Baseline Surface Water Quality Assessment for Prairie Gardens and Greenhouses Ltd.

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Introduction

On March 31, 2005 *Aqua*lity Environmental Consulting Ltd. collected surface water for routine water quality analyses on behalf of Prairie Gardens and Greenhouses Ltd. (BN 2011114432). The purpose of the sampling was to collect baseline quality data of runoff water that originates from nearby agricultural land and used for greenhouse irrigation purposes.

Recently, the town of Bon Accord released the Northeast Bon Accord Area Structure Plan, which will impact land directly upstream (south west) of Prairie Gardens and Greenhouses. The complete area structure plan can be viewed on the consultant's website at http://www.schefferandrew.com/pdf/ba_aspfinaldraft.pdf. Outlined in this plan are new residential developments and a light industrial area, which will house a small cement mixing operation (Portland Cement). The area identified in the Area Structure Plan encompasses most of the drainage area which currently supplies Prairie Gardens Greenhouses with their water (Figure 1). There is concern by the Greenhouse operators that the proposed development and subsequent landscape alterations will cause a change in both runoff water quality and quantity.

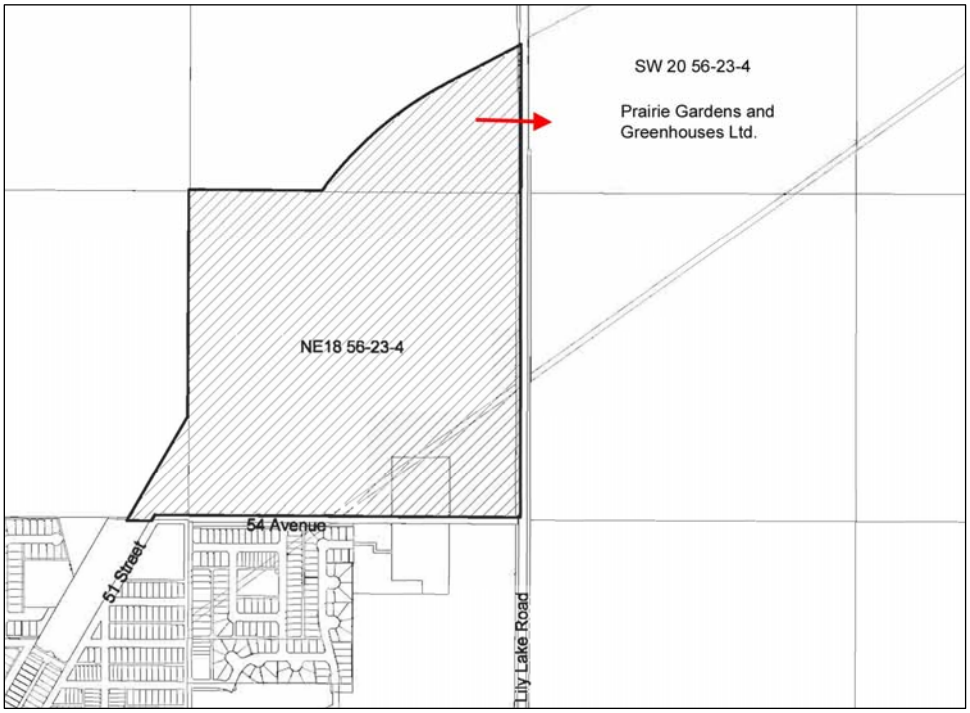

Figure 1. Map from the North East Bon Accord Area Structure Plan outlining the proposed development area. Prairie Gardens Greenhouses are located in section SW 20 56-23-4. Water currently flows from the hatch marked area, and under Lily Lake Road at the location highlighted by the red arrow. Map adapted from the North East Bon Accord Area Structure Plan, Shaffer Andrew Planners and Engineers Ltd, 2005.

Site description

Prairie Gardens is located on Lily Lake Road, approximately 2 km north of the town of Bon Accord. Surrounding lands are generally open agricultural fields with some tree cover in the form of shelter belts.

Water samples were taken at the mouth of a culvert running under Lily Lake road at N 53 50 988, W 113 23 826, on the west side of the road (Figure 2). From here, water flows along an abandoned rail line to a pond approximately 50m from the road. Water then flows through another culvert underneath the rail line and enters three storage basins on Prairie Gardens' property. Total retention capacity of the greenhouse storage basins is 9 million liters (Figure 3).

Figure 2. Photo of water quality sampling location looking south. Lily Lake road is on the left, the red arrow points to the entrance to the culvert where surface grab samples were taken (upstream of the greenhouse storage basins).

Figure 3. Photo of dugout #1 at Prairie Gardens Greenhouses. This is one of three dugouts with a combined capacity of 9 million liters.

Methods

Three water samples were collected by Aquality on March 31st, 2005 and delivered to Norwest Labs in Edmonton for analysis of standard greenhouse water quality parameters (Norwest test GW 5). The GW5 suite includes inorganic nonmetallic parameters, extractable metals, physical properties, and routine water quality parameters (Table 1). The analytical methods used by Norwest can be found in Appendix A. A paired sample set was collected at the culvert site. For quality control purposes, the third sample was a "blind" reference control blank containing de-ionized water.

Results

Inorganic Nonmetallic Parameters

Orthophosphate levels averaged 0.585 mg/L, which exceed the Alberta Surface Water Quality Guidelines for Protection of Aquatic Life (Alberta Guidelines) for Total Phosphorus, which is 0.05 mg/L (Alberta Environment 1999). There are no Canadian Council of Ministers of the Environment (CCME) Water Quality Guidelines for phosphorus (CCME 2001). There are no phosphorus guidelines for irrigation use established by Alberta or CCME. The blank samples had no detection.

Extractable Metals

Sulphur averaged 17 mg/L, Aluminum 0.081 mg/L, Boron 0.2145 mg/L, Copper 0.002 mg/L, and Zinc 0.016 mg/L. Molybdenum was not detected. CCME water quality guidelines for irrigation exist for Aluminum, Boron, Copper, Molybdenum, and Zinc. None of the metals detected were over CCME water quality guidelines for irrigation (CCME 2001). The blank samples produced no detections.

Routine Water

pH was slightly alkaline, averaging 7.125. Conductivity was low, averaging 352.5 µS/cm at 25˚C. Calcium averaged 26.4 mg/L, Sodium 16 mg/L, Potassium 33.5 mg/L, Iron 0.08 mg/L, Manganese 0.0925 mg/L, Chloride 37 mg/L, Nitrate-Nitrite 0.215 mg/L, Bicarbonate 56.5 mg/L, and Total Alkalinity 46 mg/L. Carbonate and Hydroxide were not detected. CCME irrigation water quality guidelines exist for Iron and Manganese, but detected levels were well below the guidelines (CCME 2001). The blank sample produced a pH reading of 5.87, but no other compounds were detected. Baseline water quality results are summarized in Table 1. Blank sample results were excluded for formatting purposes.

Discussion:

The baseline data collected show that surface runoff quality is currently within the CCME for all parameters for irrigation use. Thus, surface runoff water is currently acceptable for use by Prairie Gardens.

Table 1: Surface water quality results from Lily Lake road Culvert near Prairie Gardens Greenhouses collected March 31, 2005.

	Units	Detection Limit	LLR 1	LLR 2	Average	CCME Irrigation
Inorganic Nonmetallic Parameters						
Orthophosphate-P	mg/L	0.01	0.6	0.57	0.585	---
Metals Extractable						
Sulfur	mg/L	0.3	17	17	17	---
Aluminum	mg/L	0.005	0.083	0.079	0.081	5.0
Boron	mg/L	0.002	0.039	0.039	0.039	0.5 - 6.0
Copper	mg/L	0.001	0.002	0.002	0.002	0.2 - 1.0
Molybdenum	mg/L	0.001	0	0	0	0.01 - 0.05
Zinc	mg/L	0.001	0.016	0.016	0.016	1.0 - 5.0
Routine Water						
pH		N/A	7.1	7.15	7.125	---
Electrical Conductivity	µS/cm*	1	352	353	352.5	---
Calcium	mg/L	0.2	26.2	26.6	26.4	---
Magnesium	mg/L	0.1	4.8	4.9	4.85	---
Sodium	mg/L	0.4	16	16	16	---
Potassium	mg/L	0.4	33	34	33.5	---
Iron	mg/L	0.03	0.08	0.08	0.08	5.0
Manganese	mg/L	0.005	0.091	0.094	0.0925	0.2
Chloride	mg/L	0.4	37	37	37	---
Nitrate Nitrite-N	mg/L	0.02	0.21	0.22	0.215	---
Hydroxide	mg/L	5	0	0	0	---
Carbonate	mg/L	6	0	0	0	---
Bicarbonate	mg/L	5	59	54	56.5	---
T-Alkalinity	mg/L	5	48	44	46	---

* at 25˚C

However, the development plans outlined in the North East Bon Accord Area Structure Plan have the potential to impact both water quality and water quantity that is received by Prairie Gardens Greenhouses. The potential impacts on water quantity and quality has raised concerns from Prairie Garden Greenhouses which has an irrigation agreement with Alberta Environment ([# 15688] Plan # 22914-1 AB Environment File # 5062). As an adjacent landowner, Prairie Gardens Greenhouses is likely a party “directly affected” by the proposed ASP of Bon Accord.

Currently, the Area Structure Plan calls for a 3 hectare stormwater management pond that will collect water from the surrounding residential area. Once full, the stormwater pond will release water back into pre-existing ditches that feed the greenhouse dugouts. The ability of this pond to provide significant water treatment has not been shown, and there exists no mitigation strategy to address flood events, spills and other emergency situations.

As well, natural flow patterns may be significantly altered with the development footprint which will remove most of the natural porous surfaces replacing them with impervious surfaces. Impervious surfaces do not allow natural soil infiltration or groundwater recharge, and this will alter the timing of surface water flow quantity and quality. In addition, there may be a possibility that the stormwater pond does not release the same quantity of water that the current undeveloped state of the land yields.

As greenhouses require high quality water for their growing operations, runoff water quality from the planned development area is a concern for Prairie Gardens. Of greatest importance is the possibility of runoff of lime fines containing calcium carbonate and other waste materials from the proposed cement plant. Calcium carbonate is a highly basic compound (pH 12-13) commonly used in cement mixing. When tested, runoff feeding the Prairie Gardens dugouts had a nearly neutral pH of 7.125, which is ideal for growing plants. If runoff from the cement plant is not completely treated or properly controlled, there exists the potential for changes in the pH of runoff waters that flow into dugouts used by Prairie Gardens Greenhouses which will negatively impact their operations.

References

Alberta Environment. 1999. Surface Water Quality Guidelines for use in Alberta. Alberta Environment, Environmental Sciences Division, Edmonton, Alberta. 20p.

Canadian Council of Ministers of the Environment (CCME). 2001. Canadian Water Quality Guidelines for the Protection of Aquatic Life. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

Shaffer Andrew Planners and Engineers Ltd. 2005. North East Bon Accord Area Structure Plan, Final Draft. 20p.

Appendix A: Analytical Methods

Method of Analysis

Method name:	Reference	Method
Alkalinity, pH and EC in water	APHA	* Conductivity - Laboratory Method, 2510 B
Alkalinity, pH and EC in water	APHA	* Electrometric Method, 4500-H+B
Alkalinity, pH and EC in water	APHA	* Titration Method, 2320 B
Anions (Routine) by ion chromatography	APHA	Ion Chromatography with Chemical Suppression of Eluent Cond, 4110 B
Chloride in water	APHA	* Automated Ferricyanide Method, 4500-Cl-E
Metals ICP-MS (Extractable) in water	US EPA	* Determination of Trace Elements in Waters and Wastes by ICP-MS, 200.8
Metals trace (extractable) in water	APHA	* Inductively Coupled Plasma (ICP) Method, 3120 B
Orthophosphate-P in water	APHA	*Automated Ascorbic Acid Reduction Method, 4500-P F

* Norwest method(s) is based on reference method

References:

APHA	Standard Methods for the Examination of Water and wastewater
US EPA	US Environmental Protection Agency Test Methods