

Stormwater Management Plan
Grasswood Estates W1/2 26-35-5W3
R.M. of Corman Park, Saskatchewan

File S1607.4

December 14, 2012



Clifton Associates Ltd.
engineering science technology

14 December 2012
File S1607.4

Grasswood Property Estates
217 Sturgeon Place
Saskatoon, Saskatchewan
S7T 1A7

Attention: Mr. Darren Hagen

Dear Sir:

Subject: Response to Shawn Dukart - Community Planning Branch

This report is provided in response to your email forwarded to us from Shawn Dukart with Community Planning Branch on 30 November 2012 indicating that a final stormwater plan be forwarded for approval purposes.

We are pleased to provide you with this final Stormwater Management Plan for Grasswood Estates.

If you have any questions regarding this report, please contact me.

Yours truly,

Clifton Associates Ltd.

Cindy Friesen, Geoscientist-in-Training

CCF/sdb

Distribution Ray Pentland - Water Resource Consultants

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Transmittal Letter

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Hydrology Methodology Letter dated 28 June 2012 to Neil Ketilson
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Response to Saskatchewan Watershed Authority Conceptual Stormwater Management Plan, Grasswood Estates, W 1/2 26-35-5 Dated May 28, 2012 Letter dated 14 September 2012 to Mr. Spencer McNie
att: Drawing S1607.4-002, Drawing S1607.4-003, Drawing S1607.4-004
att: *Grasswood Estates - Runoff Management Report* by WRC dated 10 September 2012

Response to Saskatchewan Watershed Authority Letter dated 16 November 2012 to Darren Hagen

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Drawing 6	Conceptual Design of North Storm Pond Incorporating Wetland Area Mitigation to Enhance Canadian Toad Habitat
Drawing 7	Conceptual Cross Section of North Storm Pond with Wetland Area

1.0 Introduction

This report is a comprehensive document that summarizes the progress made from a conceptual Stormwater Management Plan, (SWMP), to the final SWMP for the Grasswood Estates subdivision located on W1/2 26-35-5 W3 (Site) in the R.M. of Corman Park. It is a document that includes correspondence with the Client and Regulatory Agencies regarding design progress. This Site is proposed to be developed for residential use by Urban Elements Development Corporation (Client).

Clifton Associates Ltd. (CAL) was retained in April 2012 by the Client to provide a preliminary stormwater drainage design in an effort to achieve rezoning approval from the R.M. of Corman Park. Rezoning requested by the Client was for residential development purposes from Agricultural to Country Residential land use within the RM of Corman Park. A concept was completed in May 2012 that included pond dimensions and a conceptual grading and drainage plan. This concept was forwarded to Saskatchewan Watershed Authority (SWA), now Water Security Agency, for approval. They responded 20 August 2012 with recommended considerations which were responded to in a letter dated 14 September 2012. This response letter included amended design parameters. Subsequently, approval to progress to detailed grading and drainage design was given by the Client on 27 August 2012. This report is provided in response to a request from Shawn Dukart with Community Planning on 30 November 2012 requesting that the amendments to the stormwater plan be compiled in a comprehensive document.

This design was based on preliminary works provided by Clifton Associates Ltd. in 2009, as well as guidelines from agencies such as Transportation Association of Canada, Railroad Association of Canada and Federation of Canadian Municipalities, R.M. of Corman Park Multi Parcel Country Residential Development Guidelines, and consideration of Saskatchewan Environment Stormwater Guidelines April 2006, and Saskatchewan Ministry of Environment.

2.0 Grading and Drainage Plan

A draft of the final grading and drainage plan has been provided for review. See Drawing numbers S1607.8-001, S1608.4-002, S1607.8-003. This plan demonstrates the drainage pathways, including the roads and ditches that will convey surface water runoff to the ponds.

The following section discusses relevant design updates to the SWMP.

3.0 Stormwater Ponds

Parameters used to assess existing and developed conditions are provided in the previously submitted concept Stormwater Management Plan dated 28 May 2012, as well as the most recent report by Water Resource Consultants (WRC) dated 10 September 2012. These documents detail the rationale and calculations that were conducted to adequately size the ponds. All discussions regarding the amended design parameters were provided in letters to our client and are provided in Appendix A.

A brief summary of the amended methodology and parameters that was discussed in the aforementioned letters, is provided as follows:

Inflow to Ponds

Subsequent to submittal of the concept plan, further analysis was done to assess post development runoff conditions. It was noted that portions of the development will not drain to the main ponds and the subdivision will not be 100% effective in contributing flow to the ponds as was assumed in the Conceptual Stormwater Management, 28 May 2012. This is summarized in a letter to Saskatchewan Watershed Authority (SWA) to Spencer McNie on 14 September 2012 in Appendix A.

The critical design levels to which the ponds will be constructed are provided in Table 1 below.

Table 1
Evaporation Ponds

Critical Design Levels	North	South
	Elevation (m)	Elevation(m)
1:500 Event	507.3	508.0
Municipal reserve boundary	505.3	505.5
Resulting Minimum Building Elevation (minimum 0.5m above max WSE)	508.3	508.5

The original design utilized a cumulative model to determine the maximum water elevations and for comparison purposes, a 1:500 year event was analysed as well. Additionally, we reviewed the whole site in comparison to this minimum building elevation, and the majority of the site is higher than this level. Please see Drawing S1607.8-004 attached. The colours represent the following relation:

- The Green represents areas where existing ground is higher than minimum building elevation;
- The Yellow represents areas where existing ground is lower than minimum building elevation by less than 1.0 metre;
- The Orange represents areas where existing ground is between 1.0 metres to 2.0 metres lower than minimum building elevation; and,
- The Red represents areas where existing ground is 2.0 metres or more lower than minimum building elevation.

It is worth noting that each pond's minimum finished floor elevation was compared to existing ground within each pond's catchment area. Based on this, we believe that the minimum building elevations can be achieved for most lots without significant earth work on the majority of the Site. The lots that have significant depressions (i.e. over 1m in depth) can be identified and recommendations for building permanent structures can be provided if required, however this level of detail is beyond the scope of this report.

Consideration of groundwater inflow was included in the final pond design and is summarized in WRC report dated 10 September 2012 included in Appendix B. During construction of the ponds, groundwater inflow will be monitored and verified. Also, wetland design parameters were considered to ensure the ponds were developed to minimize impact to the existing Canadian Toad habitat in the North Pond. See Appendix B. This was completed at the

request of CanNorth who provided environmental studies of the site and indicated that mitigation measures were recommended to limit impact to Canadian Toad Habitat. The design was based on CanNorth recommendations which we understand was directed by Ministry of Environment.

4.0 Closure

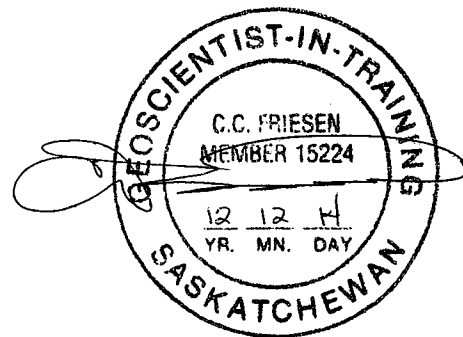
This report contains the results of CAL and WRC analyses as well as a proposed stormwater management plan upon which certain recommendations have been made. Our recommendations are based on the information available at the time of this report. Geotechnical parameters are preliminary at this time. Our mandate has been to investigate and recommend which we have completed by means of this report.

Clifton Associates Ltd.



David D. Kent, P.Eng.

Association of Professional
Engineers and Geoscientists of Saskatchewan
Certificate of Authorization No. 238

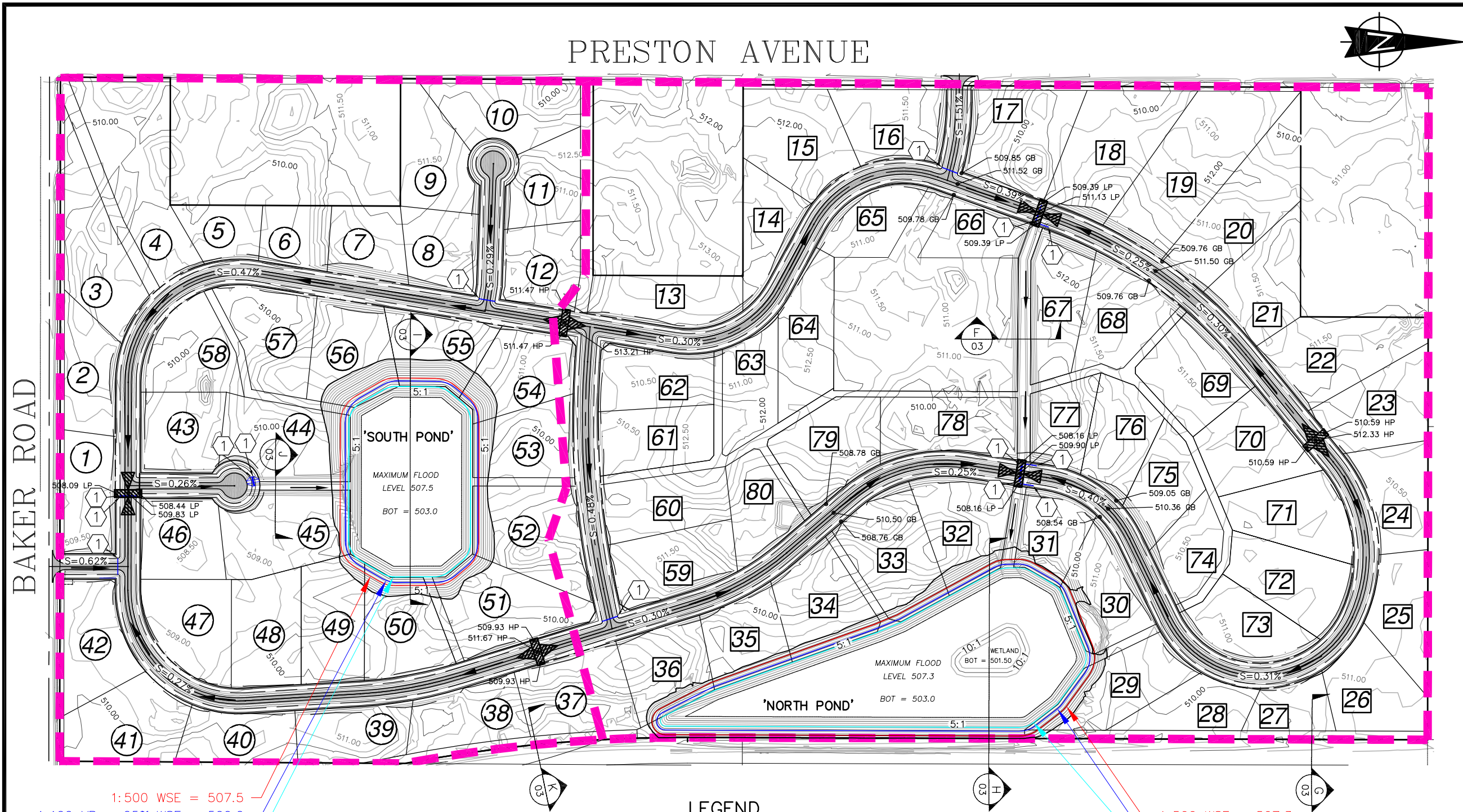


Cindy Friesen, Geoscientist in Training



Clifton Associates Ltd.
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Drawings



BAKER ROAD

PRESTON AVENUE



ABBREVIATIONS

- GB GRADE BREAK
- LP LOW POINT
- HP HIGH POINT
- BOT BOTTOM ELEVATION
- S SLOPE

- 1: 500 WSE = 507.5
- 1: 100 YR + 25% WSE = 506.2
- MUNICIPAL RESERVE WSE 505.5

- 1: 500 WSE = 507.3
- 1: 100 YR + 25% WSE = 506.2
- MUNICIPAL RESERVE WSE = 505.3

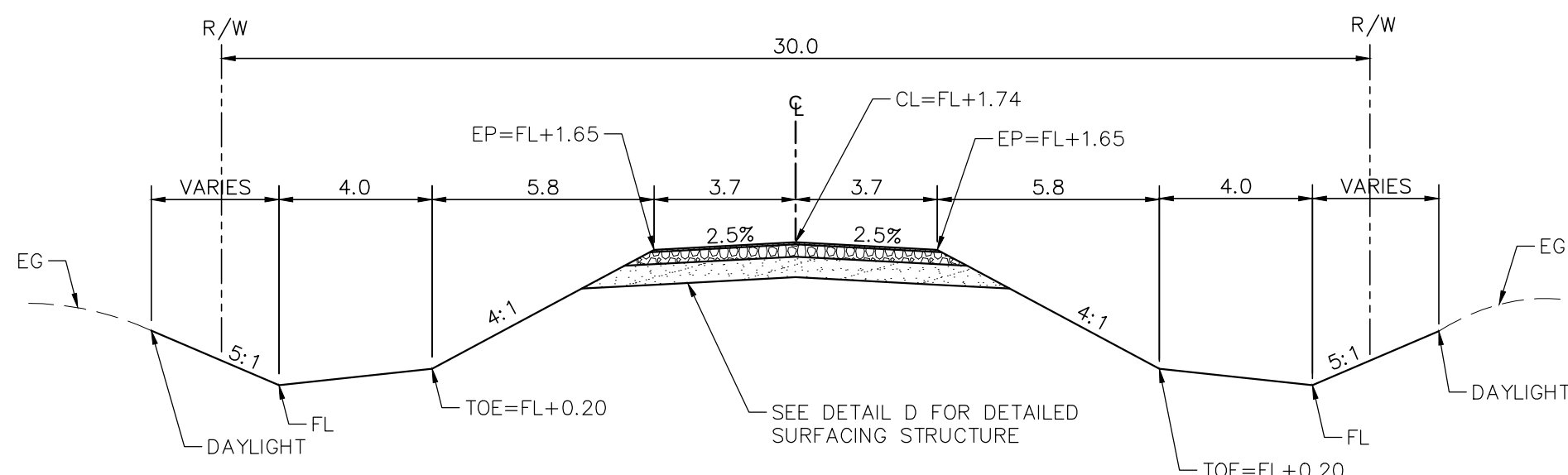
MINIMUM BUILDING ELEVATION

- ① MINIMUM BUILDING ELEVATION = 508.5
- ① MINIMUM BUILDING ELEVATION = 508.3

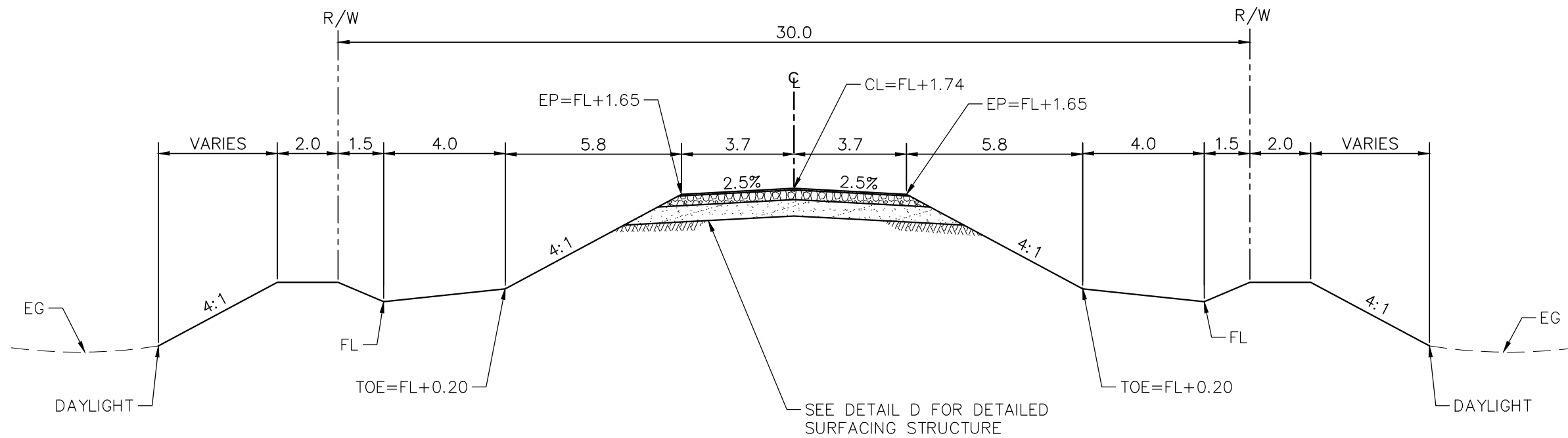
LEGEND

- DRAINAGE BOUNDARY
- 510.00 --- EXIST. MAJOR CONTOUR
- 511.50 --- EXIST. MINOR CONTOUR
- PROJECT BOUNDARY
- LOT LINE
- ↑ HIGH POINT
- ↓ LOW POINT
- ① 600 mm CSP STORM DRAIN CULVERT

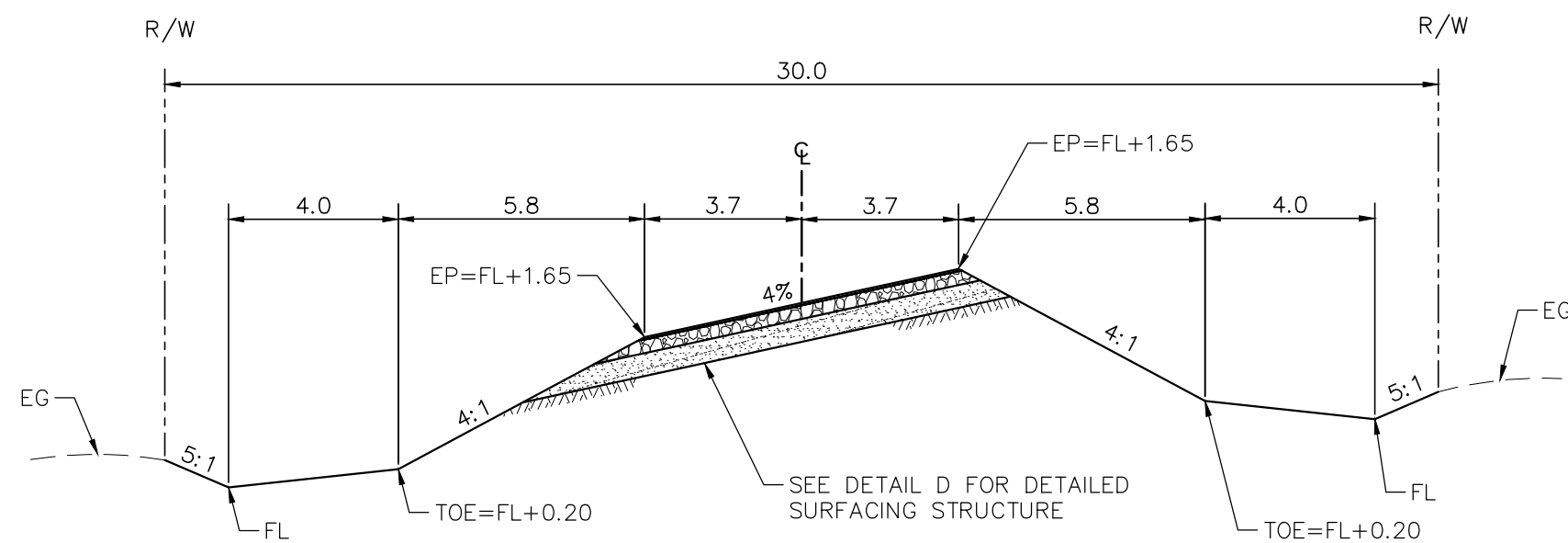
DRAWING REVISIONS			
REV	DESCRIPTION	BY	DATE
 Clifton Associates Ltd. engineering science technology			
CLIENT URBAN ELEMENTS DEVELOPMENT CORP.			
PROJECT GRASSWOOD ESTATES			
TITLE STORMWATER MANAGEMENT PLAN			
FINAL GRADING			
DESIGN	JO	SCALE 1:5000	DATE 2012-12-05
DWN. BY	JL	PROJECT NO. S1607.8	DWG. NO.
CHECKED	OZ	LAND LOCATION W1/2 26-35-5 W3	S1607.08-001



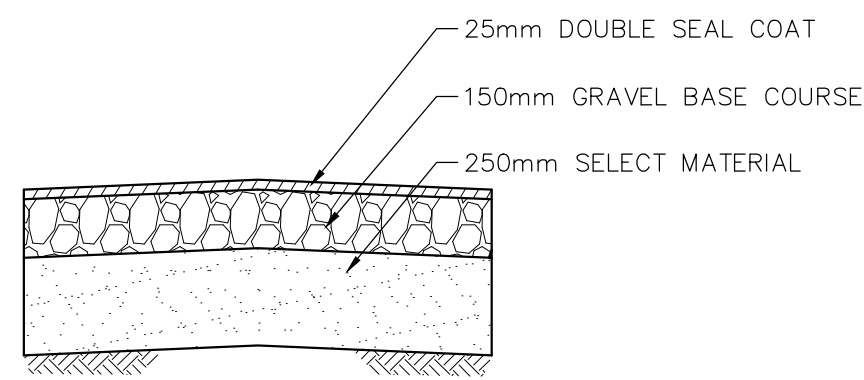
A TYPICAL ROAD CROSS SECTION (CUT)
NTS



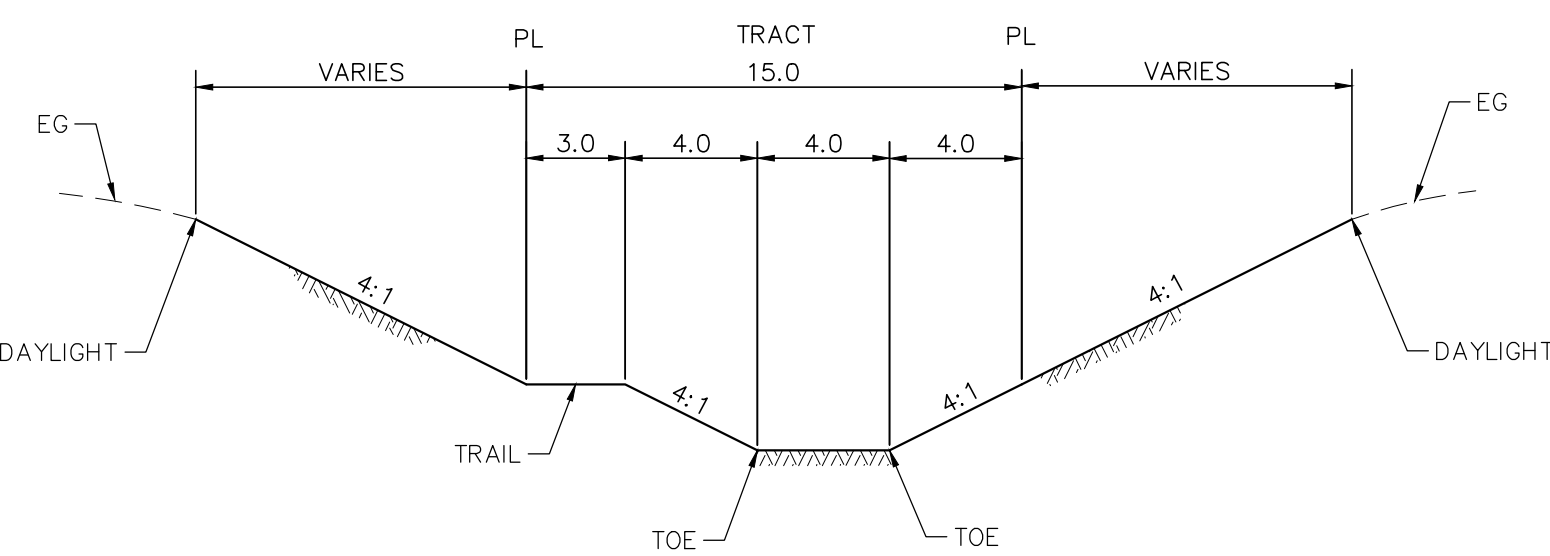
B TYPICAL ROAD CROSS SECTION (FILL)
NTS



C SUPERELEVATED CROSS SECTION
NTS



D TYPICAL ROADWAY SURFACING STRUCTURE
NTS



E CHANNEL CROSS SECTION (CUT)
NTS

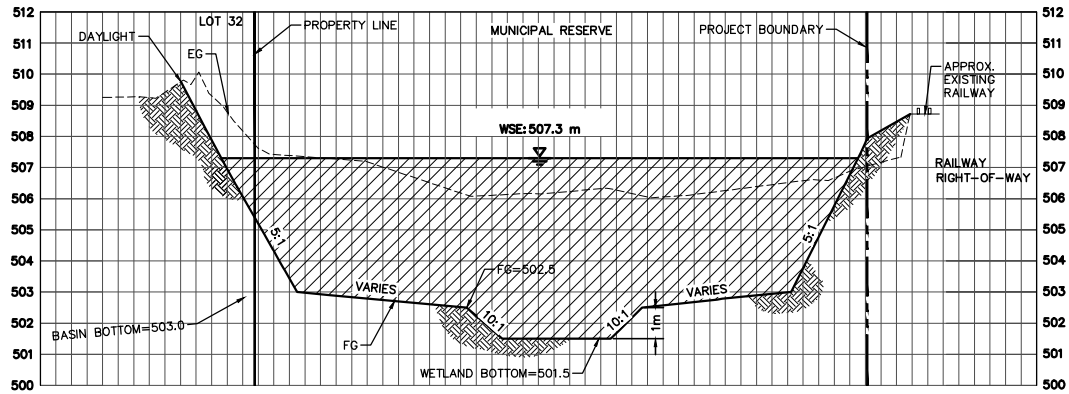
DRAWING REVISIONS			
REV	DESCRIPTION	BY	DATE

	ASSOCIATION OF PROFESSIONAL ENGINEERS OF SASKATCHEWAN CERTIFICATE OF AUTHORIZATION CLIFTON ASSOCIATES LTD. NUMBER 238 DISCIPLINE _____ PERMISSION TO CONSULT HELD BY: _____ SASK. REG. NO. _____ SIGNATURE _____

ENGINEER		Clifton Associates Ltd. engineering science technology
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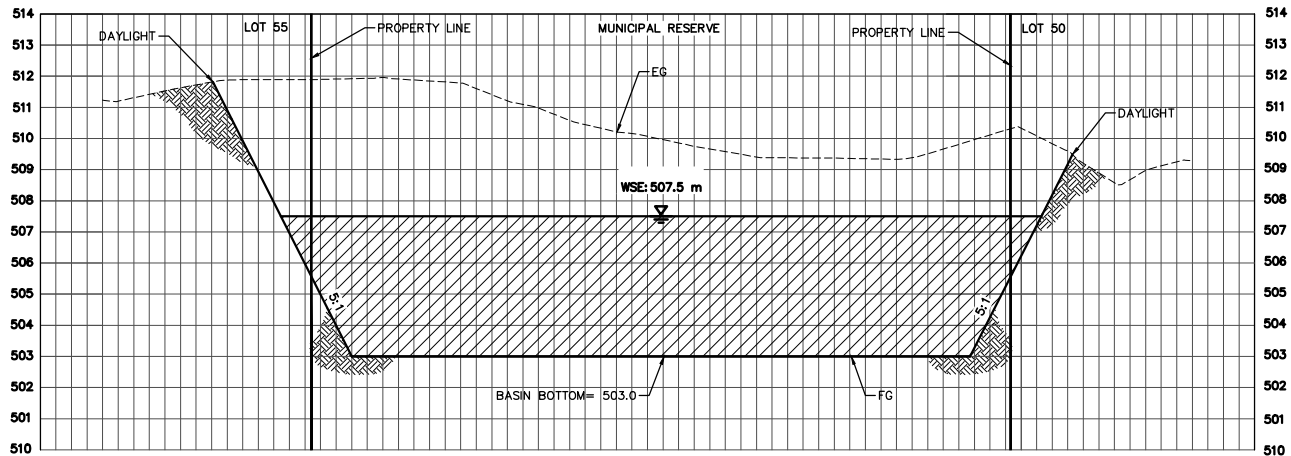
CLIENT	URBAN ELEMENTS DEVELOPMENT CORP.
PROJECT	GRASSWOOD ESTATES
TITLE	STORMWATER MANAGEMENT PLAN

TYPICAL CROSS SECTIONS			
DESIGN	J.G.	SCALE	NTS
DATE	2012-12-07	PROJECT NO.	S1607.8
DWG. NO.	S1607.8-002	CHECKED	J.G.
AND LOCATION	W1/2 26-35-05 W3	DATE	2012-12-07



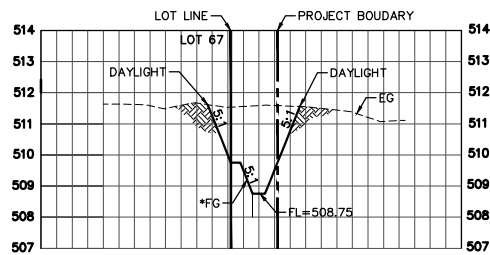
*NOTE:

(H) NORTH POND CROSS SECTION



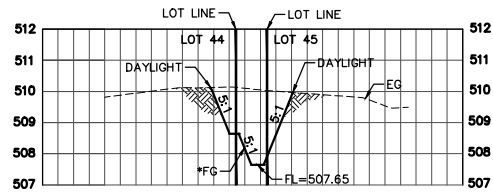
*NOTE:

(I) SOUTH POND CROSS SECTION



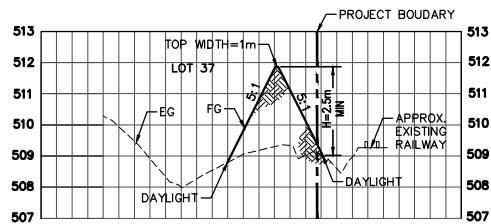
*NOTE: REFER TO DETAIL E FOR CHANNEL GEOMETRY

(F) NORTH CHANNEL CROSS SECTION

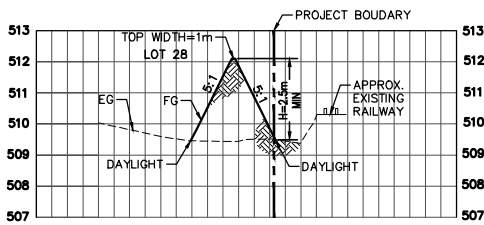


*NOTE: REFER TO DETAIL E FOR CHANNEL GEOMETRY

(J) SOUTH CHANNEL CROSS SECTION



(K) BERM CROSS SECTION (SOUTH)

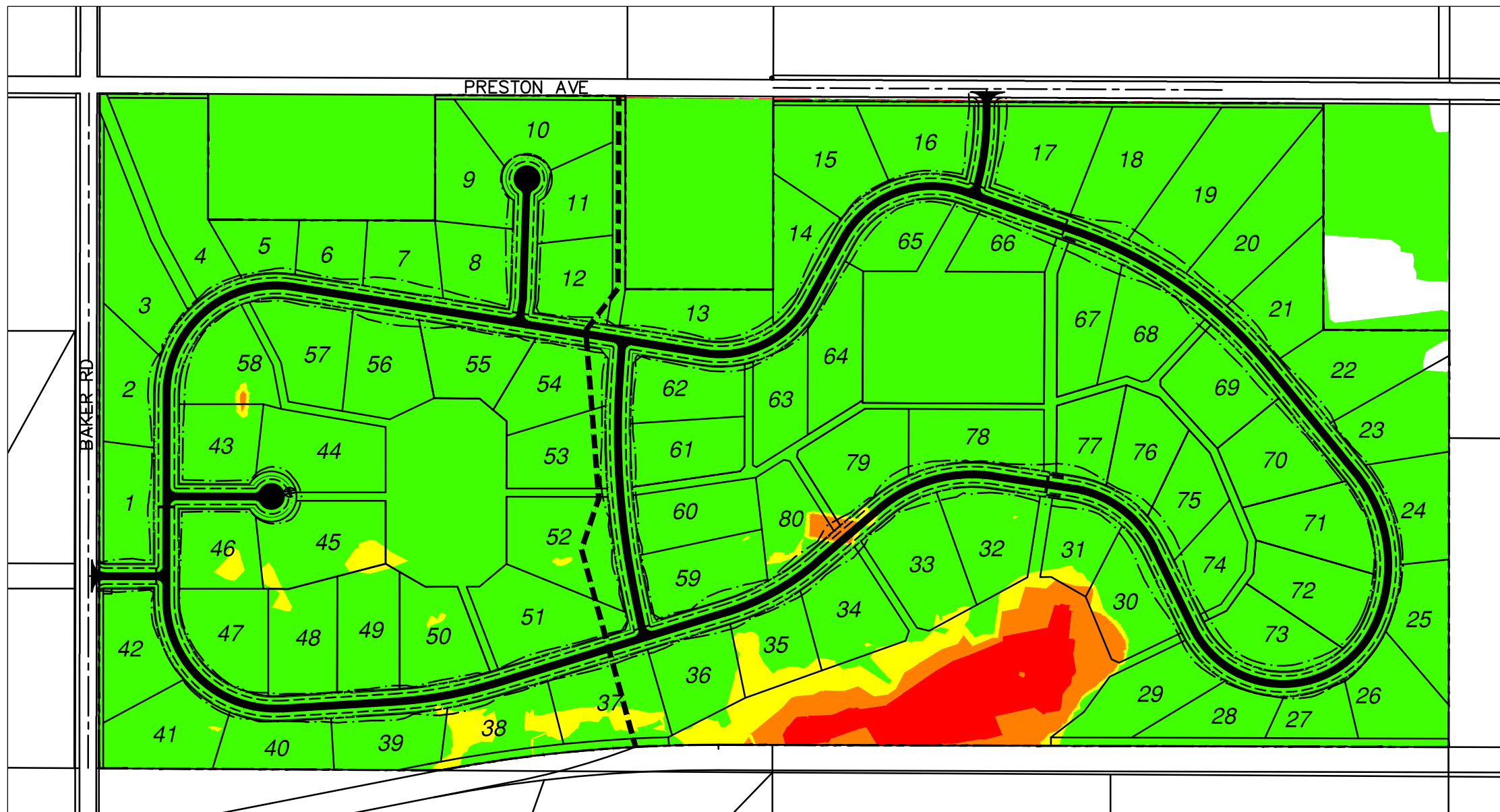


(G) BERM CROSS SECTION (NORTH)

DRAWING REVISIONS			
REV	DESCRIPTION	BY	DATE

	ASSOCIATION OF PROFESSIONAL ENGINEERS OF SASKATCHEWAN CERTIFICATE OF AUTHORIZATION CLIFTON ASSOCIATES LTD. NUMBER 238 PERMISSION TO CONSULT HELD BY: DISCIPLINE SASK REG NO. SIGNATURE

ENGINEER	 Clifton Associates Ltd. engineering science technology	
CLIENT	URBAN ELEMENTS DEVELOPMENT CORP.	
PROJECT	GRASSWOOD ESTATES	
TITLE	STORMWATER MANAGEMENT PLAN	
GRADING CROSS SECTION		
DESIGN J.G.	SCALE NTS	DATE 2012-12-07
DRAWN BY Z.Y.	PROJECT NO. S1607.8	DWG. NO.
CHECKED J.G.	LAND LOCATION: W1/2 26-35-05 W3	S1607.8-003



- EXISTING GROUND > MINIMUM MBE
- EXISTING GROUND LOWER THAN MINIMUM MBE BETWEEN 0.0 m AND 1.0 m
- EXISTING GROUND LOWER THAN MINIMUM MBE BETWEEN 1.0 m AND 2.0 m
- EXISTING GROUND LOWER THAN MINIMUM MBE BELOW 2.0 m

DRAWING REVISIONS			
REV	DESCRIPTION	BY	DATE

PROFESSIONAL ENGINEER
SASKATCHEWAN
ENGINEER'S NAME
MEMBER #
YY MM DD
YR. MN. DAY

ASSOCIATION OF PROFESSIONAL ENGINEERS
OF SASKATCHEWAN
CERTIFICATE OF AUTHORIZATION
CLIFTON ASSOCIATES LTD.
NUMBER 238
PERMISSION TO CONSULT HELD BY:
DISCIPLINE SASK. REG. NO. SIGNATURE

ENGINEER
**Clifton Associates Ltd.**
engineering science technology

CLIENT
URBAN ELEMENTS DEVELOPMENT CORP.

PROJECT
GRASSWOOD ESTATES

TITLE
STORMWATER MANAGEMENT PLAN
EXISTING GROUND vs. MINIMUM BUILDING
ELEVATION COMPARISON

DESIGN J.G.	SCALE NTS	DATE 2012-12-07
DWN. BY Z.Y.	PROJECT NO. S1607.B	DWG. NO. S1607.B-004
CHECKED J.G.	LAND LOCATION W1/2 26-35-05 W3	



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Appendix A



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28 June 2012
File S1607.4

Grasswood Estates
4780 Prairie Lane
Grasswood, Saskatchewan
S7T 1A7

Attention: Mr. Neil Ketilson

Dear Sir:

Subject: Hydrology Methodology
Grasswood, Saskatchewan

This letter is written in response to your request to provide additional information to supplement our draft hydrology report dated 28 May 2012.

We provided additional analysis of the 1:100 year storm event plus 25% as recommended in an email dated 7 June 2012 from Rebecca Row with the R.M. of Corman Park. An excerpt from the email is included below:

The main concern we have is the stormwater plan utilizing the backs of private properties to pond water. We will be asking Council to discuss this option, but Planning will likely not be supporting it.By utilizing private property we are in the opinion that the stormwater management plan has not been designed to effectively manage a 1:100 (plus 25% b/c of no outlet) storm event. We had made a comment regarding utilizing public lands in our first round of comments (#5 under Storm).

The additional analysis was conducted in response to this statement to compare our methodology to the 1:100 year storm event and 25% methodology it was conducted in accordance with the City of Saskatoon New Neighbourhood Design and Development Standards Manual, Section Six dated January 2012. This analysis was completed using the rational method utilizing a 1:100 year event based on the recommended developed conditions runoff coefficient, and 24 hour storm duration. The water surface elevation (WSE) that was generated based on this approach is indicated in green on the north pond on the attached Drawing S1607.4-002.

Results of this analysis indicated that the flood elevation of this event was significantly lower than the flood elevation that was recommended in our report which is indicated on the outer black line labeled Maximum WSE 507.3 (see attached drawing). The difference in flood elevations on the north pond is more than 6.5 m when compared.

Please note that the 1:100 year cumulative event plus 25% WSE shown in red is based on net volumes calculated throughout a 51 year period, and is provided to further demonstrate the conservative approach of our design methodology. The difference in flood elevations are approximately 3.5 m on both ponds using this comparison.

Based on these comparisons, we believe that our recommendations for establishing municipal reserve boundaries and recommended building elevations meet and exceed the R.M.'s requirements.

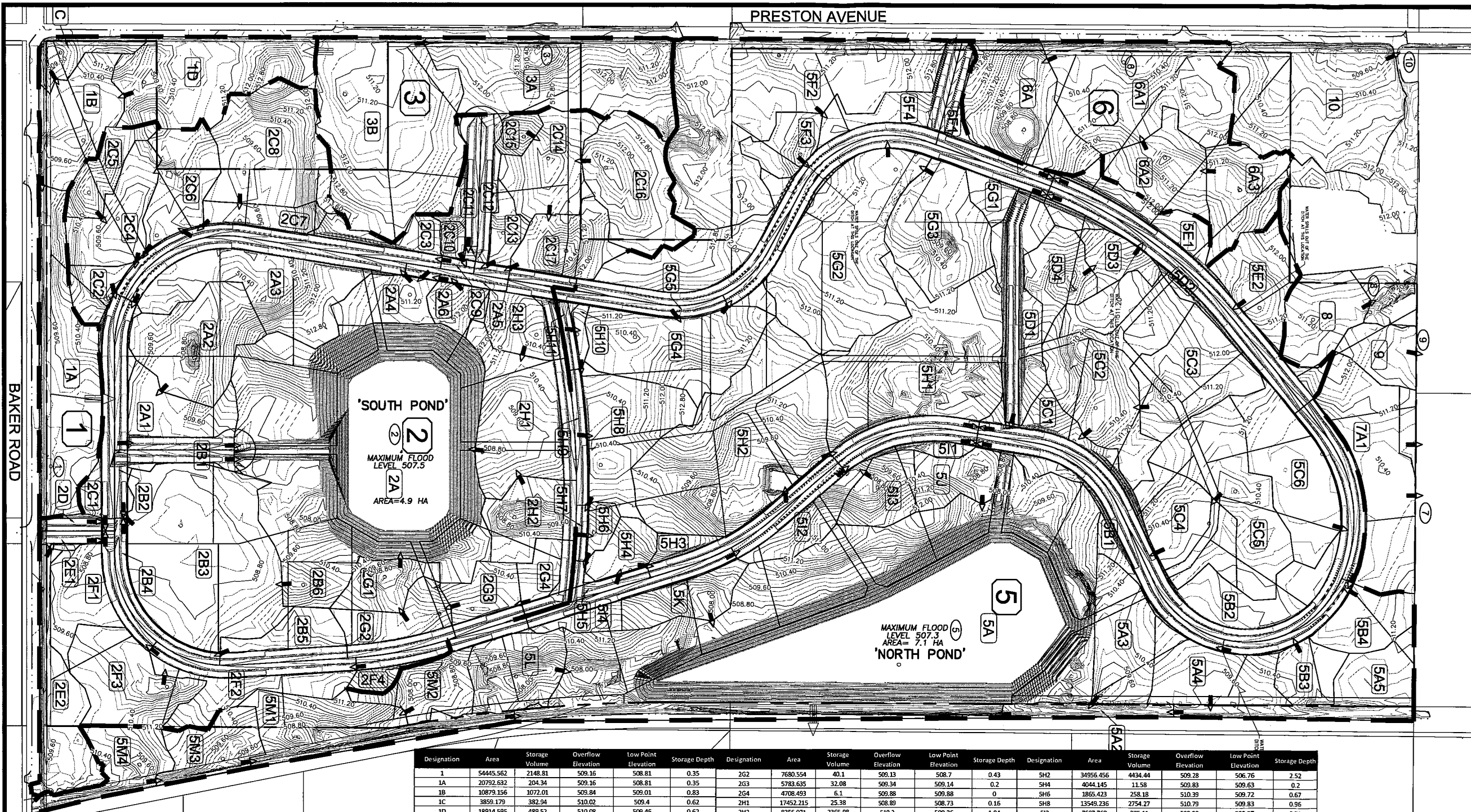
If you have any questions regarding this letter, please contact me.

Yours truly,

Clifton Associates Ltd.

Cindy Friesen, Geoscientist-in-Training
CF/alg

Attachments: Drawing S1607.4-002 Conceptual Drainage System



Designation	Area	Storage Volume	Overflow Elevation	Low Point Elevation	Storage Depth	Designation	Area	Storage Volume	Overflow Elevation	Low Point Elevation	Storage Depth	Designation	Area	Storage Volume	Overflow Elevation	Low Point Elevation	Storage Depth
1	54445.562	2148.81	509.16	508.81	0.35	2G2	7680.554	40.1	509.13	508.7	0.43	5H2	34956.456	4434.44	509.28	506.76	2.52
1A	20792.632	204.34	509.16	508.81	0.35	2G3	5783.635	32.08	509.34	509.14	0.2	5H4	4044.145	11.58	509.83	509.63	0.2
1B	10879.156	1072.01	509.84	509.01	0.83	2G4	4708.493	6.1	509.88	509.88	0	5H6	1865.423	258.18	510.39	509.72	0.67
1C	3859.179	382.94	510.02	509.4	0.62	2H1	17452.215	25.38	508.89	508.73	0.16	5H8	13549.236	2754.27	510.79	509.83	0.96
1D	18914.595	489.52	510.08	509.46	0.62	2H2	8356.071	2365.98	510.2	508.26	1.94	5I2	7607.768	275.11	509.28	508.57	0.71
						2H3	6956.979	440.56	510.75	510.05	0.7	5I3	5971.877	54.54	508.98	508.49	0.49
2					0							SJ	5559.644	391.36	509.28	508.18	1.1
2A	74862.56				0	3	57859.978	11337.64	511.76	509.65	2.11	5K	6467.278	49.85	508.06	507.8	0.26
2A1	8995.231	341.27	508.8	508.8	0	3A	24237.154	1398.02	511.12	509.65	1.47	5L	9176.082	624.49	508.45	507.82	0.63
2A2	14285.422	944.09	509.13	506.76	2.37	3B	33624.054	98.43	511.12	510.73	0.39	5M1	13803.768	557.08	508.59	507.6	0.99
2A4	5704.514	82.14	511.33	511	0.33							5M2	8146.29	708.35	508.43	507.53	0.9
2A6	3260.814	413	511.6	510.87	0.73	5					0	5M3	7225.614	1385.76	509.23	508.82	0.41
2B3	32990.505	1309.71	508.72	508.38	0.34	5A					0	5M4	7446.854	261.17	509.85	509.11	0.74
2B5	2848.048	0	509.44	509.44	0	5A3	10612.063	543.97	509.78	509.17	0.61						
2B6	3956.891	160.89	509.4	508.83	0.57	5A4	10347.149	0	509.39	509.39	0	6		5262.59	510.15	508.38	1.77
2C2	3410.993	49.24	509.71	509.32	0.39	5B3	4933.722	0	510.66	510.66	0	6A	16169.468	3315.05	510.09	508.38	1.71
2C4	8861.107	773.34	509.7	509.26	0.44	5B4	6516.234	0	510.55	510.55	0	6A1	23431.326	456.1	510.09	509.47	0.62
2C5	5041.662	1034.7	509.9	508.89	1.01	5C2	23124.282	328.47	510.09	509.63	0.46	6A2	9264.759	608.21	511.02	510.22	0.8
2C6	8809.945	425.89	509.74	509.21	0.53	5C3	8392.753	328.47	511.09	510.04	1.05	6A3	9367.787	398.86	510.9	510.36	0.54
2C8	17234.873	11.06	509.61	509.16	0.45	5C4	11270.909	43.13	510.26	509.19	1.07						
2C9	21194.836	0	509.71	509.71	0	5C5	16093.969	222.05	510.43	509.9	0.53	7A1	18404.027	140.31	510.52	510.38	0.14
2C10	12717.321	178.68	511.55	510.96	0.59	5C6	14217.048	1123.77	510.71	510.44	0.27						
2C13	2819.241	298.5	511.48	510.96	0.52	5D1	11838.839	0	509.89	509.89	0	8	8396.698	11.69	511.22	511.01	0.21
2C14	10147.839	1390.99	511.72	510.74	0.98	5D2	12238.372	0	509.99	509.99	0	9	5277.509	0	510.73	510.73	0
2C15	2287.907	180.91	511.3	510.74	0.56	5D3	4026.373	12.92	510.3	510.1	0.2	10	26871.233	5739.59	510.51	508.91	1.6
2C16	13894.718	656.77	511.7	510.97	0.73	5D4	6470.034	406.53	510.84	509.86	0.98						
2C17	8140.427	3965.67	511.87	509.87	2	5E2	8546.697	347.73	510.85	510.44	0.41						
2E2	10981.072	164.26	509.57	509.18	0.39	5F2	38856.282	3043.96	511.53	510.36	1.17						
2F1	9292.863	0	508.72	508.72	0	5F3	24053.152	73.06	511.02	510.59	0.43						
2F2	10644.729	94.34	509.2	509.2	0	5G2	27094.012	381.54	510.89	510.62	0.27						
2F3	11920.123	244.72	509.04	508.41	0.63	5G3	13715.047	1264.41	510.82	508.92	1.9						
2F4	3294.007	94.34	509.92	509.92	0	5G4	16755.881	5813.21	511.45	510.24	1.21						
2G1	5181.002	1011.06	509.48	508.38	1.1	5H1	31215.558	0	508.76	508.76	0						

LEGEND	
PROJECT BOUNDARY	
CATCHMENT BASIN BOUNDARY	
SITE DIVIDE LINE	
CATCHMENT SUB-BASIN BOUNDARY	
CATCHMENT BASIN DESIGNATION	
CATCHMENT SUB-BASIN DESIGNATION	
CONCENTRATION POINT	
CATCHMENT BASIN OVERFLOW DIRECTION	
CATCHMENT SUB-BASIN OVERFLOW DIRECTION	



CLIENT
URBAN ELEMENTS DEVELOPMENT CORP.

PROJECT	CONCEPTUAL STORMWATER MANAGEMENT PLAN GRASSWOOD ESTATES
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TITLE	CONCEPTUAL DRAINAGE SYSTEM
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DESIGN	J.O	SCALE	1:5000	DATE	2012-09-1
DWN. BY	Z.Y	PROJECT NO.	S1607.4		DWG. NO.
CHECKED	J.G	LAND LOCATION	W1/2 26-35-5W3		S1607.4-



Clifton Associates Ltd.
engineering science technology

14 September 2012
File S1607.4

Saskatchewan Watershed Authority
402 Royal Bank Tower
1101-101st Street
North Battleford, Saskatchewan

S9A OZ5

Attention: Mr. Spencer McNie

Dear Sir:

Subject: Response to Saskatchewan Watershed Authority Conceptual Stormwater
Management Plan, Grasswood Estates, W1/2 26-35-5 W3 Dated May 28, 2012

This letter is written in response to your comments and questions regarding the *Draft-Conceptual Stormwater Management Plan, Grasswood Estates W1/2 26-35-5 W3* dated May 28, 2012 by Clifton Associates Ltd. Your comments were forwarded via email to us from our client, Mr. Neil Ketilson with Grasswood Estates, dated August 20, 2012. We also had a subsequent telephone conversation on September 6th 2012 where we had further opportunity to clarify your comments and we have compiled a response below. Also, we have taken this opportunity to provide you with updated design and analysis information for the subject project.

Please find each comment and question noted below in italics, and our corresponding response.

1. A new PPS showing both ponds and the High Water marks for the 1:100 and 1:500 levels. These levels will determine which lots require flood easements. There also seems to be some issue with the elevations on the original plans; the SBE is said to be 509.5m while the contours indicate elevations in the 483-490m range, please advise.

Response: The subdivision plan and corresponding topographical data that was originally presented to SWA has been superseded and has updated spatial data. Please find updated plan S1607.4-02 attached to this letter.

2. SWA will require copies of all flood easements once they are determined and signed.

Response: We understand that the owner of the property can provide easements as they are approved. To clarify where these will be required, the lots begin at the municipal reserve boundary at contour 505.3 (north pond), 505.5 (south pond) and end at the maximum flood level at contour 507.3 (north pond) and 507.5 (south pond). Each pond cross section is attached for your reference, namely Drawing No. S1607.4-003, and S1607.4-004 respectively.

3. There is significant potential for downstream issues; SWA needs to know the outlet for the water should the ponds ever need to be pumped out.

Response: The ponds can be pumped out via overland flow to the South Saskatchewan River, approximately 3 miles west of the Site. This is further described in the attached report from WRC dated September 10, 2012

4. Has Community Planning adopted a 1:500 level for this subdivision? All the work done on this subdivision appears to be for the 1:100 level.

Response: Our analysis was based on a modeling sequence that is beyond the 1:500 year analysis and is further described in the attached report from WRC dated September 10, 2012.

Further Design work has progressed since the initial SWA review of the conceptual plan. Due to further analysis of existing runoff, topography and typical pattern of development for acreages, it is noted that portions of the development will not drain to the main ponds and the subdivision will not be 100% effective in contributing flow to the ponds as was assumed in the Conceptual Storm Water Management submitted in May 28, 2012. Refer to WRC report dated September 10, 2012. As such, for your information we have presented updated amendments to the design below.

- a) Select lots will be left in their natural state with local depressions. Drainage from these local depressions will not drain via the drainage ditches to the main ponds but will be stored within each lot and in some cases share on site storage with neighbouring lots. This is further described in report by WRC dated September 10, 2012. A storage requirement and capacity analysis will be conducted on a lot by lot basis to propose a minimum building elevation for each site. In order to estimate the required storm water storage volume, precipitation for the 1:100 year storm event will be used.
- b) Currently, an 800 mm (approximately) CSP culvert exists under the railway embankment. This project's proposed drainage concept analysis and design are based on the current condition of the culvert being blocked. We have not been able to determine the origins of this culvert but we understand it is to remain blocked.
- c) The following North and South Pond figures will be revised: S1697.4-002, S1697.4-003 and S1697.4-004 to include the updated pond bottom elevation of 503.0.

If you have any questions regarding this letter, please contact me.

Yours truly,

Clifton Associates Ltd.

Jorge Ortiz, P.Eng, PE (Arizona)

Cindy Friesen, Geoscientist-in-Training

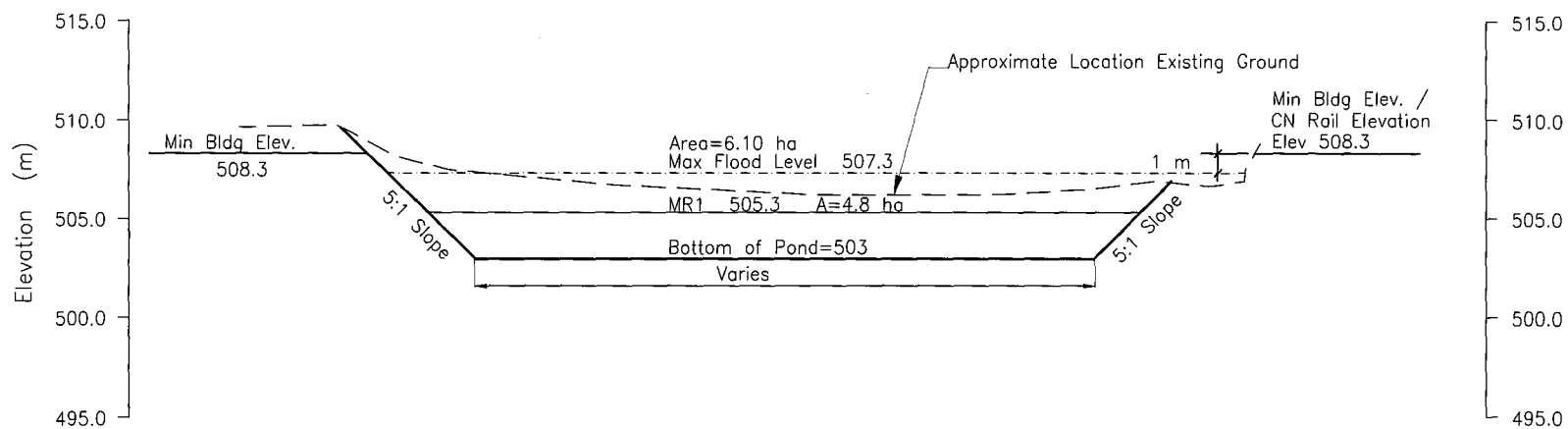
Attachments:

Figures S1607.4-002, S1607.4-003 and S1607.4-004

Grasswood Estates- Runoff Management Report by WRC dated 10 September 2012

CF/ccf

V:\S1607\CURRENT DRAWINGS\DISPLAYS\OLD\DWG FROM MICHAELS\1607.4-03.dwg



TYPICAL NORTH POND SECTION
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	Clifton Associates Ltd. engineering science technology	

CLIENT	
URBAN ELEMENTS DEVELOPMENT CORP.	
PROJECT TITLE	
CONCEPTUAL STORMWATER MANAGEMENT PLAN GRASSWOOD ESTATES W 12 20-35 SW3 R.M. OF CORMAN PARK, SASKATCHEWAN	
DRAWING TITLE	
TYPICAL SOUTH POND CROSS SECTION	

PROJECT NO.		FILE NO.	
S1607.4		S1607.4-04, dwg	
DATE	SCALE	DWG. NO.	REV.
MAY 2012	N.T.S.		
DESIGN	CHECKED		
MINO	CF	S1607.4-004	



Sept. 10, 2012
File No. 493

Clifton Associates Ltd.
4 - 1925 1st Avenue North
Saskatoon, Saskatchewan
S7L 6W1

Attention: Cindy Freisen

RE: GRASSWOOD ESTATES - RUNOFF MANAGEMENT

As requested, I have updated the runoff calculations for this project to include the most recent information. Since my May 3, 2012 report, the following new information that might impact on the drainage plan has become available:

1. Details of the road layout and proposed pond contours have been established. In May, I used an approximation of the pond shape. For the current update, the design contours were used to define the storage volume and surface area for the calculations.
2. Based on the topography and typical pattern of development for acreages, it is noted that portions of the development will not drain to the main ponds and the subdivision will not be 100% effective in contributing flow to the ponds as was assumed in my May report. To define the revised effective drainage area, subdrainage basins that flow to depressions over 1 m deep were excluded from the effective drainage area. The effective drainage area to the South Pond was reduced from 48 ha to 40 ha and the North was reduced from 81 ha to 66 ha. This is still quite conservative because even the sloughs that are less than 1 m deep will capture most of the runoff and reduce flows to the main ponds.

Although some impervious areas such as the back slopes of roofs will drain to local sloughs and not contribute to the effective runoff, it was still assumed that all impervious areas will be effective in order to maintain the conservative nature of this design.

3. Groundwater investigations have progressed to the point that a groundwater model of the site has been set up and estimates of the inflow to the ponds from groundwater for various levels of the water in the ponds have been calculated. Table 1 shows the

WATER RESOURCE CONSULTANTS LTD

3216 WINCHESTER ROAD, REGINA, SASK. S4V 2S8 TELEPHONE: (306) 751-0655

estimated inflows. This new source of inflow was added to the calculated water balance.

TABLE 1

GROUNDWATER INFLOWS

NORTH POND		SOUTH POND	
POND LEVEL (m)	INFLOW (m³/yr)	POND LEVEL (m)	INFLOW (m³/yr)
505.5	748	505.5	356
503.5	1441	503.5	779
501.5	2135	501.5	1203
499.9	2689	499.9	1543

4. Geotechnical investigations have determined that a large portion of the excavations would be in sand with high water table conditions that raise concerns regarding stability of a deep excavation and difficult construction conditions. The main reason for going as deep as the May proposal was the aesthetics of permanent deep water bodies. The depth was not critical to the water management. The bottom elevations of the pond proposed in May were set at 497.9 m.

For the current investigations, calculations were conducted to determine how shallow the ponds could be to perform their storage and evaporation function without considering aesthetics. This investigation kept the design flood levels and shape of the upper part of the ponds the same as they are currently designed so that the subdivision plan and recommended safe building levels do not need to be adjusted.

The revised calculations indicate that the reduced effective drainage area more than offsets the added groundwater flow. The basic size of the evaporation ponds is still adequate.

It was determined that the ponds can be constructed to a bottom elevation of 503.0 m and will still have sufficient storage to capture the volume of the wettest series of years in the historic period plus the 1:100 year volume so that evaporation can dispose of the water in the long run.

The Saskatchewan Watershed Authority (SWA) noted that the provincial standard is the 1:500 year flood plus 0.5 m rather than the 1:00 year required by the local authority. I was aware of this requirement and have built in conservative assumptions to ensure this higher standard is met. I used 1.0 m of freeboard on the 1:100 year design and I used the

1:100 year flood immediately following the worst flood levels of the 52 year study period which reflects a more severe probability than if I assumed it followed an average year. As a further test, I have now inserted the 1:500 year flood volume for Brightwater Creek into the calculation instead of the 1:100 year volume and still get over 0.5 m of freeboard.

SWA also asked for clarification of the proposed safety factor provided by the possibility of pumping water from the ponds if future events ever exceed the design condition. Although this project is in the Brightwater Creek drainage basin, it is in a very large closed drainage portion of that basin. It is several miles to a point where the pumped water would flow to that creek. The project is only about a mile from the drainage divide to the west where water would flow to a small tributary of the South Saskatchewan River. An emergency pumping system would have to extend beyond the divide and would likely include some ditch improvements to avoid damage to others but would be feasible as an emergency project if necessary. I have not looked at this in detail because the calculations indicate that it is less likely to be needed than the normal design standard. I only noted it as reassurance that even if an event beyond the design standard occurred, there is potential relief available.

The new simulations with the shallow ponds show that they are likely to become dry in future extended periods of drought. The proposed ponds are larger than the existing and the large area will allow greater evaporation in future droughts. If a permanent water feature is desired, a small portion of each pond could be made deeper so that only a small area would be exposed to evaporation and the ponds would extend into the water table which will be lower in a future drought.

In conclusion, the new information does not change the basic drainage plan for the subdivision. The majority of the area of the pond bottoms should be limited to 503.0 m. If a permanent water feature is desired, a small deeper area could be excavated.

Yours truly

WATER RESOURCE CONSULTANTS LTD.



R. S. Pentland, P. Eng.

RSP/dp
439-12-09-10

WATER RESOURCE CONSULTANTS LTD



Clifton Associates Ltd.
engineering science technology

November 16, 2012
File S1607.4

Grasswood Property Estates
217 Sturgeon Place
Saskatoon, Sask.
S7T 1A7

Attention: Mr. Darren Hagen
Subject: Response to Saskatchewan Watershed Authority

This letter is written in response to your email forwarded to us from Nathalie Brunet with Saskatchewan Watershed Authority on November 9, 2012 containing comments and questions regarding the WRC report dated May 3, 2012 for Grasswood Estates- Country Residential Site.

Please find each comment and question from the email noted below in italics, and our corresponding response:

1) A drainage area ratio was used based on the effective drainage area for gauge 05HG002 - Brightwater Creek near Kenaston. Although the water Survey of Canada publishes an area of 281.8 km², the PFRA publishes a drainage area of 193 km². Based on the PFRA drainage maps provides, satellite imagery, and topographic information available I believe the PFRA value of 193 km² to be correct. This change will increase the drainage area ratio by 46% (or by a factor of 1.46) and thus increase runoff values to the pond. I've attached a map showing this drainage area and a spreadsheet containing PFRA's drainage area values.

-Regarding the different effective drainage area, WRC has used a definition that Ray Pentland is familiar with since he was actively involved in developing the criteria for defining this hydrologic feature when the Water Survey of Canada numbers were derived. As such, is familiar with the criteria used and able to make the comparison of the ungauged study area compatible with the same criteria so that the results are valid. If the revised area (PFRA defined area) at the hydrometric station was used, it would require revising the definition of effective area for the initial ungauged area to match the new criteria. The result would be essentially the same. Our rationale was use of the effective drainage area and application of appropriate hydrologic experience to ensure that the gauged definition and study area definition are consistent.

2) The methodology used to determine inflow volumes to the evaporation ponds seems appropriate and conservative.

3) I believe the land location in the May 3, 2012 report should be W26-35-05 W3. This location is in fact at the upstream end of the local drainage area. See map attached.

-The analysis was completed in the correct area, however this was a typo in the May 3 2012 version of the report.

4) It's unclear how the elevation of 509.5 m was determined as the safe building elevation, I don't feel that there is sufficient information contained in the report to comment on the appropriateness of this value. A map with contours and coloured digital elevations is also included.

-The minimum building elevation noted in the WRC report dated May 3, indicated that the minimum building elevation should be 509.5 m, however in the subsequent Conceptual Stormwater Management Plan report dated May 28, 2012, the minimum building elevation was limited to the existing elevation of the neighbouring CN rail line which was defined to be 508.3 m according to a field survey conducted May 16, 2012. The drainage and grading plans were then subsequently revised accordingly.

5) The Clifton Associates drainage plan should also be reviewed to ensure the safe building elevation and ponds are incorporated.

-This is currently in the final design stage and can be submitted upon completion.

If you have any questions regarding this letter, please contact me.

Yours truly,

Clifton Associates Ltd.

Cindy Friesen, Geoscientist-in-Training

Cc: Ray Pentland- Water Resource Consultants

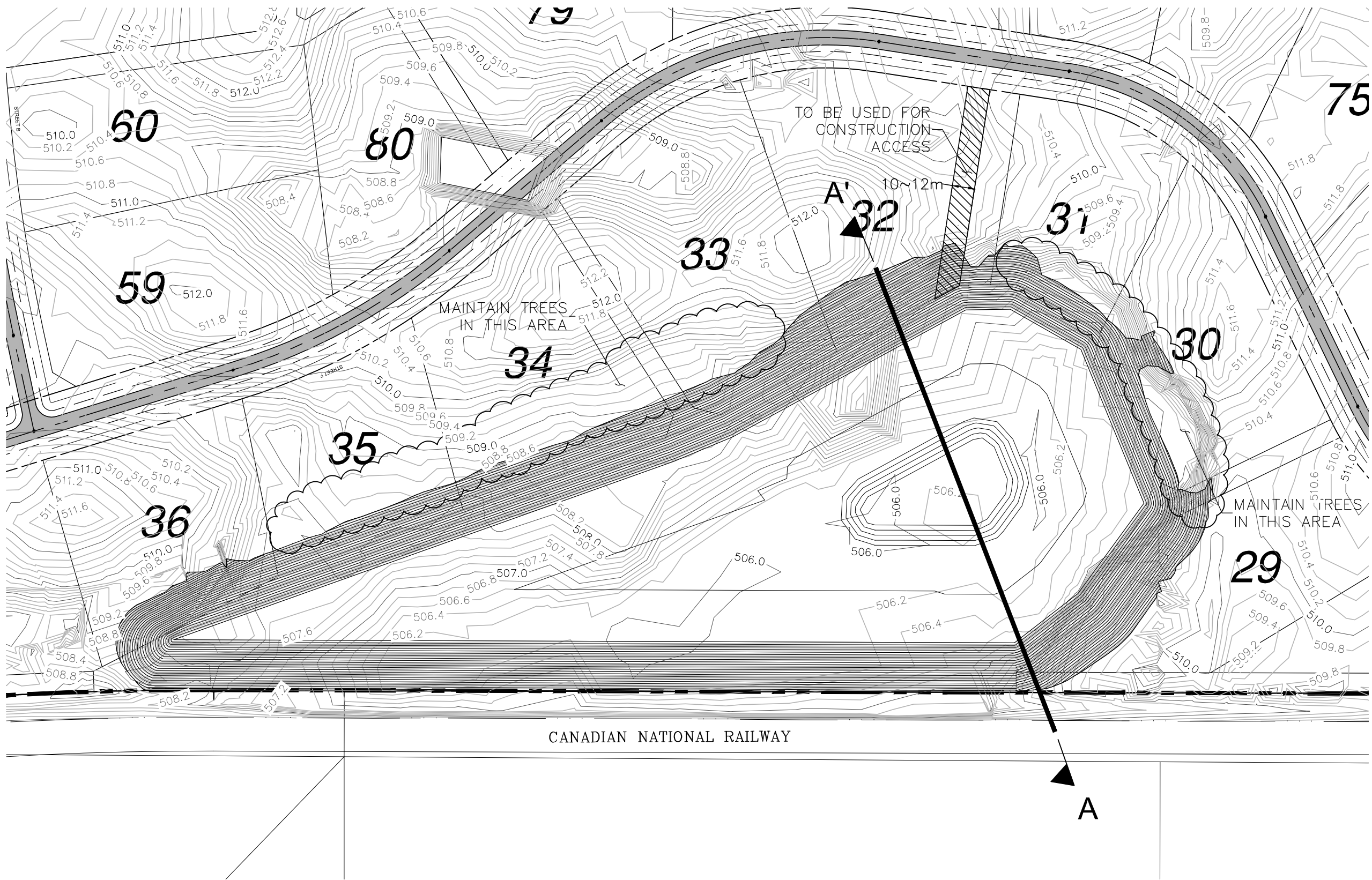
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Appendix B

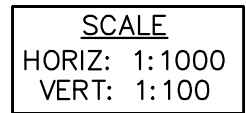
FIGURE 6 – CONCEPTUAL DESIGN OF NORTH STORM POND INCORPORATING WETLAND AREA MITIGATION TO ENHANCE CANADIAN TOAD HABITAT



DRAWING REVISIONS			
REV	DESCRIPTION	BY	DATE
 Clifton Associates Ltd. engineering science technology			
CLIENT URBAN ELEMENTS DEVELOPMENT CORP.			
PROJECT GRASSWOOD ESTATES			
TITLE CONCEPTUAL DESIGN OF NORTH STORM POND INCORPORATING WETLAND AREA MITIGATION TO ENHANCE CANADIAN TOAD HABITAT			
DESIGN	C.F.	SCALE	1:2000
DWN. BY	Z.Y.	PROJECT NO.	S1607.7
CHECKED	J.G.	LAND LOCATION	W1/2 26-35-5 W3
DATE	2012-10-03	DWG. NO.	6

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LEGEND



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REV				DESCRIPTION		BY			DATE



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CLIENT	URBAN ELEMENTS DEVELOPMENT CORP.
PROJECT	GRASSWOOD ESTATES
TITLE	CONCEPTUAL CROSS SECTION OF NORTH STORM POND WITH WETLAND AREA

DESIGN	C.F.	SCALE	1:1000	DATE	2012-10-03
DWN. BY	J.L.	PROJECT NO.	S1607.7		
CHECKED	J.G.	LAND LOCATION:	W1/2 26-35-5 W3		
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