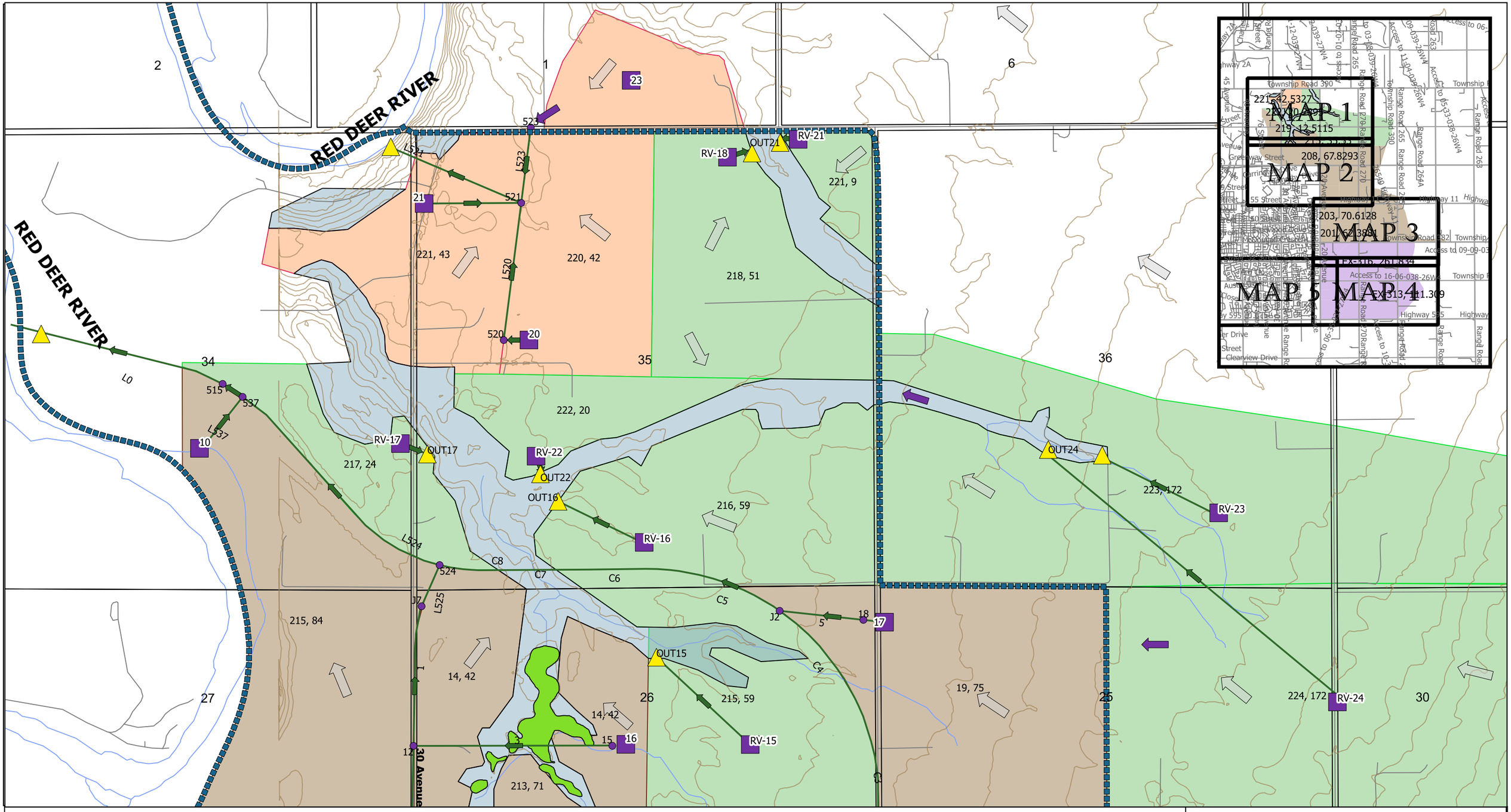

StudyArea-Matrix
Proposed Manholes
Proposed Pipes
Proposed Ponds
Proposed Outlets
External Area Inlet Location

Contours-5m
Flow Directions
Roads
Ravines
Semi- and Permanent Wetlands

Proposed Future Catchments
Piper
Ravine
RedDeer1
RedDeer2

Catchment Labels:
ID, Area (ha)

Note: The secondary outlet of the NW26 pond is into the ravine.

N

0 250 500 750 1000

1:12,500

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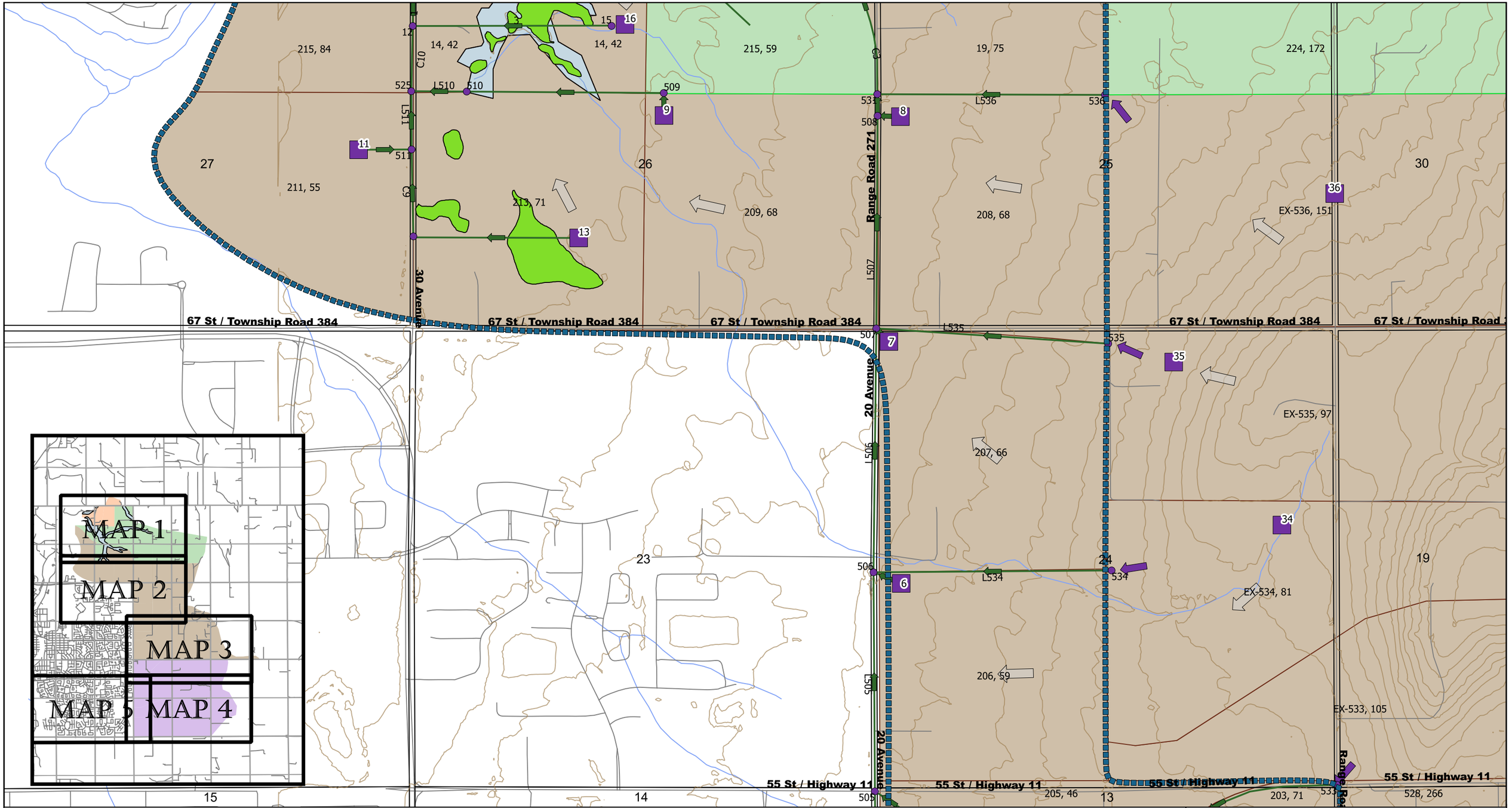
Greater East Hill Master Drainage Plan
City of Red Deer, Alberta
Project #23973

Preliminary Drainage Plan

K. Hofbauer
M. Shome

Map 4.1



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City of Red Deer, Alberta
Project #23973

Preliminary Drainage Plan

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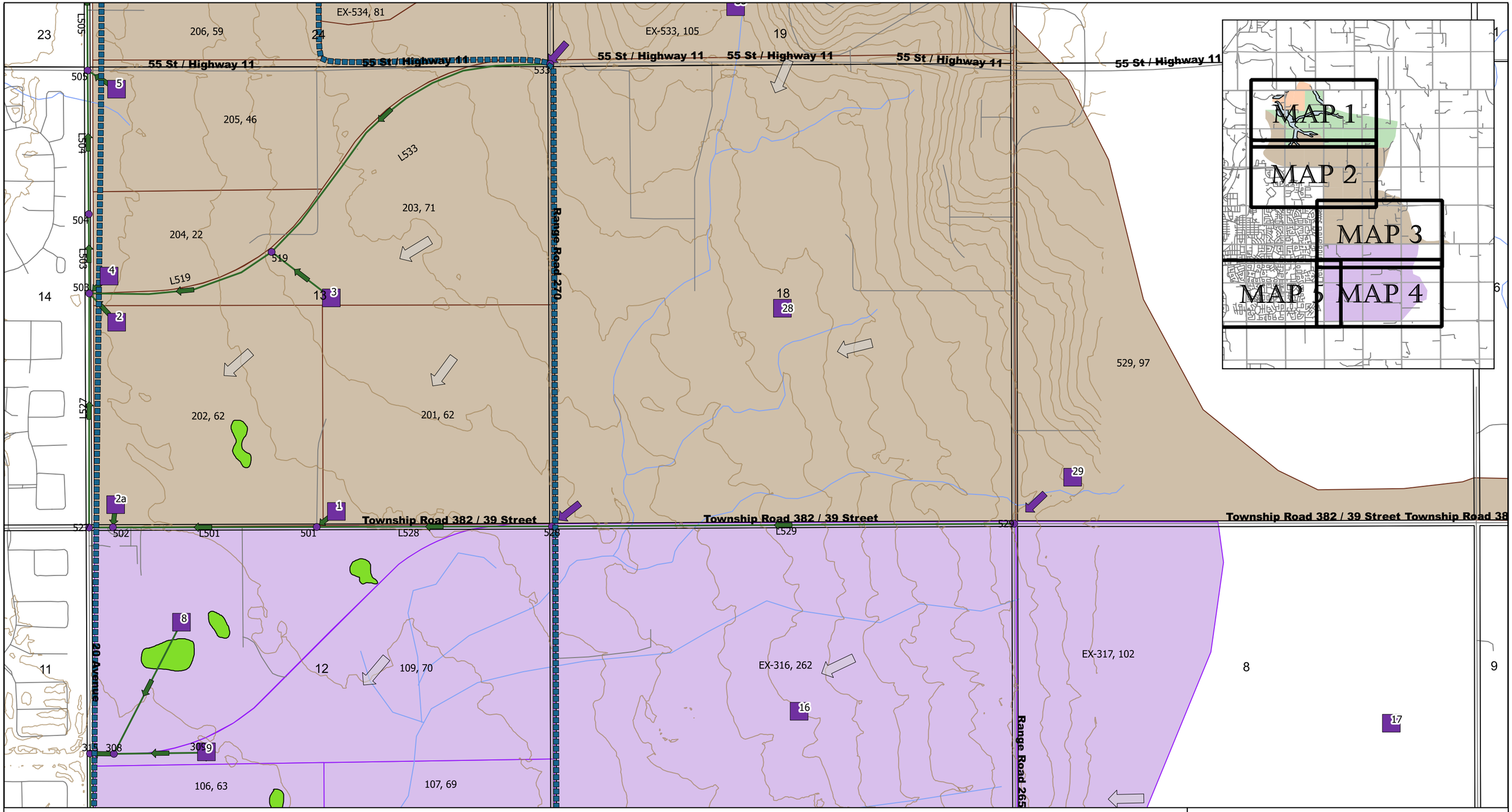
M. Shome

Map 4.2



StudyArea-Matrix
Proposed Manholes
Proposed Pipes
Proposed Ponds
Proposed Outlets
External Area Inlet Location

Contours-5m
Flow Directions
Roads
Ravines
Semi- and Permanent Wetlands

Proposed Future Catchments
Piper
Ravine
RedDeer1
RedDeer2

Catchment Labels:
ID, Area (ha)

N

0 250 500 750 1000

1:12,500

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Greater East Hill Master Drainage Plan
City of Red Deer, Alberta
Project #23973

Preliminary Drainage Plan

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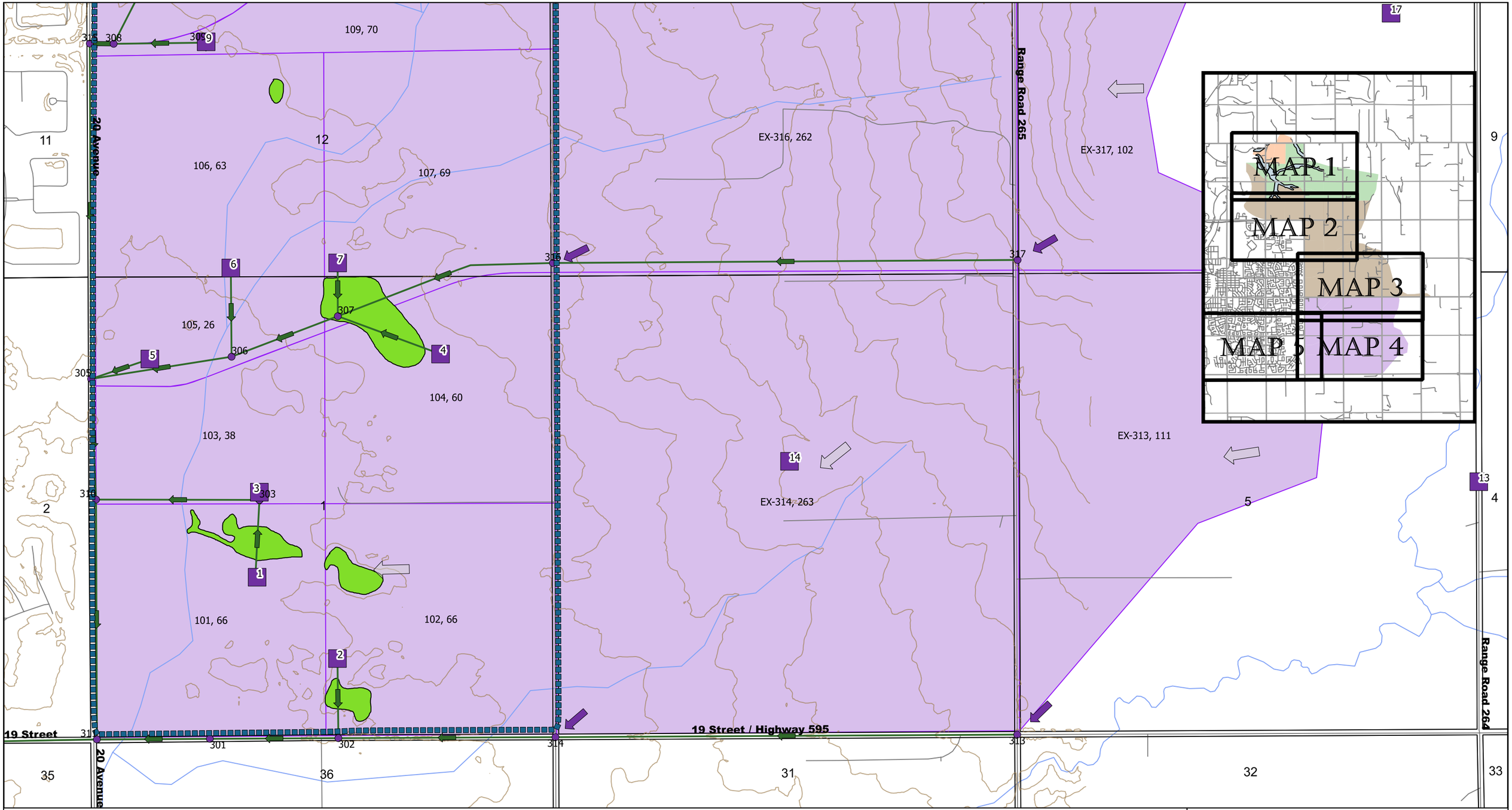
M. Shome

Map 4.3



StudyArea-Matrix
Proposed Manholes
Proposed Pipes
Proposed Ponds
Proposed Outlets
External Area Inlet Location

Contours-5m
Flow Directions
Roads
Ravines
Semi- and Permanent Wetlands

Proposed Future Catchments
Piper
Ravine
RedDeer1
RedDeer2

Catchment Labels:
ID, Area (ha)

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Greater East Hill Master Drainage Plan
City of Red Deer, Alberta
Project #23973

Preliminary Drainage Plan

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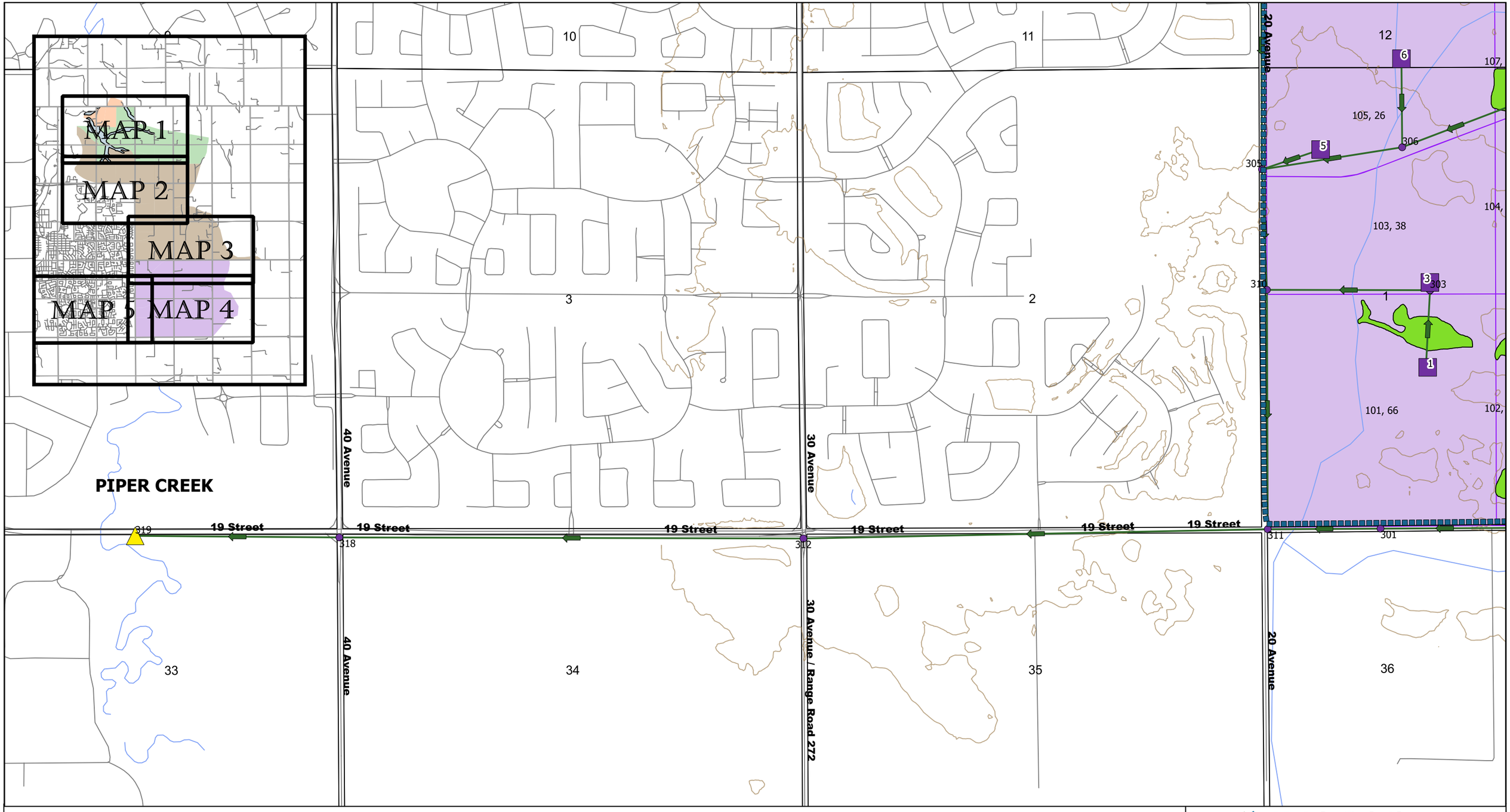
Map 4.4



StudyArea-Matrix
Proposed Manholes
Proposed Pipes
Proposed Ponds
Proposed Outlets
External Area Inlet Location

Contours-5m
Flow Directions
Roads
Ravines
Semi- and Permanent Wetlands

Proposed Future Catchments
Piper
Ravine
RedDeer1
RedDeer2

Catchment Labels:
ID, Area (ha)

N

0 250 500 750 1000

1:12,500

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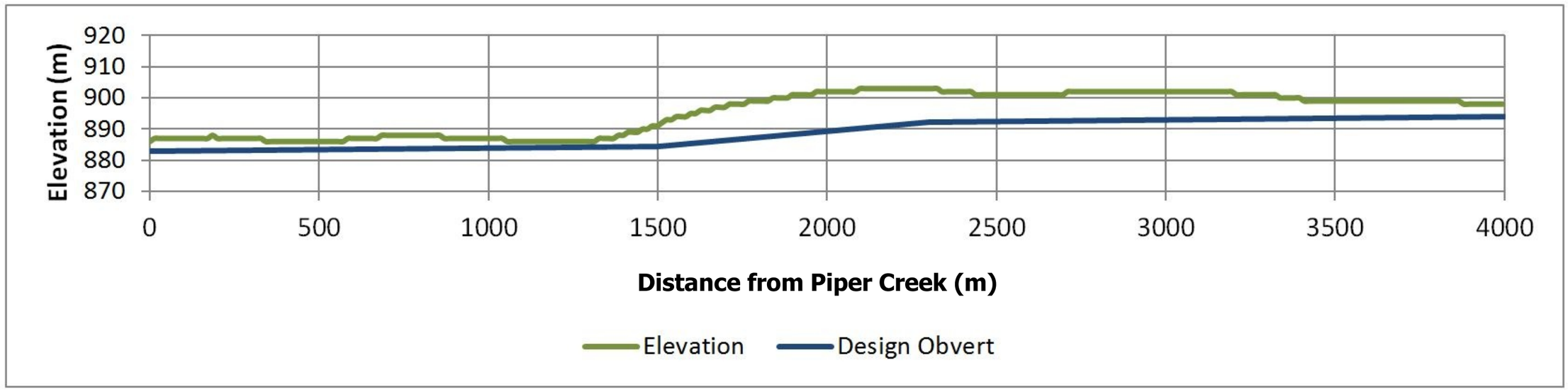
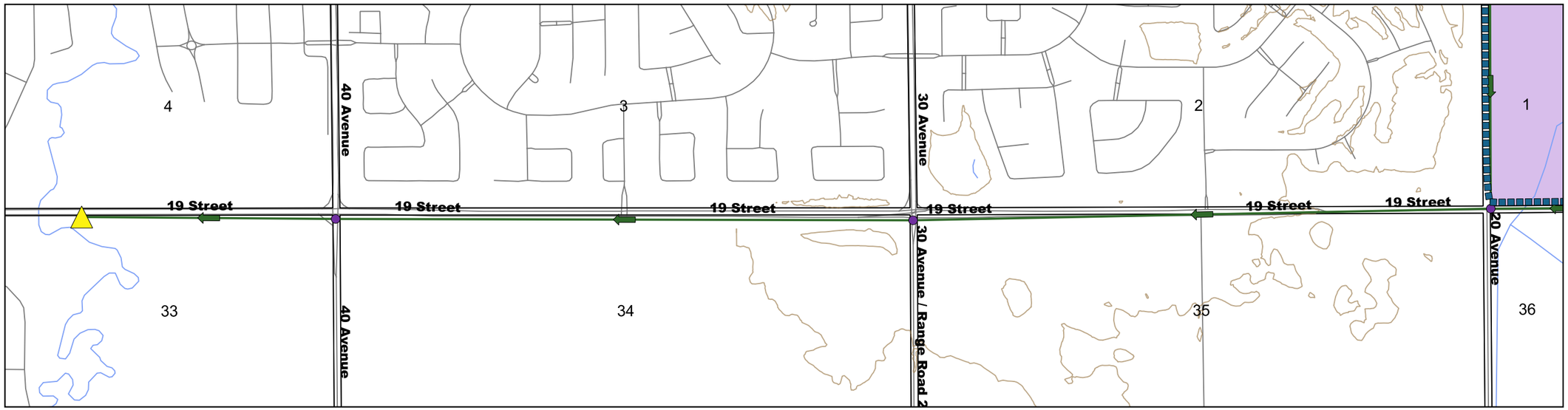
Greater East Hill Master Drainage Plan
City of Red Deer, Alberta
Project #23973

Preliminary Drainage Plan

K. Hofbauer
M. Shome

Map 4.5





Study Area
Proposed Manholes
Proposed Pipes
Proposed Outlets

Basemap
Contours-5m
Roads
Piper Creek

Notes:
1. Length of sewer downstream of 20 Ave: 4.1 km
2. Previous design length of sewer downstream of 20 Ave: 6.1 km
3. Sewer length savings: 2.0 km
4. Maximum cover on proposed sewer: 12.9 m
5. Length of sewer with > 10 m cover: 700 m
6. Length of sewer with > 5 m cover: 2400 m
7. Horizontal alignment of trunk sewer within the 19th Street road right of way has been shown for illustrative purposes only. Precise location will be determined at a later date.

N

0 250 500 750 1000 m

1:12,500

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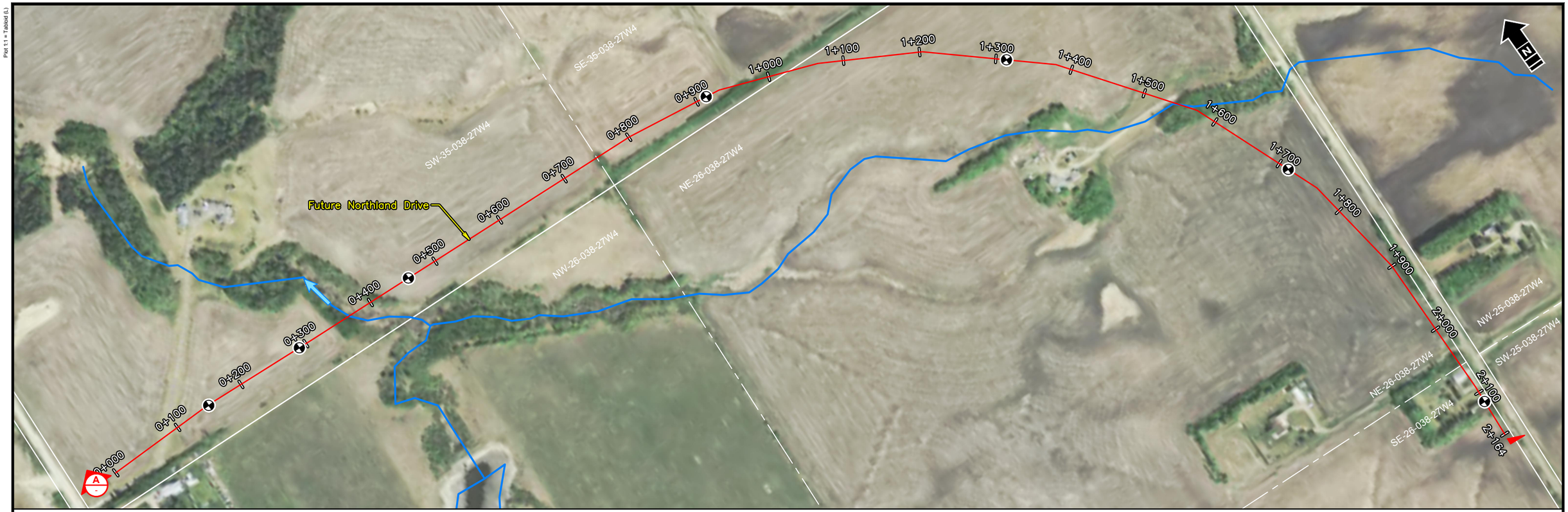
Greater East Hill Master Drainage Plan
City of Red Deer, Alberta
Project #23973

19 Street Plan and Profile

K. Hofbauer
M. Shome

Map 5

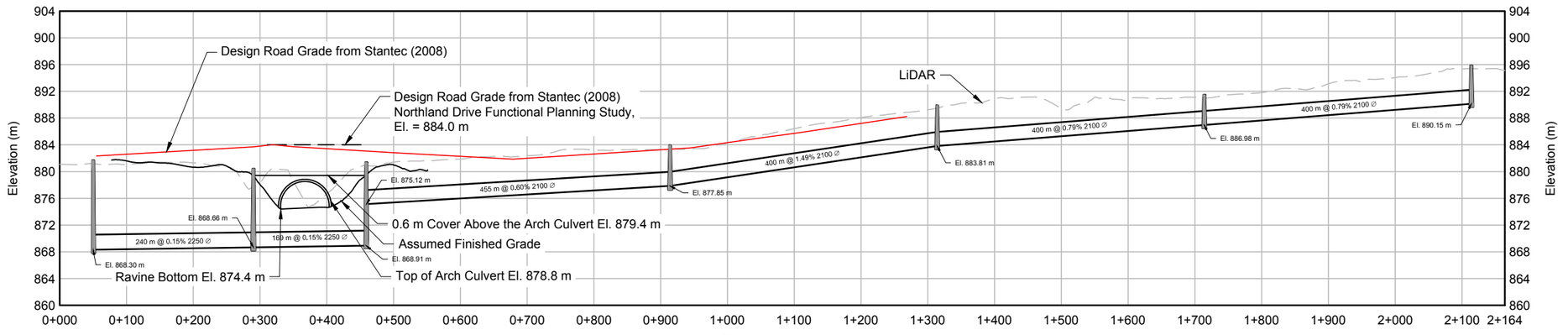
Plot 1:1 = Tabloid (L)



Plan View

Scale 1:5000

1:5000 metres
50 0 50 100
UTM83-12



Profile

Horizontal Scale 1:7500
Vertical Scale 1:750

Manhole

Reference: Aerial Photograph obtained from Valtus Imagery Services dated May 21 to Sep 22, 2013.
LiDAR from Valtus dated 2012.

REVISION					
1	2017-04-20	Issued for Conceptual Design	BC	MS	ZS
0	2016-12-20	Issued for Reference	BC	MS	ML
No.	DATE	DESCRIPTION	BY	CHK.	DRN.

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The City of Red Deer
East Hills Development Area Master Drainage Plan Release Rates Evaluation

Ravine Crossing Conceptual Design

Date:	Project:	Technical:	Reviewer:	Drawn:
December 2016	23973-SP-17-UTM	B. Coates	M. Shome	M. Lee

Map 6

F:\23973\3D\drftng\20170723973-SP-17-UTM.dwg - TEMSEC - Monday, March 20, 2017 3:25:50 PM - Zachary Steele

RED DEER RIVER

RED DEER RIVER

<501-750@5.2%

487-750@0.1%>

<482-1200@0.2%

<360-2700@0.2%

134-1350@0.4%>

500-1200@0.2%>

<400-2100@1.5%

<400-2100@0.8%

<400-2100@0.8%

<509-900@0.5%

Wildlife Crossing

Range Road 265

RV-15 RV-16 RV-17 RV-18 RV-21 RV-22 RV-23 RV-24

23 21 20 10 17 16

523 521 520 515 537 524 J4 J5 J3 J2 18 J1 15 12 J7

2 1 6 34 35 36 27 26 25 30

MAP 1 MAP 2 MAP 3 MAP 4 MAP 5

Contours-5m
Roads
Flow Directions
Ravines
Semi- and permanent wetlands

StudyArea-Matrix
Proposed Ponds
Proposed Junctions

Outfalls
Existing Pipes
Proposed Pipes
Modelled Orifices

N

0 250 500 750 1000

1:12,500

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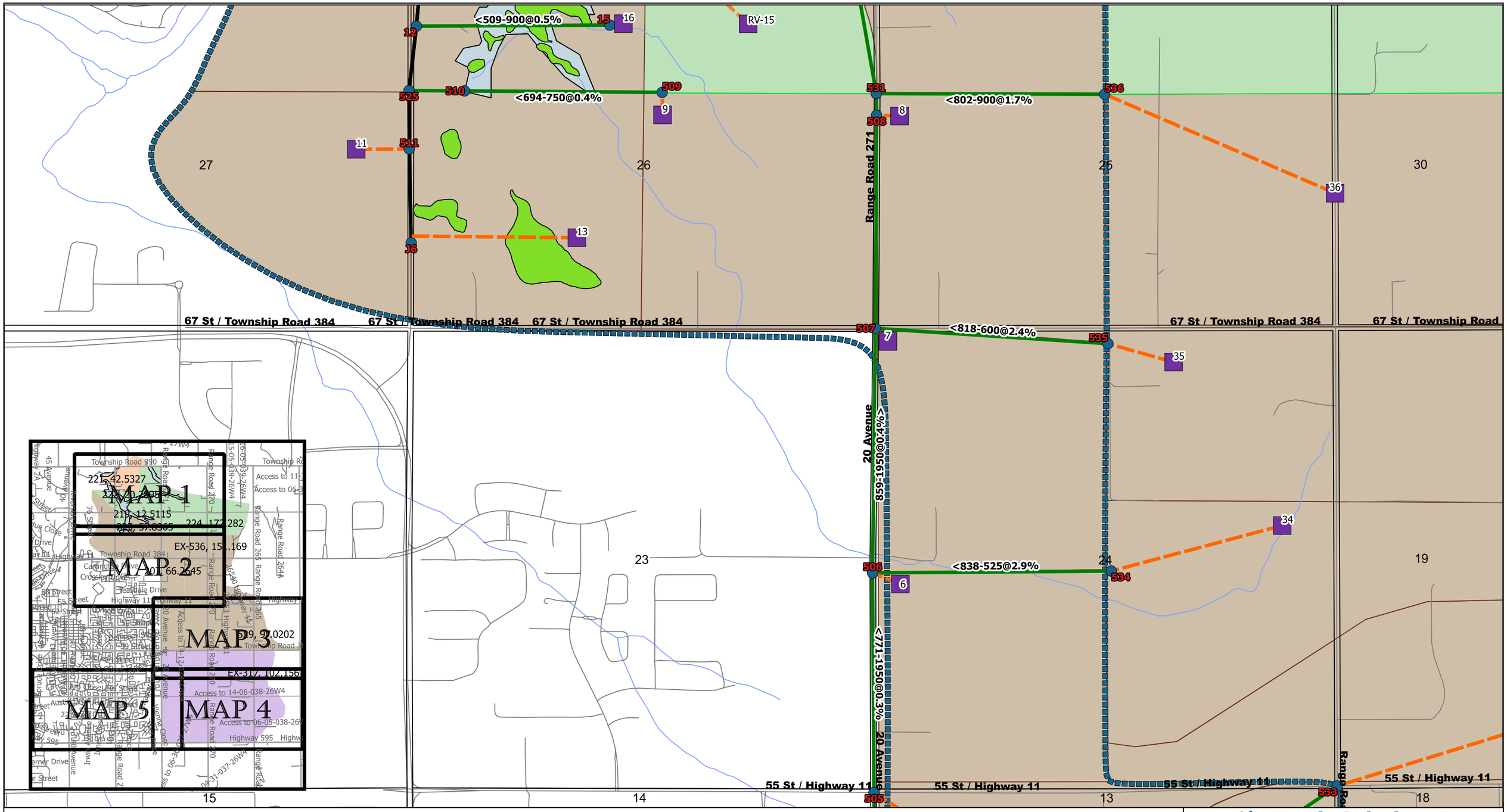
Greater East Hill Master Drainage Plan
City of Red Deer, Alberta
Project #23973

Trunk Sewer Sizing

K. Hofbauer
M. Shome

Map 7.1



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Greater East Hill Master Drainage Plan
City of Red Deer, Alberta

Project #23973

Trunk Sewer Sizing

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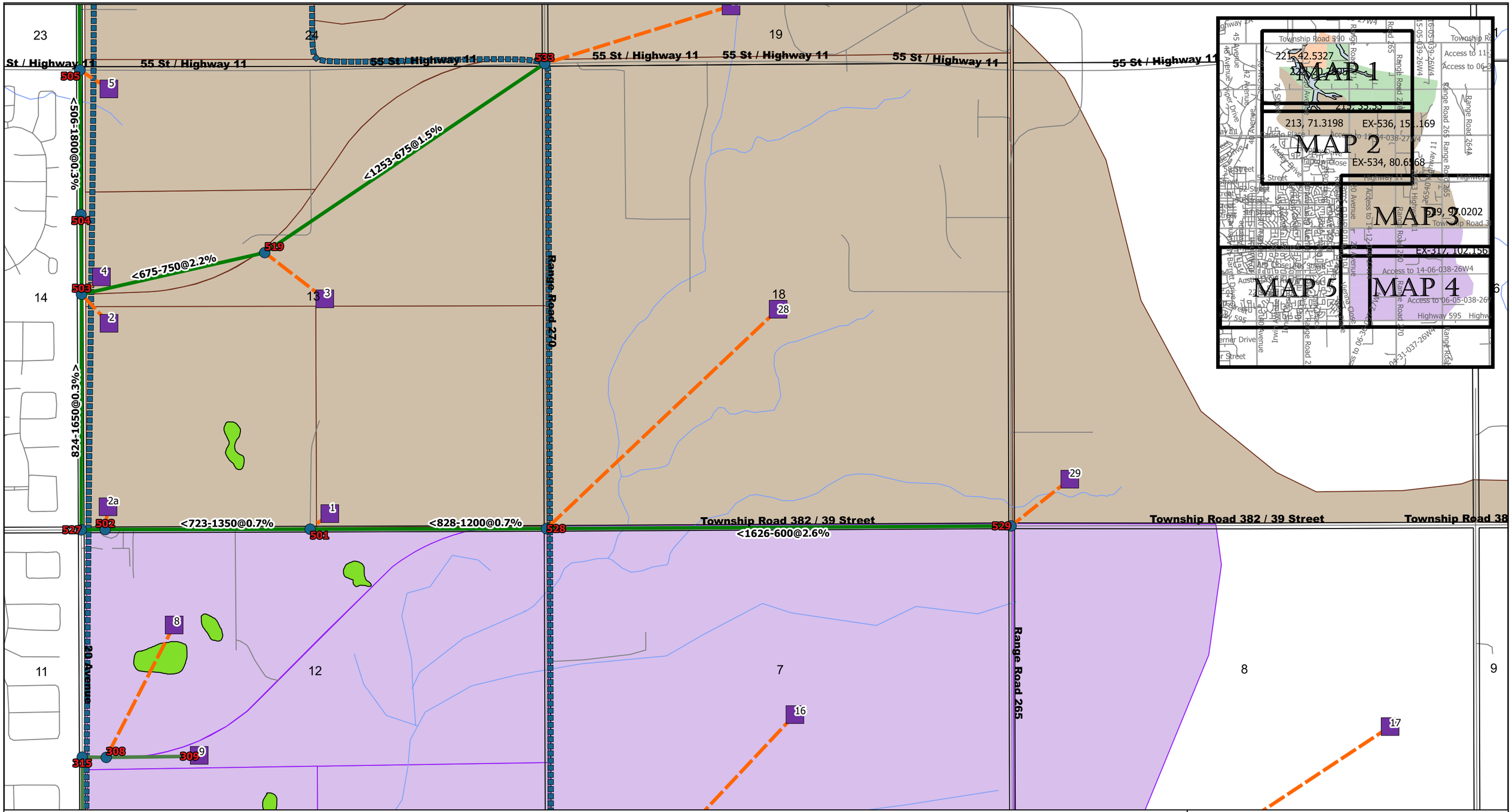
M. Shome

Map 7.2



Contours-5m
Roads
Flow Directions
Ravines
Semi- and permanent wetlands

StudyArea-Matrix
Proposed Ponds
Proposed Junctions
Outfalls
Proposed Pipes
Modelled Orifices

N

0 250 500 750 1000

1:12,500

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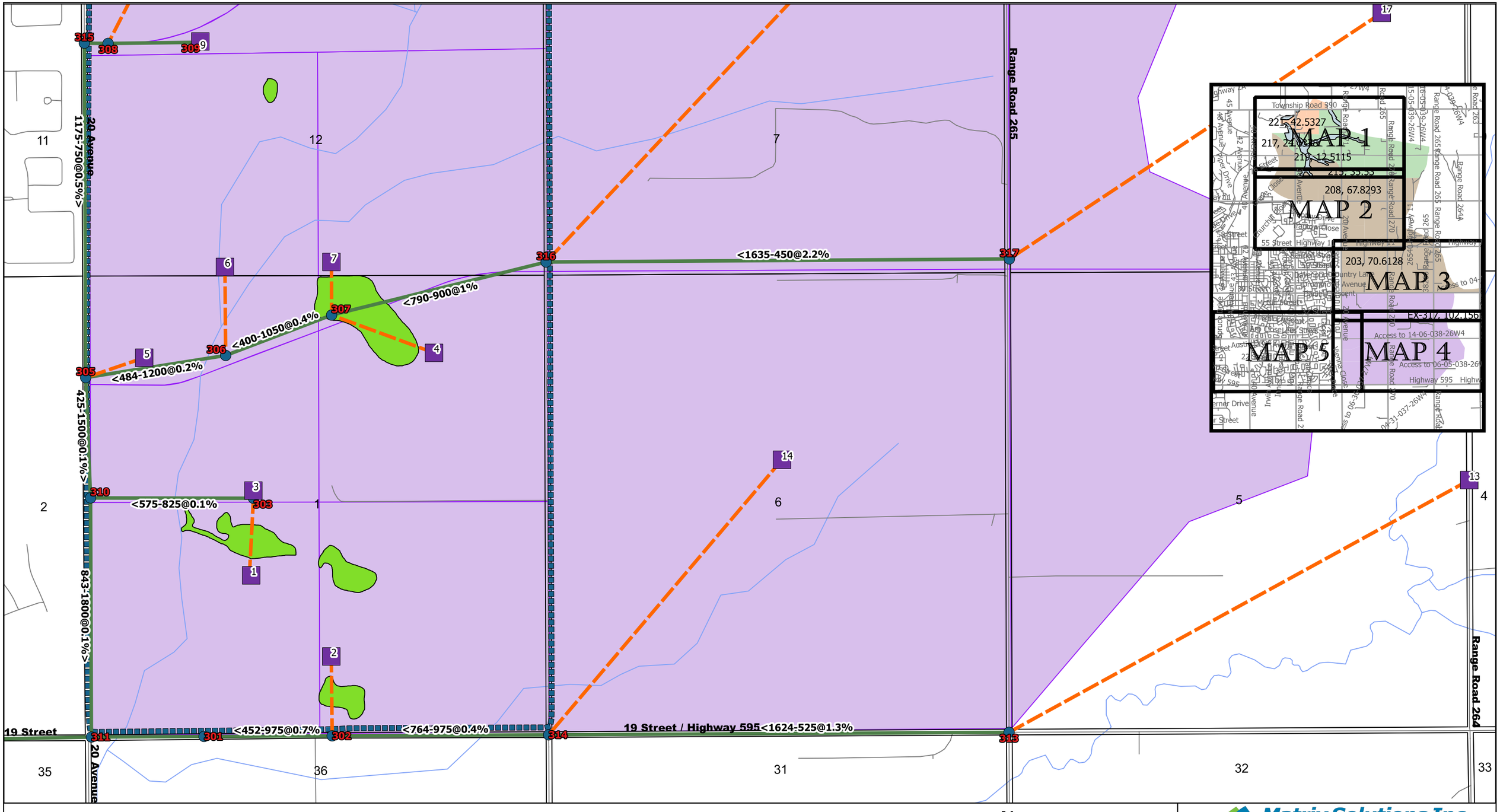
Greater East Hill Master Drainage Plan
City of Red Deer, Alberta
Project #23973

Trunk Sewer Sizing

K. Hofbauer
M. Shome

Map 7.3



Contours-5m
Roads
Flow Directions
Ravines
Semi- and permanent wetlands

StudyArea-Matrix
Proposed Ponds
Proposed Junctions
Outfalls
Proposed Pipes
Modelled Orifices

N

0 250 500 750 1000

1:12,500

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Greater East Hill Master Drainage Plan
City of Red Deer, Alberta
Project #23973

Trunk Sewer Sizing

K. Hofbauer
M. Shome

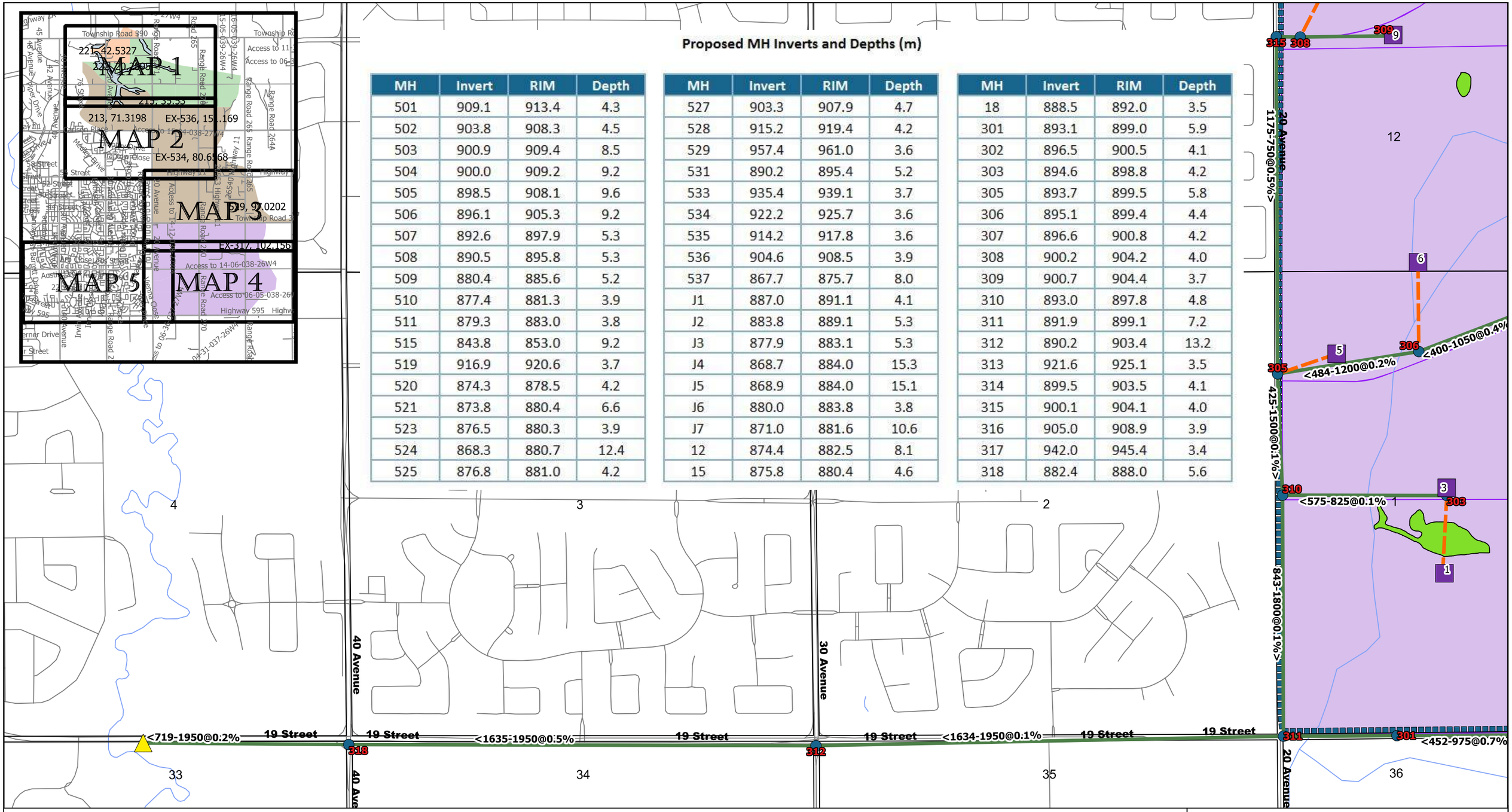
Map 7.4

Proposed MH Inverts and Depths (m)

MH	Invert	RIM	Depth
501	909.1	913.4	4.3
502	903.8	908.3	4.5
503	900.9	909.4	8.5
504	900.0	909.2	9.2
505	898.5	908.1	9.6
506	896.1	905.3	9.2
507	892.6	897.9	5.3
508	890.5	895.8	5.3
509	880.4	885.6	5.2
510	877.4	881.3	3.9
511	879.3	883.0	3.8
515	843.8	853.0	9.2
519	916.9	920.6	3.7
520	874.3	878.5	4.2
521	873.8	880.4	6.6
523	876.5	880.3	3.9
524	868.3	880.7	12.4
525	876.8	881.0	4.2

MH	Invert	RIM	Depth
527	903.3	907.9	4.7
528	915.2	919.4	4.2
529	957.4	961.0	3.6
531	890.2	895.4	5.2
533	935.4	939.1	3.7
534	922.2	925.7	3.6
535	914.2	917.8	3.6
536	904.6	908.5	3.9
537	867.7	875.7	8.0
J1	887.0	891.1	4.1
J2	883.8	889.1	5.3
J3	877.9	883.1	5.3
J4	868.7	884.0	15.3
J5	868.9	884.0	15.1
J6	880.0	883.8	3.8
J7	871.0	881.6	10.6
12	874.4	882.5	8.1
15	875.8	880.4	4.6

MH	Invert	RIM	Depth
18	888.5	892.0	3.5
301	893.1	899.0	5.9
302	896.5	900.5	4.1
303	894.6	898.8	4.2
305	893.7	899.5	5.8
306	895.1	899.4	4.4
307	896.6	900.8	4.2
308	900.2	904.2	4.0
309	900.7	904.4	3.7
310	893.0	897.8	4.8
311	891.9	899.1	7.2
312	890.2	903.4	13.2
313	921.6	925.1	3.5
314	899.5	903.5	4.1
315	900.1	904.1	4.0
316	905.0	908.9	3.9
317	942.0	945.4	3.4
318	882.4	888.0	5.6



- Contours-5m
- Roads
- Flow Directions
- Ravines
- Semi- and permanent wetlands
- StudyArea-Matrix
- Proposed Ponds
- Proposed Junctions
- Outfalls
- Proposed Pipes
- Modelled Orifices

N

0 250 500 750 1000

1:12,500

Matrix Solutions Inc.
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Greater East Hill Master Drainage Plan
City of Red Deer, Alberta
Project #23973

Trunk Sewer Sizing

K. Hofbauer
M. Shome

Map 7.5

APPENDIX A
Design Storm Hyetographs

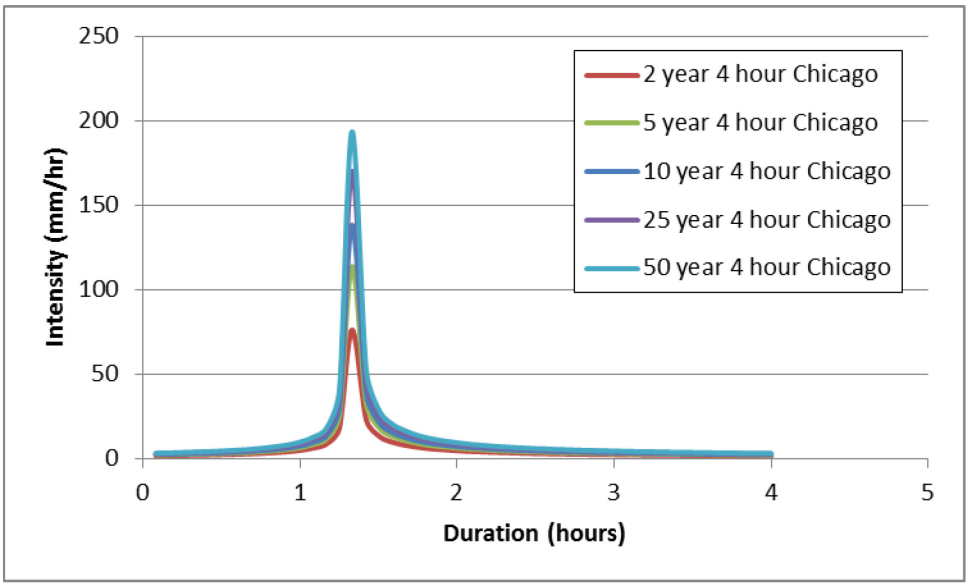

Figure A1 2 year to 50 year Design Storm (4 hours)

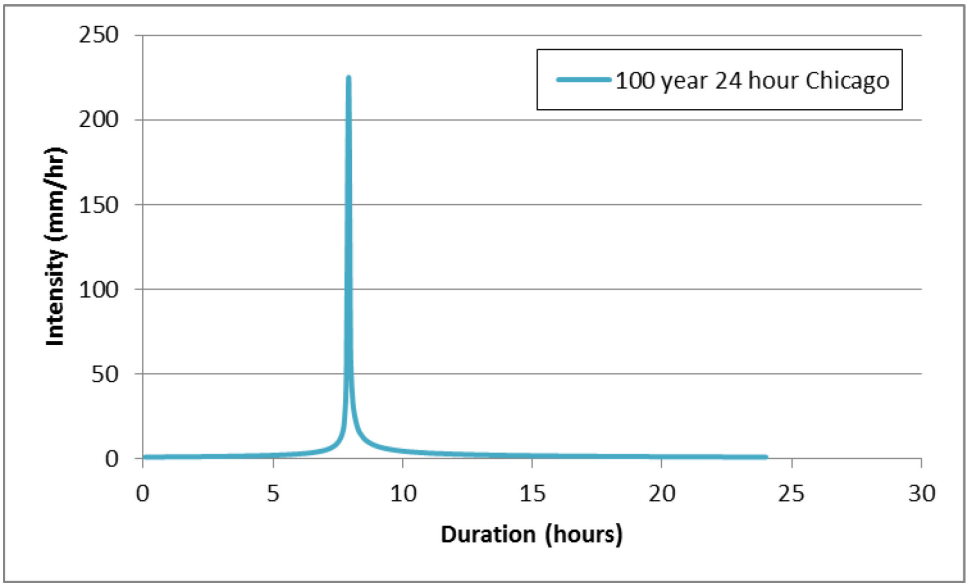

Figure A2 100 year Design Storm (24 hours)

APPENDIX B
Hydraulic Model Results Summary

Table B1 Summary of Modelling Results of Stormwater Ponds draining to the Red Deer River

ID	Area (ha)	5 year, 4 hour		10 year, 4 hour		25 year, 4 hour		50 year, 4 hour	
		High Water Level (m)	Peak Outflows (m^3/s)	High Water Level (m)	Peak Outflows (m^3/s)	High Water Level (m)	Peak Outflows (m^3/s)	High Water Level (m)	Peak Outflows (m^3/s)
1	62.4	911.9	0.269	912.0	0.322	912.2	0.386	912.3	0.429
2	31.2	907.8	0.147	907.9	0.175	908.1	0.209	908.3	0.232
2A	31.2	906.7	0.147	906.8	0.175	907.0	0.209	907.2	0.232
3	70.6	919.0	0.256	919.1	0.327	919.3	0.405	919.4	0.457
4	21.9	907.6	0.096	907.7	0.113	907.9	0.134	908.1	0.148
5	46.4	906.5	0.194	906.6	0.234	906.8	0.283	907.0	0.316
6	59.1	903.6	0.239	903.7	0.290	903.9	0.353	904.0	0.396
7	66.3	896.2	0.241	896.3	0.302	896.5	0.371	896.6	0.418
8	67.8	894.1	0.248	894.2	0.307	894.4	0.377	894.5	0.424
9	68.3	884.0	0.250	884.1	0.309	884.3	0.379	884.4	0.426
10	84.2	874.1	0.319	874.2	0.422	874.4	0.526	874.5	0.597
11	55.4	881.7	0.217	881.8	0.263	882.0	0.322	882.1	0.361
20	41.6	876.5	0.162	876.6	0.193	876.8	0.232	877.0	0.258
21	42.5	878.8	0.165	878.9	0.196	879.1	0.235	879.3	0.261
23	21.0	878.3	0.109	878.4	0.128	878.6	0.153	878.8	0.169
28	265.9	917.9	0.655	918.0	0.877	918.2	1.229	918.3	1.527
29	97.0	959.4	0.328	959.5	0.441	959.7	0.553	959.8	0.629
33	104.9	937.5	0.376	937.7	0.504	937.8	0.628	938.0	0.713
34	80.7	924.1	0.304	924.2	0.390	924.4	0.481	924.6	0.544
35	97.1	916.2	0.328	916.3	0.442	916.5	0.554	916.6	0.630
36	151.2	906.9	0.462	907.1	0.618	907.2	0.841	907.4	0.966
13	71.3	881.6	0.250	881.7	0.309	881.9	0.378	882.0	0.426
16	42.2	879.4	0.164	879.5	0.195	879.7	0.234	879.9	0.260
17	74.9	891.0	0.265	891.1	0.321	891.3	0.392	891.5	0.440

Table B2 Summary of Modelling Results of Stormwater Ponds draining to Piper Creek

ID	Area (ha)	5 year, 4 hour		10 year, 4 hour		25 year, 4 hour		50 year, 4 hour	
		High Water Level (m)	Peak Outflows (m^3/s)	High Water Level (m)	Peak Outflows (m^3/s)	High Water Level (m)	Peak Outflows (m^3/s)	High Water Level (m)	Peak Outflows (m^3/s)
1	65.8	897.2	0.114	897.3	0.133	897.5	0.158	897.6	0.175
2	65.8	898.9	0.114	899.0	0.133	899.2	0.158	899.3	0.175
3	38	897.2	0.069	897.3	0.080	897.5	0.094	897.6	0.103
4	59.8	899.1	0.105	899.2	0.123	899.4	0.146	899.5	0.162
5	26.1	897.9	0.048	898.0	0.056	898.2	0.065	898.3	0.071
6	62.8	897.8	0.115	897.9	0.135	898.1	0.160	898.2	0.177
7	68.9	899.1	0.120	899.2	0.141	899.4	0.167	899.6	0.185
8	63.8	902.5	0.115	902.7	0.135	902.8	0.159	903.0	0.176
9	70.3	902.8	0.121	902.9	0.143	903.1	0.169	903.2	0.187
13	111.3	923.4	0.182	923.5	0.217	923.7	0.262	923.9	0.292
14	263	901.9	0.312	902.0	0.423	902.2	0.553	902.3	0.631
16	262	907.3	0.305	907.4	0.414	907.5	0.546	907.7	0.624
17	102.2	943.7	0.151	943.8	0.180	944.0	0.218	944.1	0.243

Table B3 Summary of Modelling Results of Ravine Stormwater Ponds

ID	Area (ha)	5 year, 4 hour		10 year, 4 hour		25 year, 4 hour		50 year, 4 hour	
		High Water Level (m)	Peak Outflows (m^3/s)	High Water Level (m)	Peak Outflows (m^3/s)	High Water Level (m)	Peak Outflows (m^3/s)	High Water Level (m)	Peak Outflows (m^3/s)
RV-15	59.3	890.0	0.104	890.1	0.123	890.3	0.146	890.4	0.161
RV-16	58.5	877.0	0.103	877.1	0.122	877.2	0.145	877.4	0.160
RV-17	24.1	878.8	0.050	878.9	0.058	879.1	0.068	879.2	0.074
RV-22	20.3	878.8	0.038	878.9	0.044	879.1	0.051	879.2	0.056
RV-18	50.7	881.9	0.087	882.0	0.102	882.2	0.121	882.3	0.133
RV-21	9.4	882.8	0.020	882.9	0.023	883.1	0.026	883.3	0.029
RV-23	172.3	900.5	0.233	900.6	0.309	900.7	0.384	900.8	0.435
RV-24	172.3	904.0	0.233	904.1	0.309	904.2	0.384	904.3	0.435
RV-15	59.3	890.0	0.104	890.1	0.123	890.3	0.146	890.4	0.161
RV-16	58.5	877.0	0.103	877.1	0.122	877.2	0.145	877.4	0.160
RV-17	24.1	878.8	0.050	878.9	0.058	879.1	0.068	879.2	0.074
RV-22	20.3	878.8	0.038	878.9	0.044	879.1	0.051	879.2	0.056

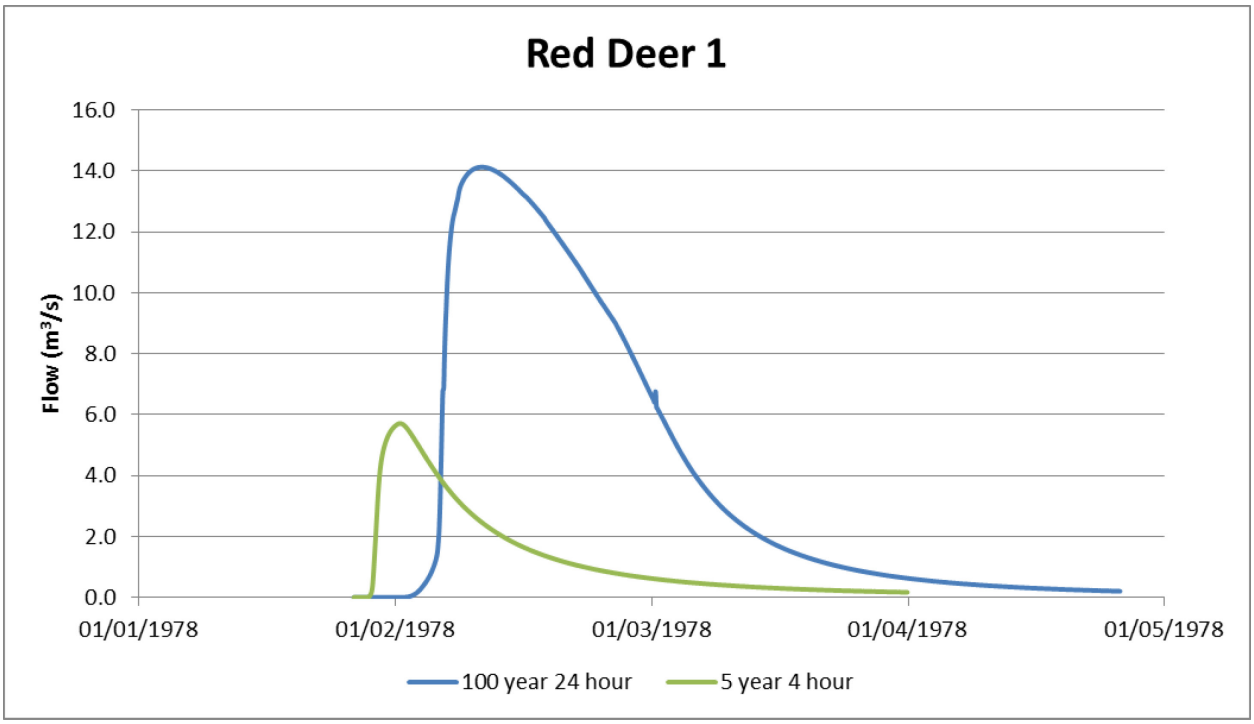

Figure B1 **Red Deer 1 Outlet Hydrographs for 5 year and 100 year storms**

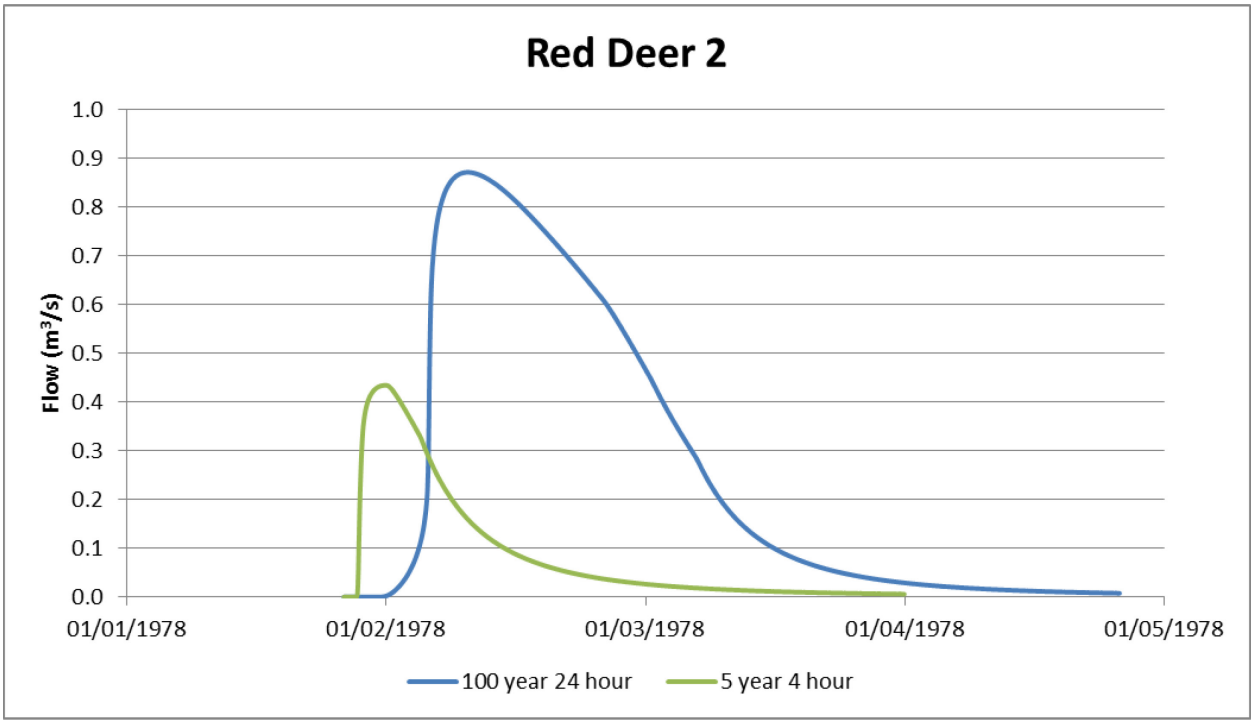

Figure B2 **Red Deer 2 Outlet Hydrographs for 5 year and 100 year storms**

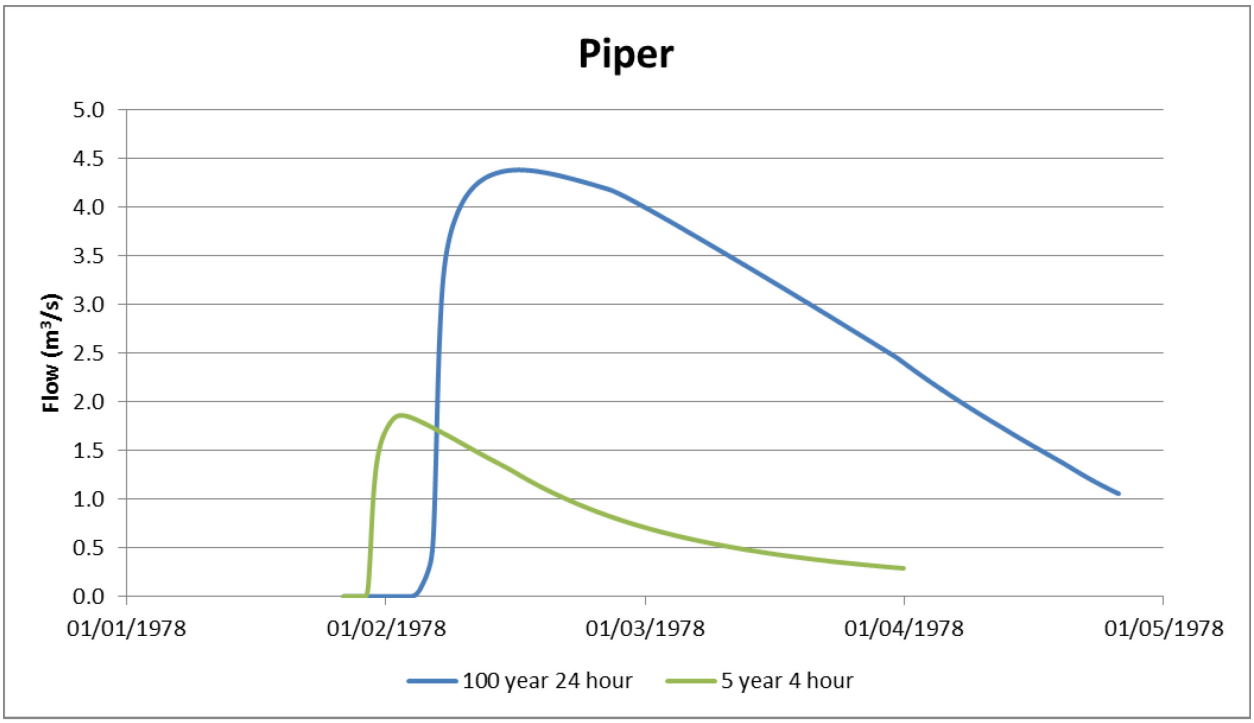

Figure B3 **Piper Creek Outlet Hydrograph for 5 year and 100 year storms**

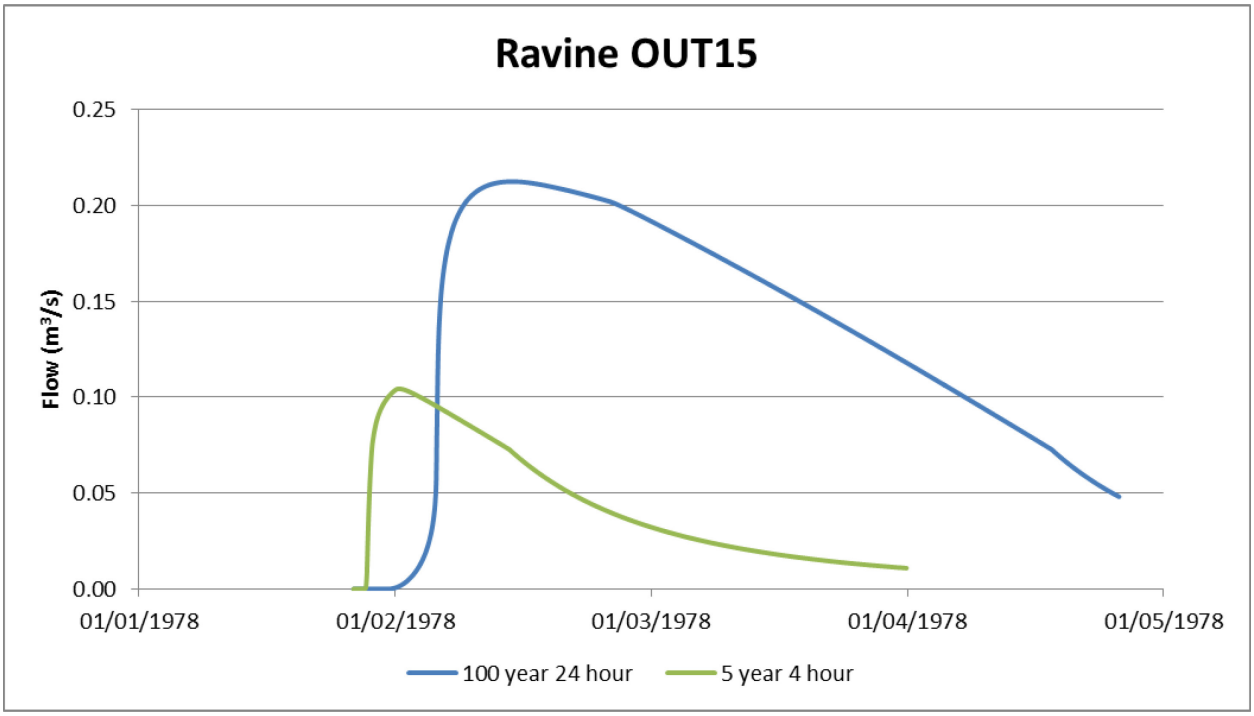

Figure B4 **Ravine Outlet 15 Hydrograph for 5 year and 100 year storms**

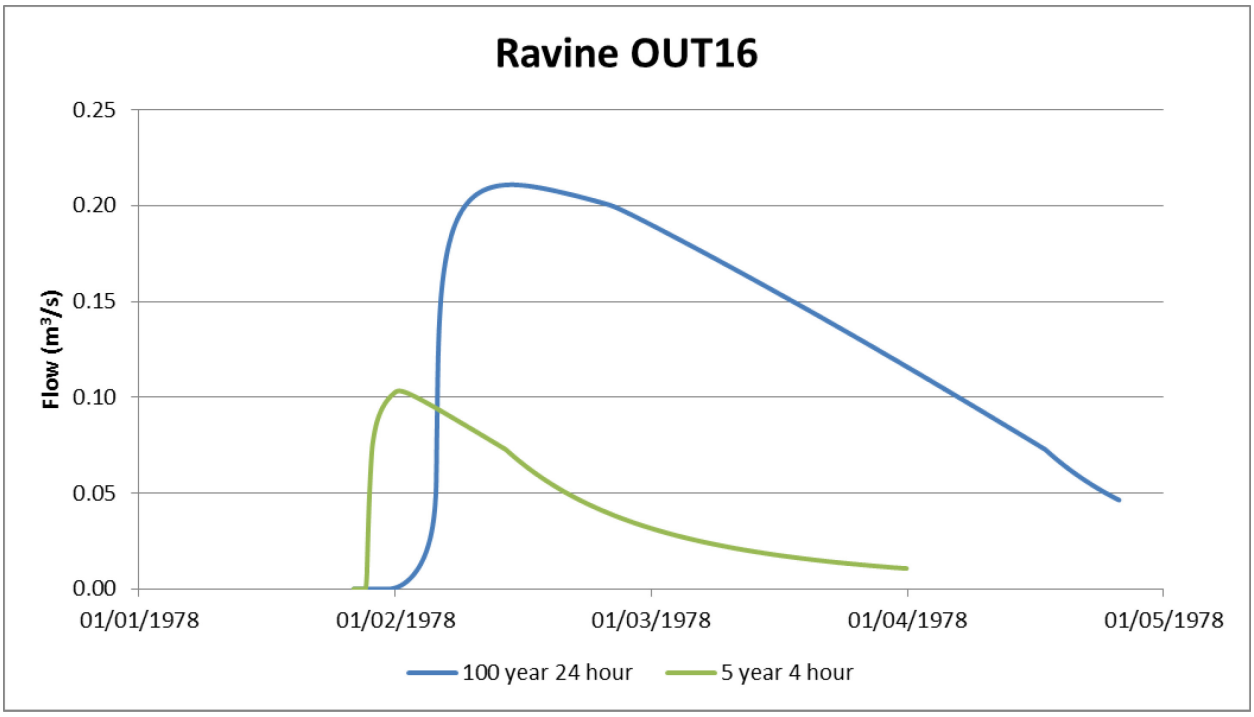

Figure B5 **Ravine Outlet 16 Hydrograph for 5 year and 100 year storms**

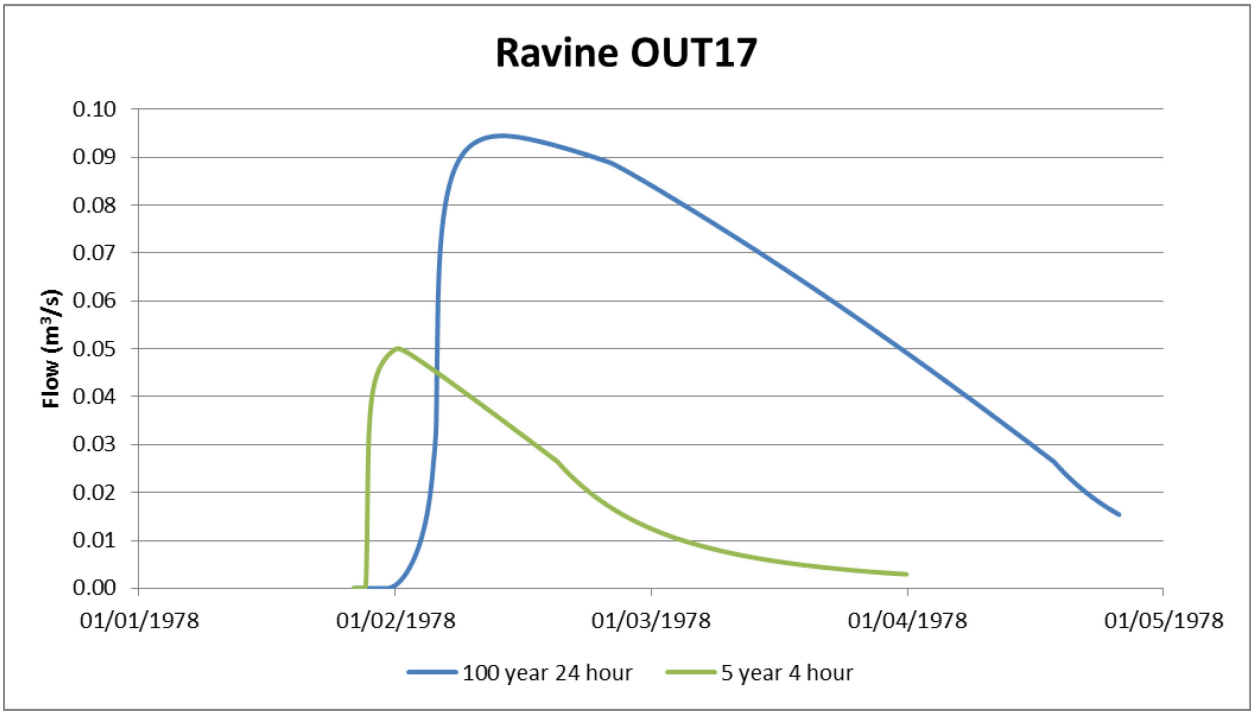

Figure B6 **Ravine Outlet 17 Hydrograph for 5 year and 100 year storms**

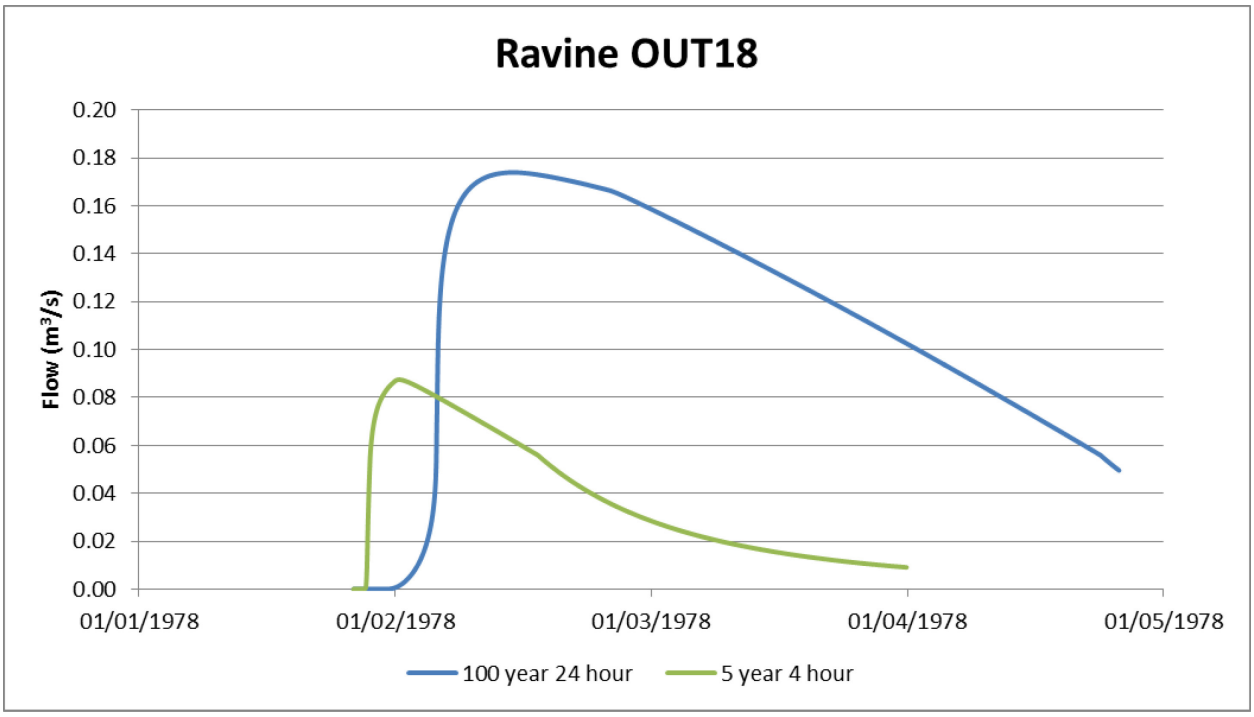

Figure B7 **Ravine Outlet 18 Hydrograph for 5 year and 100 year storms**

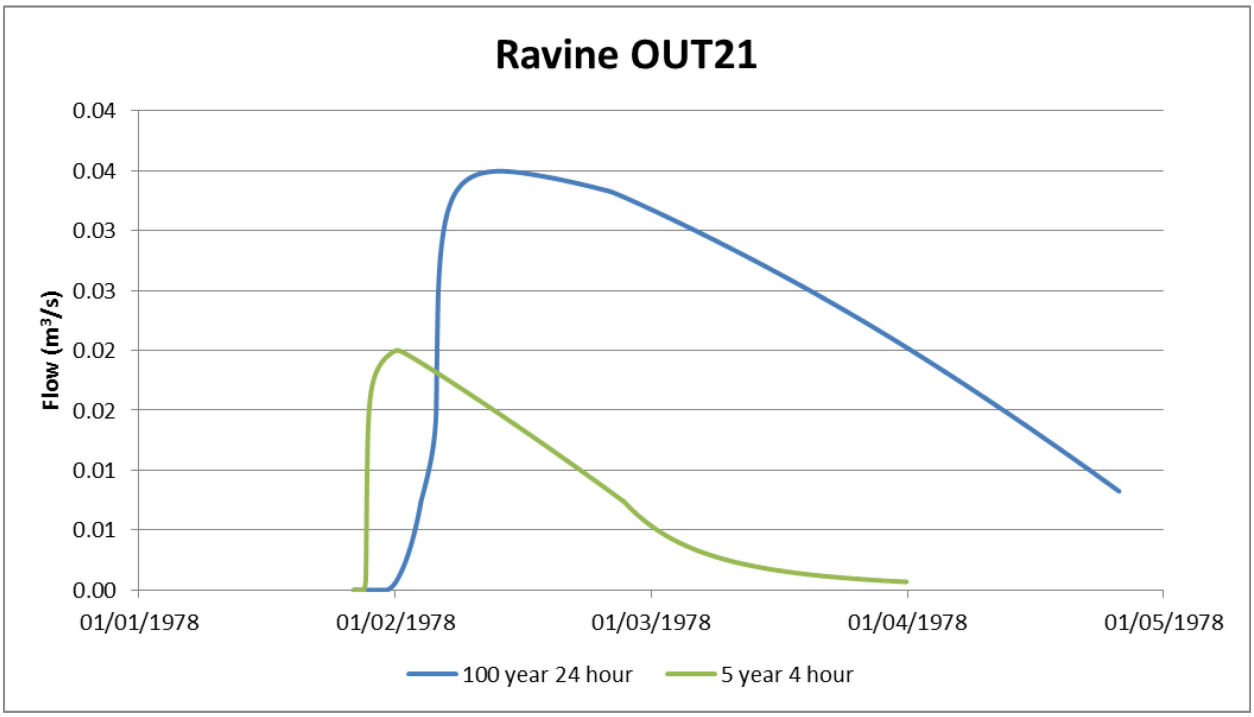

Figure B8 **Ravine Outlet 21 Hydrograph for 5 year and 100 year storms**

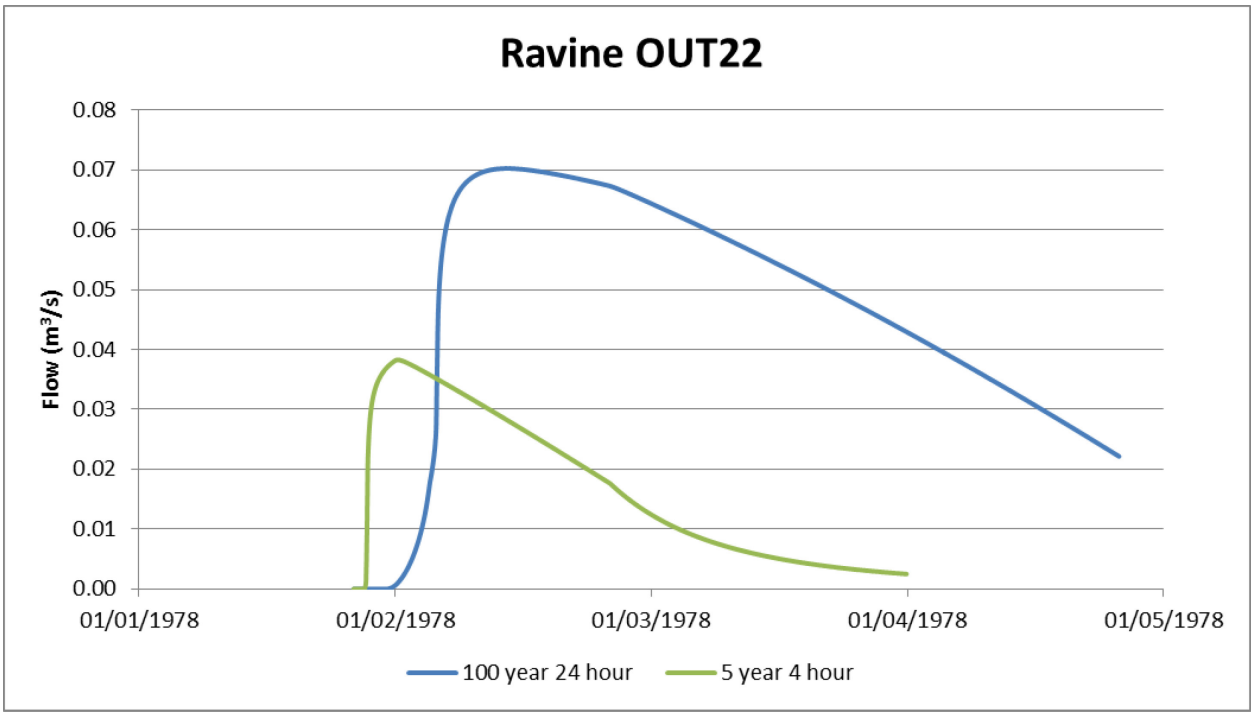

Figure B9 **Ravine Outlet 22 Hydrograph for 5 year and 100 year storms**

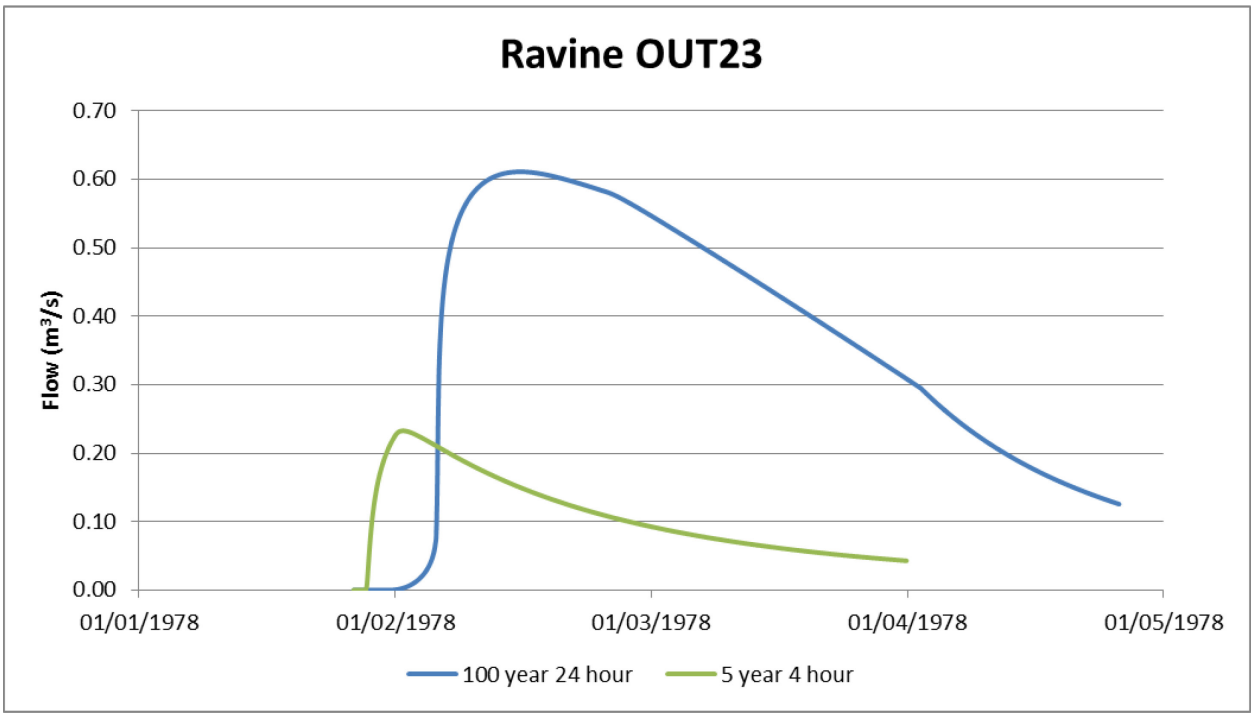

Figure B10 **Ravine Outlet 23 Hydrograph for 5 year and 100 year storms**

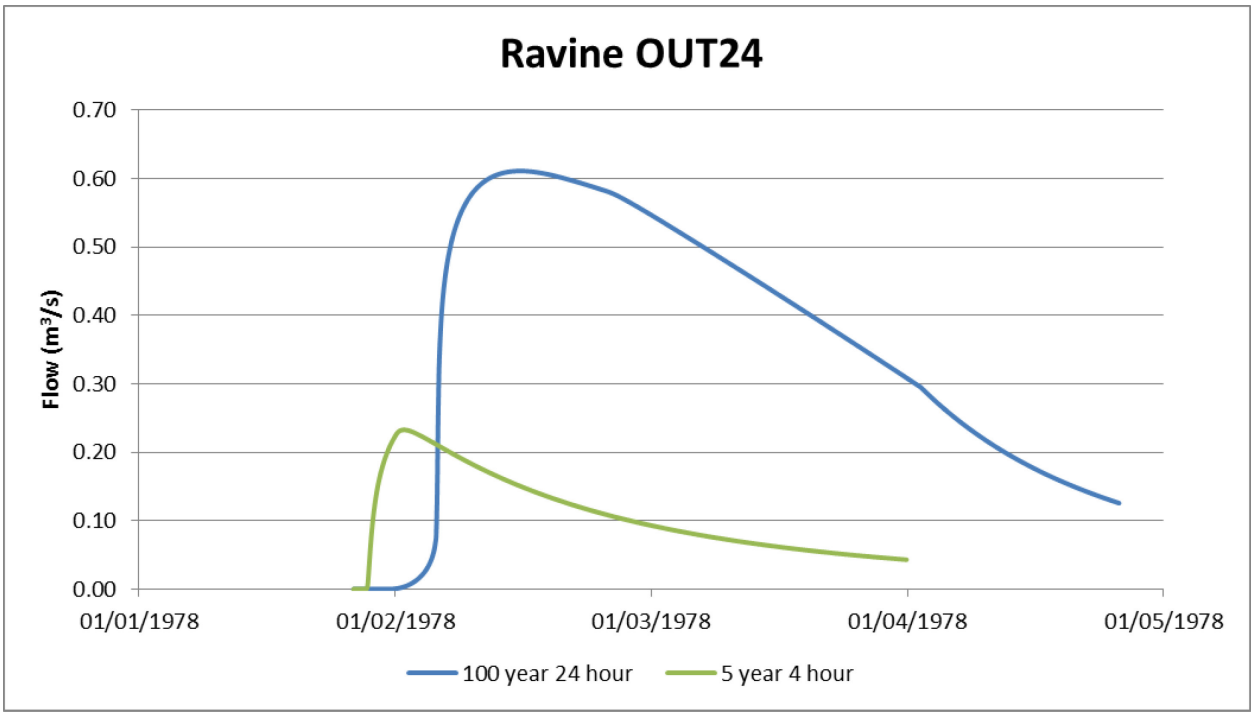

Figure B11 Ravine Outlet 24 Hydrograph for 5 year and 100 year storms

Table B4 Pipe Details for Red Deer and Ravine Trunk

Catchment	Pipe Label	Size (m)	100 year 24 hour Peak Flow (m^3/s)
Red Deer 1	C10	1200	1.59
Red Deer 1	C3	2100	10.8
Red Deer 1	C4	2100	10.8
Red Deer 1	C5	2100	11.4
Red Deer 1	C6	2100	11.4
Red Deer 1	C7	2250	11.4
Red Deer 1	C8	2700	11.4
Red Deer 1	C9	750	0.559
Red Deer 1	L0	1200x2400[1]	14.1
Red Deer 1	L501	1350	3.6
Red Deer 1	L502	1500	3.9
Red Deer 1	L503	1800	5.9
Red Deer 1	L504	1800	5.9
Red Deer 1	L505	1950	6.4
Red Deer 1	L506	1950	7.6
Red Deer 1	L507	2100	9.0
Red Deer 1	L508	2100	9.5
Red Deer 1	L509	750	0.558
Red Deer 1	L510	900	0.558
Red Deer 1	L511	750	1.0
Red Deer 1	L519	750	1.6
Red Deer 1	L524	2700	13.3
Red Deer 1	L525	1350	1.9
Red Deer 1	L527	1650	3.9
Red Deer 1	L528	1200	3.1
Red Deer 1	L529	600	0.841
Red Deer 1	L533	675	0.950
Red Deer 1	L534	525	0.716
Red Deer 1	L535	600	0.842
Red Deer 1	L536	900	1.32
Red Deer 1	L537	1650	14.1
Red Deer 1	1	1200	1.92
Red Deer 1	3	900	0.332
Red Deer 1	5	750	0.575
Red Deer 2	L520	750	0.329
Red Deer 2	L521	750	0.871
Red Deer 2	L523	600	0.210
Piper	L301	1200	1.53
Piper	L302	975	1.53
Piper	L303	825	0.363
Piper	L305	1500	2.49
Piper	L306	1200	1.92
Piper	L307	1050	1.69

Catchment	Pipe Label	Size (m)	100 year 24 hour Peak Flow (m^3/s)
Piper	L308	750	0.479
Piper	L309	750	0.247
Piper	L310	1800	2.85
Piper	L311	1950	4.38
Piper	L312	1950	4.38
Piper	L313	525	0.396
Piper	L314	975	1.30
Piper	L315	750	0.479
Piper	L316	900	1.23
Piper	L317	450	0.331
Piper	L318	1950	4.38

Notes: 1 Box pipe

APPENDIX C
PCSWMM Model Files
(provided digitally)