

Executive Summary – Rosewood Groundwater Study

Introduction

Boychuk Investments Ltd. is planning to develop the Rosewood Subdivision in south east Saskatoon. The south east sector of the city has experienced high water table conditions in other developments. This assessment has been completed to identify high water table areas within the subdivision so that remedial measures can be designed to ensure future commercial and residential development can proceed. The study was intended to characterize the hydrogeologic setting so that the causes and effects of the water table conditions would be understood and the experience could be applied to future developments.

Background Information

A series of five ponds have been developed to control runoff and storm drainage from the Lakewood, Briarwood, Lakeridge and Rosewood subdivisions. They are located along the west side of the Rosewood Subdivision. Ponds 1 and 2 have been excavated and serve as the main surface drainage and storm drainage collection areas for the developed area east of Boychuk Drive. Ponds 3 to 5 have not been engineered but act as natural surface drainage collection for the area. Pond 5 is at the high end of the drainage system, at an elevation of 505.86 m and Pond 1 is located at the low end at an elevation of 503.34 m (October 2007). Surface water flow occurs from Pond 5, sequentially, to Pond 1. Water drains from Pond 1 into the City of Saskatoon storm water system that leads northward. Drainage from the proposed Rosewood Subdivision is also planned to be directed into these ponds.

The storm drainage ponds are situated in a regional topographic low that trends southwestward along the east side of the City of Saskatoon. The Strawberry Hills and Sutherland Moraine form regional topographic highs east and west of the site, respectively. The Sutherland Moraine is a ridge that trends north-south through Wildwood and Lakeview subdivisions. Surface drainage and shallow groundwater flow is from the topographic highs toward the central low at the drainage ponds. Natural drainage from the topographic low is southwestward to a sand plain that extends toward the South Saskatchewan River. The sand plain is related to the “Saskatoon Low”, a geologic feature created by salt dissolution at depth and subsidence of overlying ground prior to the last glaciation.

Investigation Summary

Five (5) rotary test holes and over thirty (30) shallow auger test holes and piezometers were established across the site to define the geology and hydrogeology. Bedrock geology consists of Bearpaw Formation clay shale and Bearpaw sand members. The sand members form

aquifers whose lateral extent is structurally cut off by the “Saskatoon Low” and thus are under substantial artesian pressures in the southeast sector of the city. The overlying Dundurn and Warman Formations are clayey glacial tills totalling over thirty (30) meters thick. These formations create a thick, low permeability barrier overlying the bedrock sand aquifers which limits upward flow contributions from the aquifer to insignificant amounts.

The Battleford and Haultain Formations directly overlie the Warman Formation at the site. Both of these formations are loosely consolidated and exhibit wide variations in grain size distributions. The Battleford Formation is a sandy till and the Haultain Formation is lacustrine in origin and varies from a silty clay to a sandy silt in texture. The shallow groundwater flow system occurs primarily through the Haultain Formation and the uppermost 1 to 2 m of the Battleford Formation. Within the Haultain Formation upper, middle and lower zones have been defined. The middle zone is characterized by high clay contents and forms a lower permeability barrier between the more permeable upper and lower units. Hydraulic gradients within the Haultain and Battleford Formations indicate the eastern third of the Rosewood site is a groundwater recharge area while the western two thirds is a groundwater discharge area with highly variable vertical and horizontal gradients.

The Battleford Formation becomes thicker and the top of the formation forms a subsurface ridge beneath the storm ponds while the topographic elevation drops approaching the ponds. This results in the shallow Haultain flow section becoming constricted to less than 5 m. This reduces the transmissivity of the flow section and causes the hydraulic gradient to increase near the ponds. The low transmissivity keeps the water table at high elevations that come close to surface in the upgradient area between the 512 and 513 m ASL. Four land categories have been defined across the site based on the depth to the water table and minimum residential basement depths of 2 m, they are:

- Category I lands; water table less than 2 m below ground on poorly drained land, remedial measures recommended.
- Category II lands; water table less than 2 m below ground on land immediately surrounding the storm ponds, remedial measures recommended.
- Category III lands; water table 2 to 3 m below ground, consideration of basement elevations in grading plan is recommended.
- Category IV lands; water table greater than 3 m below ground, no special consideration required.

The area between 512 and 513 m elevation is defined as Category I land where remedial measures will be required to accommodate residential construction. Low lying areas

immediately surrounding the ponds and typically below 506.5 m elevation are Category II lands.

Recommendations

The following summarizes the recommendations for the different land categories as well as general recommendations for future monitoring and hydrogeologic definition. Drawing No. WM231-23 shows the areal extent of the land categories.

Category I Lands

- Strip and prepare the area between 512 and 513 m elevation. Some of the zones within this area are sloughs and may require deep stripping to remove organic material built up in the slough bottoms.
- Consider placement of approximately 1 m of compacted fill above original grade to bring the elevations up to between 512 and 514 m with a 0.5% westward slope from 514 m to 512 m.
- Consider construction of a minimum of two parallel sub-drains that extend nominally 1,500 m from north to south across the subdivision and spaced approximately 120 m apart to depress the groundwater table by a minimum of 1 m. Detailed design of the subdrains is required to determine spacing, anticipated inflow and capacity of drainage pipe.
- Maintain existing monitoring points and establish additional points at several select locations across the Category I lands.
- Conduct a geotechnical study to determine the potential impact and design considerations for the traffic interchange at Rosewood Gate South. This interchange is the main south access to the subdivision.

Category II Lands

The majority of Category II lands are outside the proposed development area and on the City of Saskatoon lands immediately surrounding the storm drainage ponds. There are however three areas that are designated for residential or multi-unit dwellings, they are:

- Slough 2 and the area leading down to the north end of Pond 3 from the slough.
- The low area off the southeast corner of Pond 3 that is below 506.5 m elevation.
- The low area adjacent to Boychuk Drive along the west boundary of the subdivision.

Slough 2 is a perched freshwater slough therefore once it is drained and properly graded to shed surface water the water table is expected to drop to greater than 2 m below surface.

The other two areas have low topography and the shallow water table is the regional water table less than 2 m below surface. These areas cover relatively small areas and additional fill is recommended in both areas to ensure the grade is raised to ± 509 m elevation.

On the City of Saskatoon Category II lands, construction of toe drains is recommended along the southern margins of Pond 2 and Pond 3 at 100 m intervals and wherever groundwater piping is currently observed. The toe drains will maintain efficient drainage and limit erosion due to groundwater piping.

Category III Lands

Category III lands do not require special remedial attention however, the following points are recommended for implementation:

- Further piezometers and monitoring points are required on Category III land to adequately define and confirm water table conditions in this area so that the grading plan can be developed.
- Once the water table is better defined, the grading plan for Category III lands should ensure that no cuts should be made that would place basement elevations below the water table.

Hydrogeological Monitoring

Residential development will change the local hydrogeologic conditions due to pavement, lawn irrigation and drainage. The following summarizes anticipated effects:

- Pavement and basements in the recharge areas will reduce infiltration and therefore may reduce the water table elevation.
- Pavement and basements in the discharge areas will reduce discharge, therefore may increase water table.
- Irrigation of lawns and gardens will increase water table elevation.

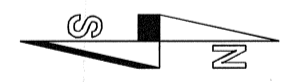
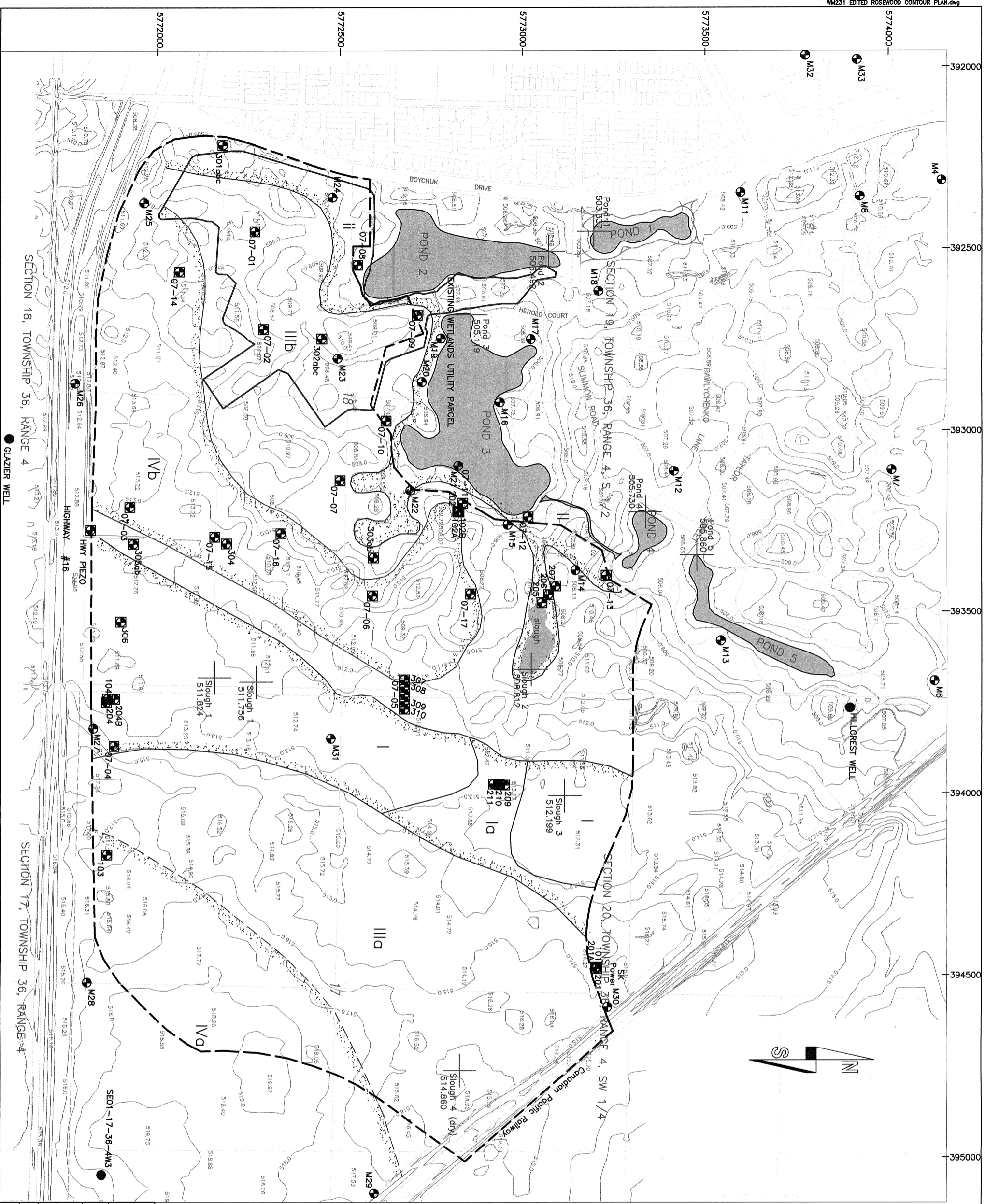
Long term monitoring will aid in assessing the level of these impacts on the local hydrogeologic regime. Information obtained will provide a valuable historic record of changes that can be used to anticipate changes in future subdivisions.

Regular monitoring of all existing and additional piezometers is recommended. A schedule for regular monitoring and reporting is recommended.

Regional Hydrogeologic Compilation

Further regional compilation is recommended to develop a better understanding of the hydrogeological interrelationships between various subdivisions. Site specific investigations are often interpreted in isolation without consideration of the surrounding area while groundwater flow systems extend beyond these boundaries and a more complete understanding of the system can be gained by examining the region as a whole. For example, the incorporation of the 1986 Machibroda data for the Lakewood Subdivision aided in characterization and understanding of some of the structural control on the flow system in the Rosewood Subdivision. Similarly compilation of previous geotechnical studies from Lakeridge, Briarwood, Stonebridge and surrounding areas, into a single map area encompassing the south and southeast outlying areas around the City of Saskatoon would provide a substantial database and a baseline from which new subdivisions or issues in existing subdivisions can move forward.

One outstanding issue that could be answered by a regional compilation is whether some of the shallow flow, in the southwest corner of the Rosewood site, exits the site in the area around the Boychuk Drive and Highway 16 or whether all of the shallow flow is toward the storm ponds. Further definition of the flow system southwest of the Rosewood site may have implications on the water balance at the Rosewood site as well as on other developments west of the site. It may also further define the complex hydrogeologic setting and the impact that the "Saskatoon Low" has on the regional groundwater flow system. The outcome of the hydrogeological compilation will identify data deficiencies so that additional future work can be focussed on appropriate areas.



LEGEND

- PIEZOMETER
- ▣ EXISTING WELL
- PHASE I DEVELOPMENT AREA

CATAGORY I Shallow Artesian, and water table <2m, poorly drained, upward hydraulic gradient.

CATAGORY Ia Water table <2m, poorly drained, downward hydraulic gradient.

CATAGORY II Areas within historic high water mark surrounding ponds and water table <2m below surface.

CATAGORY IIIa Water table 2-3m below ground, poorly drained, flat.

CATAGORY IIIb Water table 2-3m below ground, land is moderately well drained.

CATAGORY IV Water table >3m below ground, and land is well drained; IVa—elevation is above 517m. IVb—elevation is between 509m & 512m.



DATE: 28 FEB 08	DRAWN BY: WMB	APPROVED BY: WAU
SCALE: 1:10,000	FILE NO: WM231	DRAWING NO: WM231-23
CLIENT: UMA ENGINEERING LTD.		
PROJECT: ROSEWOOD SUBDIVISION		
TITLE: LAND DEVELOPMENT CATEGORIES		