000
50	60	1	100D Concrete	750	1.2272	1.2272	3.334	100.000
500	510	1	100D Concrete	825	0.9329	0.9729	2.270	78.000
510	511	1	MP SW CH	TYPE CC-1	0.9312	0.9409	1.674	99.000
511	480	1	100D Concrete	750	0.7935	0.7935	2.150	100.000
513	516	1	100D Concrete	1350	7.4654	7.4654	6.769	100.000
516	520	1	100D Concrete	1350	7.1486	7.1486	6.502	100.000

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Link Name	Next Link Name	Number of Links	Link Type	Calculated Size	Flow m3/s	Capacity m3/s	Velocity m/s	Flow Depth %
520	523	1	100D Concrete	1350	5.0731	5.0731	4.600	100.000
523	525	1	100D Concrete	1350	3.9303	3.9303	3.563	100.000
525	530	1	Box Culvert	1800 x 900	5.7556	5.7556	3.553	100.000
530	860	2	Box Culvert	2 x 2100 x 900	23.0956	35.9198	8.701	70.000
540	545	1	MP SW CH	Overland Ch	0.3486	1.7218	1.598	45.000
545	550	1	100D Concrete	525	0.5263	0.5263	2.813	100.000
550	570	1	100D Concrete	1050	3.3413	3.9158	5.761	71.000
560	565	1	75D Concrete	900	1.0994	3.0865	4.756	40.000
565	565A	1	75D Concrete	900	1.0885	4.3553	6.083	33.000
565A	565B	1	75D Concrete	900	1.0702	3.8993	5.640	36.000
565B	550	1	75D Concrete	900	1.0883	3.9252	5.691	36.000
570	580	1	100D Concrete	1050	2.3385	2.3385	3.473	100.000
580	585	1	75D Concrete	1200	2.5012	2.5012	2.698	100.000
585	590	1	Drains	Sheet flow	3.3514	9.1638	2.374	68.000
590	600	1	Reservoir	Ruthfirst Pond	8.4017	1.6330	0.000	0.000
60	65	1	100D Concrete	825	2.4810	2.4810	5.769	100.000
600	610	1	100D Concrete	600	0.7519	0.7519	3.173	100.000
610	620	1	100D Concrete	1050	0.7519	1.3096	1.777	54.000
620	630	1	100D Concrete	600	0.3093	0.3093	1.305	100.000
630	640	1	MP SW CH	TYPE CC-N1A	1.1717	7.1600	1.477	45.000
640	650	1	MP SW CH	TYPE CC-N1A	1.4863	9.6576	1.944	43.000
65	67	1	100D Concrete	900	1.2616	1.2616	2.412	100.000
650	660	1	MP SW CH	TYPE CC-N2A	1.8398	9.7366	1.652	46.000
660	664	1	100D Concrete	825	1.4836	1.4836	3.450	100.000
664	670	1	100D Concrete	825	1.7198	1.7198	3.999	100.000
67	68	1	100D Concrete	900	1.2641	1.2641	2.417	100.000
670	680	1	100D Concrete	825	1.9498	2.0251	4.727	78.000
68	70	1	100D Concrete	900	4.0243	4.8307	9.110	69.000
680	684	1	100D Concrete	825	1.8274	1.8274	4.250	100.000
684	685	1	100D Concrete	825	1.5305	1.5305	3.559	100.000
685	686	1	100D Concrete	825	1.5035	1.5035	3.496	100.000
686	690	1	100D Concrete	825	1.1589	1.1589	2.695	100.000
690	692	1	100D Concrete	825	2.0751	2.0751	4.826	100.000
692	693	1	100D Concrete	825	1.2197	1.2197	2.841	100.000
693	695	1	100D Concrete	825	0.9729	0.9729	2.263	100.000
695	697	1	100D Concrete	825	1.3536	1.3536	3.148	100.000
697	698	1	100D Concrete	825	1.5945	1.5945	3.708	100.000
698	699	1	100D Concrete	825	1.9274	1.9274	4.490	100.000
699	700	1	100D Concrete	825	1.4930	1.4930	3.472	100.000
70	80	1	100D Concrete	1050	4.0185	6.5777	9.032	56.000
700	701	1	100D Concrete	825	3.4039	3.4039	7.916	100.000
700A	700	1	100D Concrete	525	0.3114	0.3114	1.709	100.000
701	702	1	100D Concrete	825	2.9616	2.9616	6.892	100.000
702	704	1	100D Concrete	825	3.0504	3.0504	7.094	100.000

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Link Name	Next Link Name	Number of Links	Link Type	Calculated Size	Flow m3/s	Capacity m3/s	Velocity m/s	Flow Depth %
704	706	1	100D Concrete	825	2.3711	2.3711	5.514	100.000
706	708	1	100D Concrete	900	1.2152	1.2152	2.328	100.000
708	525	1	100D Concrete	825	3.7685	3.7685	8.764	100.000
710	530	1	100D Concrete	450	0.2066	0.7766	4.224	35.000
720	730	1	MP SW CH	Overland Ch	0.4202	0.4202	0.567	100.000
730	760	1	MP SW CH	Overland Ch	1.1553	1.1553	1.650	100.000
740	750	1	75D Concrete	900	0.6392	1.0433	1.848	56.000
750	752	1	100D Concrete	1050	1.7689	1.7689	2.635	100.000
752	752A	1	75D Concrete	900	0.7964	0.7964	1.530	100.000
752A	752B	1	75D Concrete	900	0.7964	0.7964	1.531	100.000
752B	754	1	75D Concrete	900	0.7954	0.7954	1.528	100.000
754	756	1	50D Concrete	1500	3.1665	3.1665	2.142	100.000
756	590	1	Drains	Sheet flow	4.1216	4.6382	1.493	95.000
760	750	1	75D Concrete	900	1.1659	1.1659	2.240	100.000
770	775	1	75D Concrete	1200	0.0000	2.0028	0.000	0.000
775	780	1	75D Concrete	1200	0.4339	1.7009	1.333	33.000
780	790	1	100D Concrete	1200	0.4097	1.8084	1.451	31.000
790	630	1	MP SW CH	TYPE ED-1	0.3928	1.7493	0.733	42.000
80	110	1	100D Concrete	1050	4.4484	5.9506	8.534	64.000
800	810	1	100D Concrete	375	0.2447	0.3114	3.214	66.000
810	690	1	100D Concrete	600	0.5172	1.1319	4.114	47.000
820	830	1	100D Concrete	300	0.2074	0.2074	3.373	100.000
830	840	1	100D Concrete	450	0.3343	0.3343	2.438	100.000
840	850	1	100D Concrete	450	0.2611	0.2611	1.906	100.000
850	700	1	100D Concrete	525	0.8145	0.8145	4.452	100.000
860	862	1	Box Culvert	1500 x 1200	14.4943	14.4943	7.621	100.000
862	866	1	Box Culvert	1500 x 1200	7.8016	7.8016	4.334	100.000
866	870	1	Box Culvert	1500 x 1200	11.2880	11.2880	6.203	100.000
870	873	1	Box Culvert	1500 x 1200	10.6493	10.6493	5.908	100.000
873	876	1	Portal Culvert	1500 x 1200	8.5785	8.5785	5.107	100.000
876	880	1	Portal Culvert	1500 x 1200	6.4126	6.4126	3.817	100.000
880	890	1	Box Culvert	1500 x 1200	5.4647	5.4647	3.036	100.000
890	900	2	Portal Culvert	2 x 1500 x 1200	14.9525	14.9525	4.451	100.000
90	95	1	100D Concrete	450	0.2663	0.6308	3.920	46.000
900	910	1	Box Culvert	1800 x 1500	9.4874	9.4874	3.514	100.000
910	920	2	Portal Culvert	2 x 1500 x 1200	25.1666	33.2991	9.911	72.000
920	930	1	MP SW CH	TYPE GBC -1	24.1417	24.1417	2.003	99.000
930	940	1	MP SW CH	TYPE GBC -1	24.6440	24.6440	2.052	99.000
940	1000	1	Reservoir	100 year pond	25.6498	10.0000	0.000	0.000
95	130	1	100D Concrete	450	0.2755	0.5746	3.670	49.000
OUT		1	MP SW CH	Overland wide	1.2213	1.2213	0.000	0.000

Illudas Overflow Analysis

Link Name	Next Link Name	Overflow Node	Inflow m3/s	Design Flow m3/s	Capacity m3/s	Overflow m3/s	Storage m3	Inflow Storage m3
10	20	20	1.1578	0.6040	0.6040	0.5538	0.0	0.0
100	110	110	1.1032	1.0555	1.0555	0.0477	0.0	0.0
1000	1010		2.5372	2.5372	27.9730	0.0000	0.0	0.0
1010	OUT		2.5380	1.2213	1.2213	1.3167	19025.4	0.0
110	180	180	8.2312	6.7117	6.7117	1.5195	0.0	0.0
120	100	100	0.1289	0.1289	0.5117	0.0000	0.0	0.0
130	100	100	0.6836	0.6836	1.2940	0.0000	0.0	0.0
140	290	290	0.1233	0.1233	1.7116	0.0000	0.0	0.0
150	130	130	0.2857	0.2857	0.6412	0.0000	0.0	0.0
160	170	170	2.5380	2.5380	3.5312	0.0000	0.0	0.0
170	110	110	2.5274	2.5274	3.8611	0.0000	0.0	0.0
180	190	190	8.2312	8.2312	9.5210	0.0000	0.0	0.0
190	200	200	8.2118	7.7205	7.7205	0.4914	0.0	0.0
20	30	30	2.3910	1.4886	1.4886	0.9025	0.0	0.0
200	210	210	8.2118	5.2450	5.2450	2.9669	0.0	0.0
210	250	250	8.8588	8.8588	9.3089	0.0000	0.0	0.0
220	230	230	0.3940	0.3940	0.4726	0.0000	0.0	0.0
230	240	240	0.3823	0.3823	0.4396	0.0000	0.0	0.0
240	210	210	0.3583	0.3583	1.6384	0.0000	0.0	0.0
250	260	375	9.0516	4.6758	4.6758	4.3758	0.0	0.0
260	280	280	5.2071	5.2071	7.2791	0.0000	0.0	0.0
270	260	375	0.2505	0.2505	3.7924	0.0000	0.0	0.0
280	470	470	13.2778	5.8551	5.8551	7.4226	0.0	0.0
290	300	300	0.3962	0.2599	0.2599	0.1363	0.0	0.0
30	50	50	2.6617	1.4413	1.4413	1.2204	0.0	0.0
300	310	310	0.6040	0.2897	0.2897	0.3144	0.0	0.0
310	320	320	0.6040	0.4700	0.4700	0.1340	0.0	0.0
320	330	330	0.6040	0.4255	0.4255	0.1786	0.0	0.0
330	340	340	0.6040	0.6040	0.7935	0.0000	0.0	0.0
340	342	342	1.4203	1.4203	2.1949	0.0000	0.0	0.0
342	343	344	1.4202	1.4202	1.7310	0.0000	0.0	0.0
343	344	344	2.0803	1.5145	1.5145	0.5657	0.0	0.0
344	350	350	2.0803	1.7382	1.7382	0.3420	0.0	0.0
350	360	360	2.3874	2.3874	2.4340	0.0000	0.0	0.0
360	370	370	2.8605	2.8605	3.2767	0.0000	0.0	0.0
365	360	392	0.3447	0.3447	1.3283	0.0000	0.0	0.0
370	375	375	2.9386	2.9386	3.9535	0.0000	0.0	0.0
375	380	380	7.4129	3.3571	3.3571	4.0558	0.0	0.0
380	382	382	7.4129	1.5207	1.5207	5.8922	0.0	0.0
382	384	384	7.4129	1.5207	1.5207	5.8922	0.0	0.0
384	390	390	7.4129	1.5207	1.5207	5.8922	0.0	0.0
390	395	395	7.9526	1.5207	1.5207	6.4320	0.0	0.0

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Link Name	Next Link Name	Overflow Node	Inflow m3/s	Design Flow m3/s	Capacity m3/s	Overflow m3/s	Storage m3	Inflow Storage m3
391	392	392	0.1836	0.1836	1.8493	0.0000	0.0	0.0
392	394	394	0.2572	0.2572	0.8802	0.0000	0.0	0.0
394	390	390	0.2581	0.1287	0.1287	0.1294	0.0	0.0
395	400	400	7.9526	2.6809	2.6809	5.2718	0.0	0.0
40	50	50	0.1906	0.1906	0.2661	0.0000	0.0	0.0
400	280	280	7.9526	7.9526	11.4662	0.0000	0.0	0.0
410	420	420	0.1788	0.1788	0.7450	0.0000	0.0	0.0
420	340	340	0.1786	0.1786	1.0856	0.0000	0.0	0.0
430	440	440	0.0905	0.0905	0.3863	0.0000	0.0	0.0
440	450	450	0.6222	0.4041	0.4041	0.2181	0.0	0.0
450	460	460	0.6634	0.5184	0.5184	0.1450	0.0	0.0
460	343	343	0.6634	0.6634	0.7669	0.0000	0.0	0.0
470	480	480	13.7851	13.7851	21.3432	0.0000	0.0	0.0
480	513	513	14.8097	3.6632	3.6632	11.1465	0.0	0.0
490	500	500	0.8610	0.8610	0.8673	0.0000	0.0	0.0
50	60	60	2.8588	1.2272	1.2272	1.6316	0.0	0.0
500	510	510	0.9329	0.9329	0.9729	0.0000	0.0	0.0
510	511	511	0.9312	0.9312	0.9409	0.0000	0.0	0.0
511	480	480	0.9278	0.7935	0.7935	0.1343	0.0	0.0
513	516	516	14.8097	7.4654	7.4654	7.3443	0.0	0.0
516	520	520	15.0277	7.1486	7.1486	7.8792	0.0	0.0
520	523	523	16.5317	5.0731	5.0731	11.4585	0.0	0.0
523	525	525	16.5317	3.9303	3.9303	12.6014	0.0	0.0
525	530	530	22.0756	5.7556	5.7556	16.3199	0.0	0.0
530	860	860	23.0956	23.0956	35.9198	0.0000	0.0	0.0
540	545	545	0.3486	0.3486	1.7218	0.0000	0.0	0.0
545	550	550	1.0585	0.5263	0.5263	0.5322	0.0	0.0
550	570	570	3.3413	3.3413	3.9158	0.0000	0.0	0.0
560	565	565	1.0994	1.0994	3.0865	0.0000	0.0	0.0
565	565A	565A	1.0885	1.0885	4.3553	0.0000	0.0	0.0
565A	565B	565B	1.0702	1.0702	3.8993	0.0000	0.0	0.0
565B	550	550	1.0883	1.0883	3.9252	0.0000	0.0	0.0
570	580	580	3.3514	2.3385	2.3385	1.0129	0.0	0.0
580	585	585	3.3514	2.5012	2.5012	0.8502	0.0	0.0
585	590	590	3.3514	3.3514	9.1638	0.0000	0.0	0.0
590	600		8.3404	8.4017	1.6330	0.0000	0.0	0.0
60	65	65	4.0243	2.4810	2.4810	1.5433	0.0	0.0
600	610		1.4857	0.7519	0.7519	0.7338	11307.2	0.0
610	620	620	0.7519	0.7519	1.3096	0.0000	0.0	0.0
620	630	630	0.7576	0.3093	0.3093	0.4483	0.0	0.0
630	640	640	1.1717	1.1717	7.1600	0.0000	0.0	0.0
640	650	650	1.4863	1.4863	9.6576	0.0000	0.0	0.0
65	67	67	4.0243	1.2616	1.2616	2.7627	0.0	0.0
650	660	660	1.8398	1.8398	9.7366	0.0000	0.0	0.0

Link Name	Next Link Name	Overflow Node	Inflow m3/s	Design Flow m3/s	Capacity m3/s	Overflow m3/s	Storage m3	Inflow Storage m3
660	664	664	1.9498	1.4836	1.4836	0.4662	0.0	0.0
664	670	670	1.9498	1.7198	1.7198	0.2301	0.0	0.0
67	68	68	4.0243	1.2641	1.2641	2.7602	0.0	0.0
670	680	680	1.9498	1.9498	2.0251	0.0000	0.0	0.0
68	70	70	4.0243	4.0243	4.8307	0.0000	0.0	0.0
680	684	684	1.9482	1.8274	1.8274	0.1207	0.0	0.0
684	685	685	1.9482	1.5305	1.5305	0.4176	0.0	0.0
685	686	686	1.9482	1.5035	1.5035	0.4447	0.0	0.0
686	690	690	1.9482	1.1589	1.1589	0.7893	0.0	0.0
690	692	692	2.6595	2.0751	2.0751	0.5844	0.0	0.0
692	693	693	2.6595	1.2197	1.2197	1.4398	0.0	0.0
693	695	695	2.6595	0.9729	0.9729	1.6866	0.0	0.0
695	697	697	2.6595	1.3536	1.3536	1.3059	0.0	0.0
697	698	698	2.6595	1.5945	1.5945	1.0650	0.0	0.0
698	699	699	2.6595	1.9274	1.9274	0.7321	0.0	0.0
699	700	700	2.6595	1.4930	1.4930	1.1665	0.0	0.0
70	80	80	4.0185	4.0185	6.5777	0.0000	0.0	0.0
700	701	701	5.5439	3.4039	3.4039	2.1400	0.0	0.0
700A	700	700	2.6257	0.3114	0.3114	2.3144	0.0	0.0
701	702	702	5.5439	2.9616	2.9616	2.5823	0.0	0.0
702	704	704	5.5439	3.0504	3.0504	2.4935	0.0	0.0
704	706	706	5.5439	2.3711	2.3711	3.1728	0.0	0.0
706	708	708	5.5439	1.2152	1.2152	4.3287	0.0	0.0
708	525	525	5.5439	3.7685	3.7685	1.7754	0.0	0.0
710	530	530	0.2066	0.2066	0.7766	0.0000	0.0	0.0
720	730	730	0.9691	0.4202	0.4202	0.5490	0.0	0.0
730	760	760	3.1606	1.1553	1.1553	2.0053	0.0	0.0
740	750	750	0.6392	0.6392	1.0433	0.0000	0.0	0.0
750	752	752	4.1216	1.7689	1.7689	2.3528	0.0	0.0
752	752A	752A	4.1216	0.7964	0.7964	3.3252	0.0	0.0
752A	752B	752B	4.1216	0.7964	0.7964	3.3252	0.0	0.0
752B	754	754	4.1216	0.7954	0.7954	3.3263	0.0	0.0
754	756	756	4.1216	3.1665	3.1665	0.9551	0.0	0.0
756	590	590	4.1216	4.1216	4.6382	0.0000	0.0	0.0
760	750	750	3.4814	1.1659	1.1659	2.3155	0.0	0.0
770	775	775	0.0000	0.0000	2.0028	0.0000	0.0	0.0
775	780	780	0.4339	0.4339	1.7009	0.0000	0.0	0.0
780	790	790	0.4097	0.4097	1.8084	0.0000	0.0	0.0
790	630	630	0.3928	0.3928	1.7493	0.0000	0.0	0.0
80	110	110	4.4484	4.4484	5.9506	0.0000	0.0	0.0
800	810	810	0.2447	0.2447	0.3114	0.0000	0.0	0.0
810	690	690	0.5172	0.5172	1.1319	0.0000	0.0	0.0
820	830	830	0.2383	0.2074	0.2074	0.0309	0.0	0.0
830	840	840	0.4466	0.3343	0.3343	0.1123	0.0	0.0

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Link Name	Next Link Name	Overflow Node	Inflow m3/s	Design Flow m3/s	Capacity m3/s	Overflow m3/s	Storage m3	Inflow Storage m3
840	850	850	0.6874	0.2611	0.2611	0.4263	0.0	0.0
850	700	700	0.8530	0.8145	0.8145	0.0385	0.0	0.0
860	862	862	23.0898	14.4943	14.4943	8.5956	0.0	0.0
862	866	866	23.0898	7.8016	7.8016	15.2883	0.0	0.0
866	870	870	23.0898	11.2880	11.2880	11.8018	0.0	0.0
870	873	873	23.4846	10.6493	10.6493	12.8353	0.0	0.0
873	876	876	23.4846	8.5785	8.5785	14.9061	0.0	0.0
876	880	880	23.4846	6.4126	6.4126	17.0721	0.0	0.0
880	890	890	23.9170	5.4647	5.4647	18.4522	0.0	0.0
890	900	900	23.9170	14.9525	14.9525	8.9644	0.0	0.0
90	95	95	0.2663	0.2663	0.6308	0.0000	0.0	0.0
900	910	910	25.1257	9.4874	9.4874	15.6382	0.0	0.0
910	920	920	25.1666	25.1666	33.2991	0.0000	0.0	0.0
920	930	930	25.1591	24.1417	24.1417	1.0174	0.0	0.0
930	940	940	25.6498	24.6440	24.6440	1.0058	0.0	0.0
940	1000		25.5906	25.6498	10.0000	0.0000	0.0	0.0
95	130	130	0.2755	0.2755	0.5746	0.0000	0.0	0.0
OUT			1.2213	1.2213	1.2213	0.0000	0.0	0.0