The Town of Blackfalds 2015 Wastewater Master Plan Update

Final Report

Prepared for:
The Town of Blackfalds

Prepared by:
Stantec Consulting Ltd.

113929362-07

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Sign-off Sheet

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Stephan Weninger **Brad Vander Heyden**

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Abbreviations

AC	Asbestos Cement
ADWF	Average Dry Weather Flow
AVG	Average
BOD	Biochemical Oxygen Demand
CBOD	Carbonaceous Biochemical Oxygen Demand
DEM	Digital Elevation Model
DWF	Dry Weather Flow
GIS	Geographic Information Systems
HGL	Hydraulic Grade Line
HRT	Hydraulic Retension Time
I&I	Inflow and Infiltration
IDF	Intensity-Duration-Frequency
Kg/cp/d	Kg per capita per day
LOS	Level Of Service
Lpcd	Liters per capita per day
NRDRWWC	North Red Deer Regional Waste Water Commission
PDWF	Peak Dry Weather Flow
PE	People
PWWF	Peak Wet Weather Flow
RDII	Rainfall Dependent Inflow and Infiltration
RG	Rain Gauge
ROW	Right Of Way
SRTC	Sensitivity-based Radio Tuning Calibration
TSS	Total Suspended Solids

UHM	Unit Hydrograph Method
WWF	Wet Weather Flow
WWTF	Wastewater Treatment Facility
WWTP	Wastewater Treatment Plant

1.0 BACKGROUND

The Town of Blackfalds (the Town) collects and treats the wastewater generated within its boundaries and the Lacombe County Joint Economics Areas (JEA) to the west of Highway 2. With the fast growth within the Town and the Lacombe CountyJEA, the Town needs to construct new infrastructure as well as upgrade the existing wastewater collection and treatment systems to keep up with the wastewater volume increase.

Meanwhile, as a participant member of the North Red Deer Regional Wastewater Commission, the Town is depending on the future construction of the regional wastewater line to convey the wastewater collected by the Town and the City of Lacombe to the City of Red Deer for high level treatment.

To assess the impacts from the new developments, the regionalization plan on the wastewater infrastructure and identify the necessary upgrades, the Town of Blackfalds retained Stantec Consulting Ltd. (Stantec) to complete this Wastewater Master Plan Update.

1.1 STUDY OBJECTIVES

The primary objectives of the Town of Blackfalds 2014 Wastewater Master Plan Update are to update the existing Master Plan and Wastewater Model based on the following key considerations:

- Build a more user-friendly sanitary model to replace the spreadsheet model;
- Incorporation of updated as-built data, existing available flow records and updated growth and development plans;
- Updating the planned sanitary sewer sub-basin boundary in McKay Ranch to account for the portion of development serviced by the gravity collection system to the east;
- Inclusion of the JEA into the Master Plan and Model;
- Review of opportunities to eliminate the need for one of the two previously proposed future lift stations in the northwest quadrant of town (Aurora Heights and the neighboring north quarter section), including the potential for expanding the sewer shed of the northwest quadrant northward needs, to beyond the Town's current limits into Lacombe County lands;
- Reviewing of an alignment for the future North Red Deer Regional Wastewater pipeline through the Town that will be amenable to the Town and the Regional Commission; and
- Review the current wastewater treatment capacity and develop an interim strategy to service the new developments before the implementation of the North Red Deer Regional Wastewater System.

1.2 PREVIOUS STUDIES AND AVAILABLE DATA

The following studies and data sets were reviewed and form the basis of this study:

- Town of Blackfalds Interim Lift Station Preliminary Design (Stantec 2008);
- Town of Blackfalds Wastewater Treatment Study (Stantec 2005);
- Town of Blackfalds Master Plan (Stantec 2008);
- Area Structure Plans for Mckay Ridge, Aurora Heights and Lakeside;
- Water Billings from 2010 – 2012;
- Lift Station #1 Flow Meter Data from 2011 – 2013; and
- Rain Gauge Data from the City of Red Deer for 2012.

2.0 STUDY AREA AND EXISTING SYSTEM

2.1 CURRENT TOWN BOUNDARY

The current Town of Blackfalds municipal boundary contains a total area of 1709 hectares (ha), as presented in Figure 2-1. The area west of the Highway 2 is the JEA area, developed by Lacombe County and serviced by the Town. The breakdown of the planned areas in Figure 2-1 is tabulated in the following table:

Table 2-1 Future Development Areas

Residential		Industrial*		Commercial	
Area ID	Gross Area (ha)	Area ID	Gross Area (ha)	Area ID	Gross Area (ha)
E4	12.7	I1B	8.5	C4	11.8
E5	50	I1C	9.8	C8	7.1
E6	53.2	I2	16.5	C9	14.2
E7	57.5	I8	27.8	C11	8
E8	49.5	I9	25.2	C12	16
N2	36.3	I12	24	C10	5.1
N3	17.5	I13	46.4		
N4	16.4	I14	16.2		
N5	41.2				
N6	22.6				
NE4	6				
S1	4				
S2	27.5				
S3	32.8				
W3	34.3				
E3	29.4				
N1	13.3				
TW3	13.9				
W2A	4.5				
W2D	8.2				
E2	42				
Total Residential	572.8	Total Industrial	174.4	Total Commercial	62.2

*The total gross area of the planned JEA development is approximately 632 Ha with 375 Ha considered developable.

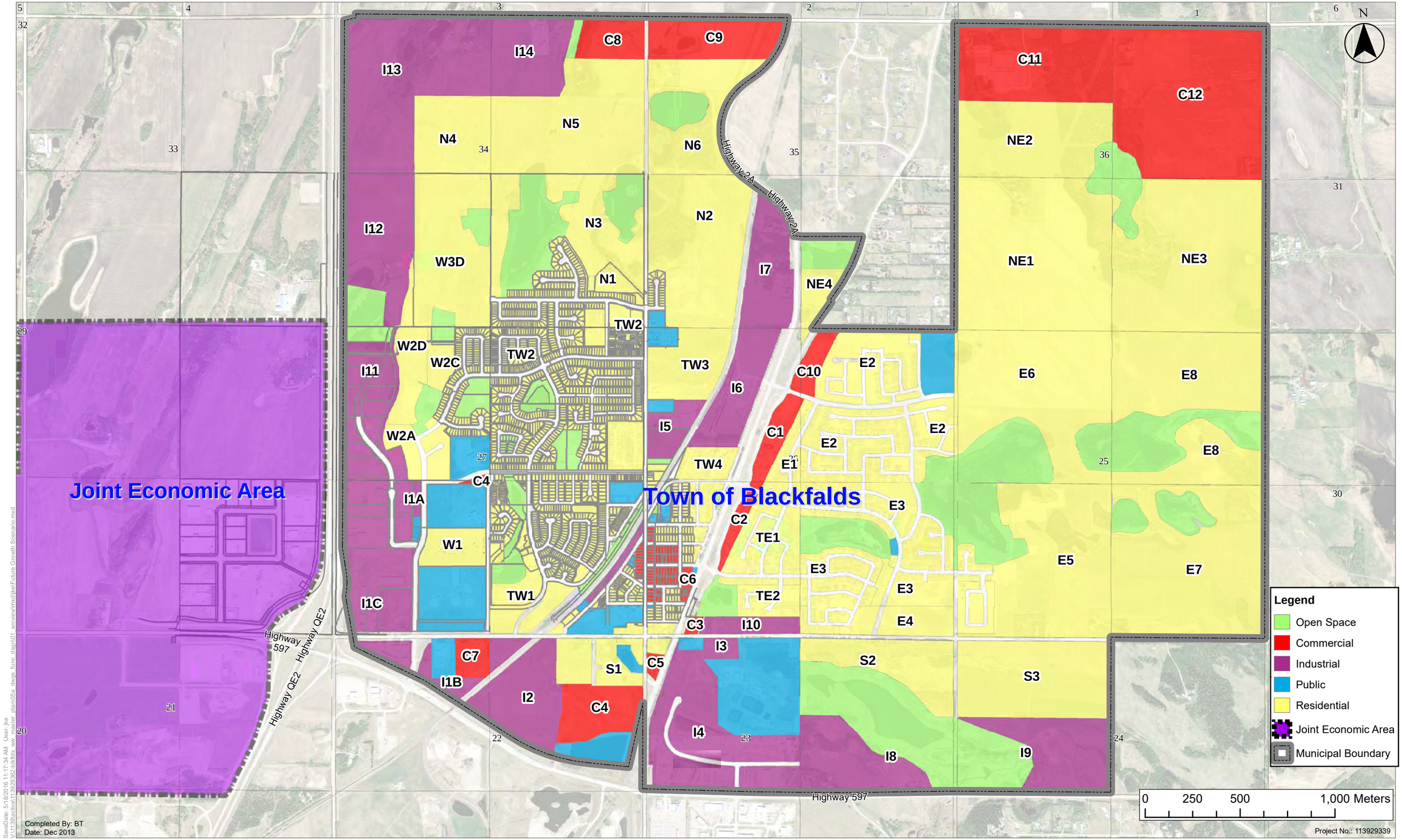

Figure 2.1: Study Area and Land Use Type
Town of Blackfalds and Joint Economic Area

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2.2 POPULATION GROWTH

The Town of Blackfalds has experienced significant growth in the past 11 years. The last 11 years municipal census results are presented in the following table:

Table 2-2 Blackfalds Census Results and Growth Rates

Year	Population	Population Growth	Year-Year Growth Rate
2003	3812	-	-
2004	3955	143	4%
2005	4373	418	11%
2006	4741	368	8%
2007	4843	102	2%
2008*	5182	339	7%
2009	5610	428	8%
2010*	6003	393	7%
2011	6399	396	7%
2012	6767	368	6%
2013	7275	508	8%
2014	7858	583	8%

Note: There was no census conducted in 2008 or 2010. The values presented in the table were interpreted based on an assumed average yearly growth rate of 7%.

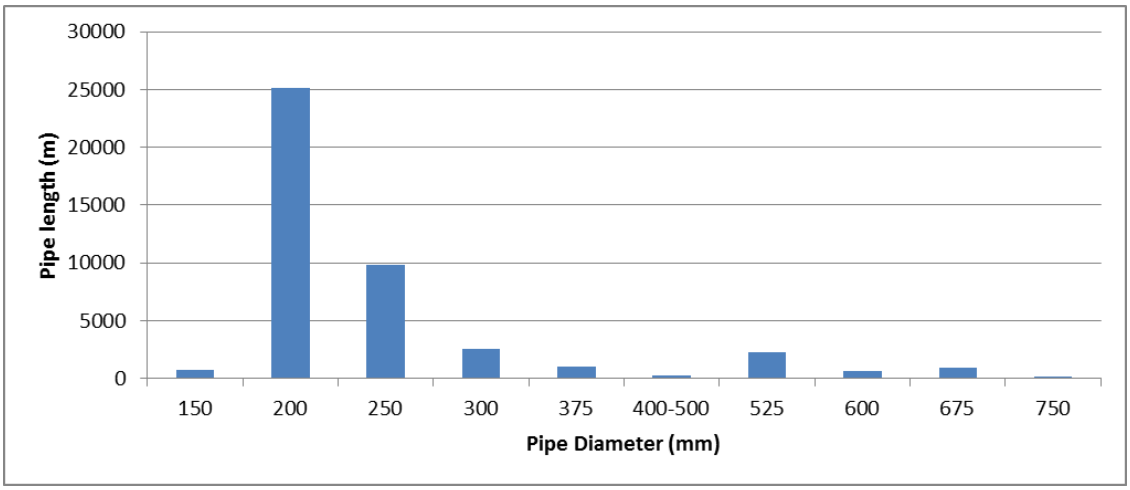
The average annual growth rate for the 11 year period from 2003 to 2014 is approximately 7%, which is extremely high when compared to other municipalities in central Alberta.

2.3 EXISTING SANITARY SEWER SYSTEM

2.3.1 Existing Sewer and Lift stations

The existing sanitary sewer system in the Town consists of gravity pipes, forcemains, six lift stations and an aerated lagoon treatment facility. The majority of the existing gravity sewer pipes are PVC with a total length of about 50 kilometres (km). The breakdown of the pipes is presented in the following figure:

Figure 2-2 Existing Sanitary Pipes



Note: Forcemain pressure pipes are not included in the above quantities.

Currently, there are seven major lift stations operating in the sanitary system. The North West Lift Station (NWLS) pumps wastewater from the Town's northwest corner either east to MH109 which flows to the Briarwood lift station, or east to MH143 on Broadway Avenue, that flows south to the Stanley Street Lift Station (SSLS). The sewage wastewater generated in the west portion of the Town flows to the SSLS. The SSLS then conveys the flow to the gravity system which flows to the gravity trunks connecting to the Lift Station #1 (LS1).

In Panorama Lift Station (PNLS), located on Panorama Drive, services both the Panorama Estates and Cottonwood Meadows neighborhoods, which are located on the east side of the existing Town boundary. This lift station currently pumps wastewater to the existing gravity system in Park Street, which ultimately flows to LS1.

The LS1 is the final station that receives the wastewater from the town and discharges into the lagoon for treatment. After the treatment process, the treated effluent will flow into the lagoon discharge lift station, which is equipped with a single pump to continuously convey the lagoon effluent to the Red Deer River outlet 3 kilometers away.

There are temporary lift stations, e.g. Decan lift Station, Mckay rang lift station in the upstream locations. These temporary will be removed or replaced by permanent ones in the future.

The seven existing major lift station capacities are presented in the following table:

Table 2-3 Existing Major Lift Station Capacities

		Forcemain		Pumping capacity (firm)[3]	
NO.	Lift Station name	Dia (mm)	L (m)	Q (l/s)	TDH (m)
1	Briarwood Lift Station (BWLS)	250	736	57	17
2	North West Lift Station (NWLS) to Broadway [1]	250	588	49	12.7
3	Panorama Lift Station (PNLS) (Current) [2]	200	360	78	20.8
4	Stanley Street Lift Station (SSLS)	150/250	360	58 [5]	15.4
5	Lift Station 1 (LS1)	400	68	160	11
6	Aspelund Lift Station(APLS) [4]	350	365	75	12
7	Lagoon Discharge Lift Station	200	2000	29 [6]	31

Notes:

1. North West lift station has dual discharge pipes. The valves in the discharge pipes can be actuated to divert the flow to sewers in Broadway Avenue or Westridge Road.
2. Panorama lift station pumping output is currently throttled to 20 litres per second (l/s) to avoid surcharging in the downstream gravity sewers along Park Street. The Pioneer lift station will discharge into sewers along Panorama Drive in the future.
3. The lift station firm capacity was calculated assuming the biggest pump is off-line.
4. Aspelund lift station is listed for reference only. The Town is not responsible for the operation of the Aspelund lift station, which is located outside of the Town boundary and owned and operated by Lacombe County.
5. If the Stanley lift station forcemain size increases to 250 (millimeters) mm, the Stanley Lift station firm capacity can be increased to 75 L/s.
6. Capacity after the 2014 upgrade.

All lift stations are currently running within their designed capacities. As new developments are constructed and tied in to the sanitary sewer system, upgrades to these lift stations or construction of new lift stations will be required.

2.3.2 Existing Sanitary Model

In previous Master plan updates, an Excel spreadsheet sanitary sewer system capacity model was utilized to identify the sanitary upgrade needs. The spreadsheet model is generally conservative with peak flow calculations and pipe section capacity calculations because the model was developed based on the following:

- The projected flow for an existing area is determined by multiplying the land use type based design sanitary flow criteria in the existing built out areas, which tends to overestimate the flows that are actually in the system;

- The projected peak flow is based on the Harmon or ICI peaking factors specified in the Town's Design Guidelines;
- The spreadsheet model is not based on hydraulic calculation (i.e. surcharge depth cannot be calculated); and
- The upstream peak flow is directly carried over to the downstream without considering the attenuation effects in the gravity pipes.

Based on similar sanitary hydraulic modeling projects in other communities, a portion of the gravity pipe capacities can be made available if the billing data is utilized to calibrate the model in the built out areas.

In this study, the commercially available sanitary hydraulic modeling program PCSWMM was selected to build a hydraulic-based model to study and plan the Town's future sanitary sewer system.

2.4 EXISTING WASTEWATER TREATMENT FACILITY (WWTF)

The Town is currently utilizing an aerated lagoon system for its wastewater treatment under the Environmental Protection and Enhancement Act (EPEA) Approval #425-02-00 as attached in Appendix A. The effluent discharge is continuous and the effluent carbonaceous biochemical oxygen demand (CBOD) limit is 25 milligrams per litre (mg/L). The expiry date of the Approval is June 30, 2019. In addition to the EPEA Approval, the discharge effluent is obligated to meet other regulations, e.g. the Wastewater Systems Effluent Regulations (WSER). The Town has implemented ammonia testing since 2013 as an effort to meet the WSER requirement.

The aerated lagoon system is a standard aeration lagoon which consists of one completely mixed aerated cell, two partially mixed aerated cells and a polishing cell. The design parameters are presented in the following Table.

Table 2-4 Existing Lagoon Design Parameters

Cell #	Cell Name	Water Volume (m^3)	Water Depth (m)	Design Retention Time (days)[1]
1	Complete Mixing	5,448	3.92	2
2	Partial Mixing	16,643	4.58	28 [2]
3	Partial Mixing	25,878	4.09	-
4	Polishing Cell	2,393	3.45	5

Notes:
1. Design retention time in days as per Alberta guidelines
2. The total required retention time in the two partial mixing cells.

The most recent interim process upgrade was completed in 2008. Nelson Environmental Inc. carried out this process upgrade by adding fine bubble diffusers and two 75 horse power (HP) positive displacement blowers to increase the oxygen supply and mixing capacity. However, even with the aeration upgrades, the effluent quality from the lagoon system sometimes exceeds the Approval requirements, especially in the cold weather months. Lambourne Environmental Ltd. conducted a sludge survey of the four lagoon cells on March 12, 2014 prior to removing of the sludge from the lagoon in the spring of 2015. The survey results are attached in Appendix B and are presented in the following table.

Table 2-5 Design Lagoon Cell Volumes and Survey Sludge Volumes

Cell #	Cell Name	Design Water Volume (m3)	Sludge Volume[1]	Sludge Volume/Design Water Volume
1	Complete Mixing	5,448	950	17%
2	Partial Mixing	16,643	3,200	19%
3	Partial Mixing	25,878	4,300	17%
4	Polishing Cell	2,393	1,050	44%

Notes:
1. Sludge refers to solid layers containing TSS >1% (10,000 mg/L).

The lagoon effluent discharge lift station (the discharge lift station) was constructed and commissioned in 1975. As the effluent discharge facility, the lift station conveys the treated wastewater from the last cell of the aerated lagoon to the Red Deer River. The lift station consists of a concrete vault containing an overflow weir and an ITT Flygt CP3126 10 HP submersible pump. The above ground control panel for the pump is installed adjacent to the concrete vault. The pump discharges to the 2 km long, 200 mm diameter Asbestos Cement (AC) forcemain and 1 km long 250 mm diameter gravity pipe.

In 2014, a retrofit on the lagoon discharge lift station replaced the existing pump with a Flygt NP 3153 HT 20 HP to raise the capacity to 29 l/s. The retrofit project was completed as an effort to increase the pumping capacity to match the incoming flows for the next 5 years. The technical memorandum on the lagoon discharge lift station retrofit is attached to this report in Appendix C.

3.0 MODEL CONSTRUCTION AND CALIBRATION

3.1 AVAILABLE SEWER DATA SETS

The following databases were utilized in the PCSWMM model construction:

- Existing sanitary sewer network geographic information system (GIS) database (sewer network as-built);
- Existing sanitary lift stations as-built drawings for Lift Station#1, Stanley Street Lift Station, and the NorthWest Lift Station. The Panorama Lift Station and Briarwood Lift Station as-built drawings are not available;
- 2010 - 2013 water meter monthly billing records, which were used to allocate the wastewater generation from the water users within the Town;
- Lift Station #1 (LS1) flow record 2010 - 2013 (10 second interval flow readings);
- City of Red Deer north rain gauge record 2010 – 2013; and
- Digital Elevation Map and 0.5 meter (m) interval contour for the Blackfalds area.

The PCSWMM model was constructed using the GIS database as the physical network base. Continuity checks have been conducted on the physical model. Where the rim or invert elevations of a manhole or a pipe are missing, the values were interpreted from the upstream or downstream elements or from the contours.

The monthly water billing records for 2010, 2011, and 2012 within the Town were assessed to determine the approximate distribution of the sanitary loading throughout the network. The flows were then normalized to the 2013 flows before the flows were allocated in the model. The normalized flows were then assigned spatially to the nearest sanitary manhole (Nearest Node Method), which was given the three (3) year average water demand as the base generation rate.

The existing sanitary system is presented in Figure 3-1.

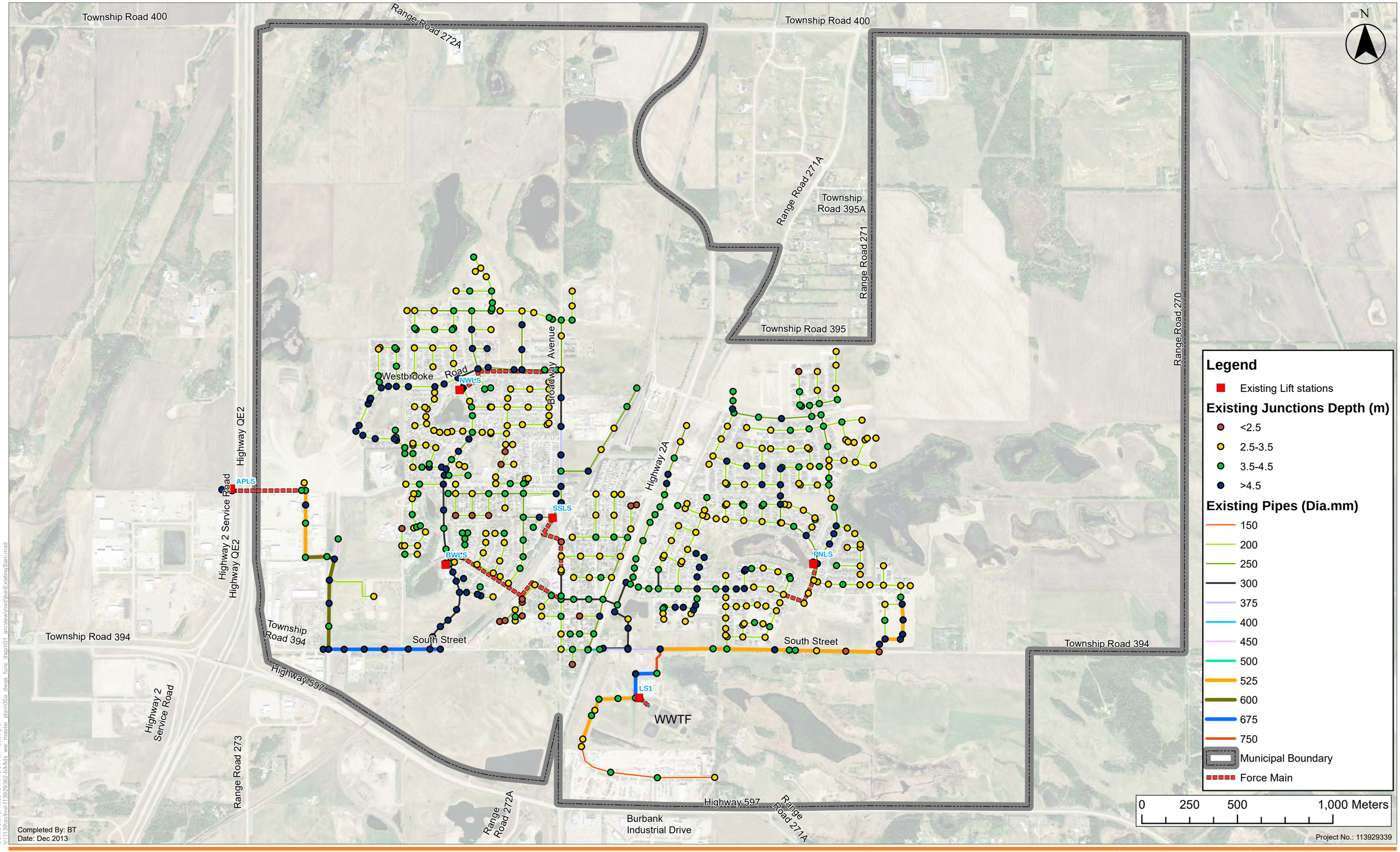


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Figure 3.1: Existing System Sanitary Sewer System

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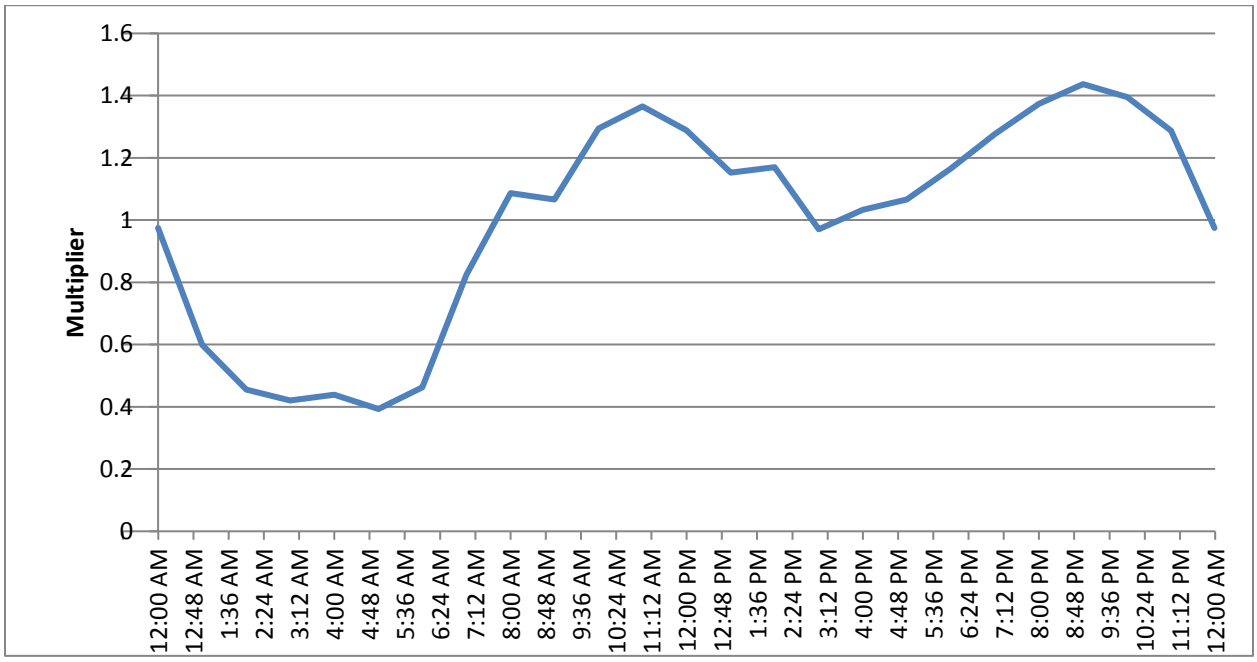
3.2 MODEL CALIBRATION

The Town has not conducted a sanitary flow monitoring program in recent years. For calibration purposes, the metered flows from LS1 were utilized as the calibration flows in the calibration exercise. The metered flows were converted into 5 minute interval flows and assigned to the last gravity sewer section coming into LS1.

A dry weather diurnal curve was derived from the LS1 meter readings from several random dry weather days.

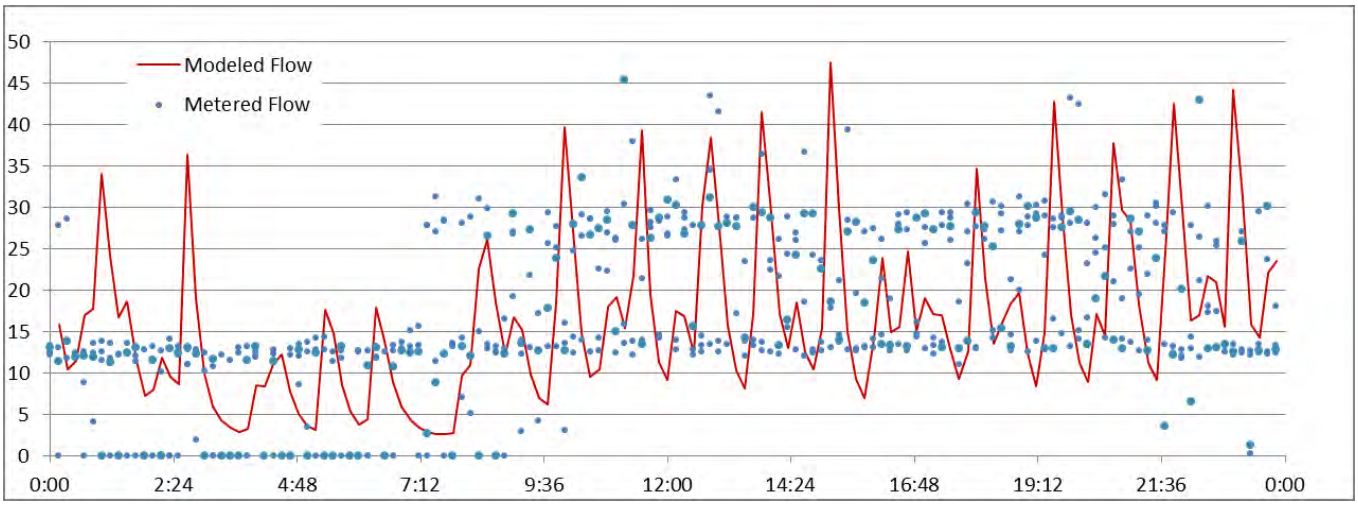
Figure 3-2 Dry Weather Diurnal Curve Derived from LS1 Flow Records



3.2.1 Dry Weather Calibration

With the wastewater generated from the water billing records, the PCSWMM model was calibrated with the LS1 meter data by adjusting the water to wastewater ratio and the base flow ratio. The following graph shows the dry weather calibration results with an 85% water to wastewater ratio and a based flow ratio of 5%. The dry weather flows (DWF) were derived from the metered flows in the LS1 forcemain from Jan 1 - Jan 5, 2013.

Figure 3-3 Dry Weather Flow Calibration Hydrograph



As shown in Figure 3-3 the modeled flow generally reflects the metered flow. In the low demand period, 12:00 am – 9:00 am, the modeled flow appears to have more peaks than the metered flow and the modeled flow values are generally higher than the metered flow. During the high demand period, 9:00 am – 12:00 am, the modeled flow represents the metered flow range quite well.

The statistics of the data shown in the DWF calibration figure are presented in the following table:

Table 3-1 Dry Weather Flow Calibration Result Statistics

Flows	Modeled data	Metered flow						Differential
		Day 1	Day 2	Day 3	Day 4	Day 5	Average	
Total flow (m3/d)	1424.0	1524.1	1443.2	1388.6	1334.7	1435.5	1425.2	-0.09%
Max flow (l/s)	47.47	42.46	43.40	40.01	31.22	45.45	45.4	4.27%
Mean flow (l/s)	16.48	17.64	16.70	16.07	15.45	16.61	16.5	-0.09%
Min flow (l/s)	2.59	0	0	0	0	0	0	-

The statistics table presents the statistical parameter of the DWF calibration figure. The differential of the total flow shows that a good mass balance has been achieved in the calibrated model. The maximum and minimum flows projected by the model are bit more conservative, which is preferred in a hydraulic model.

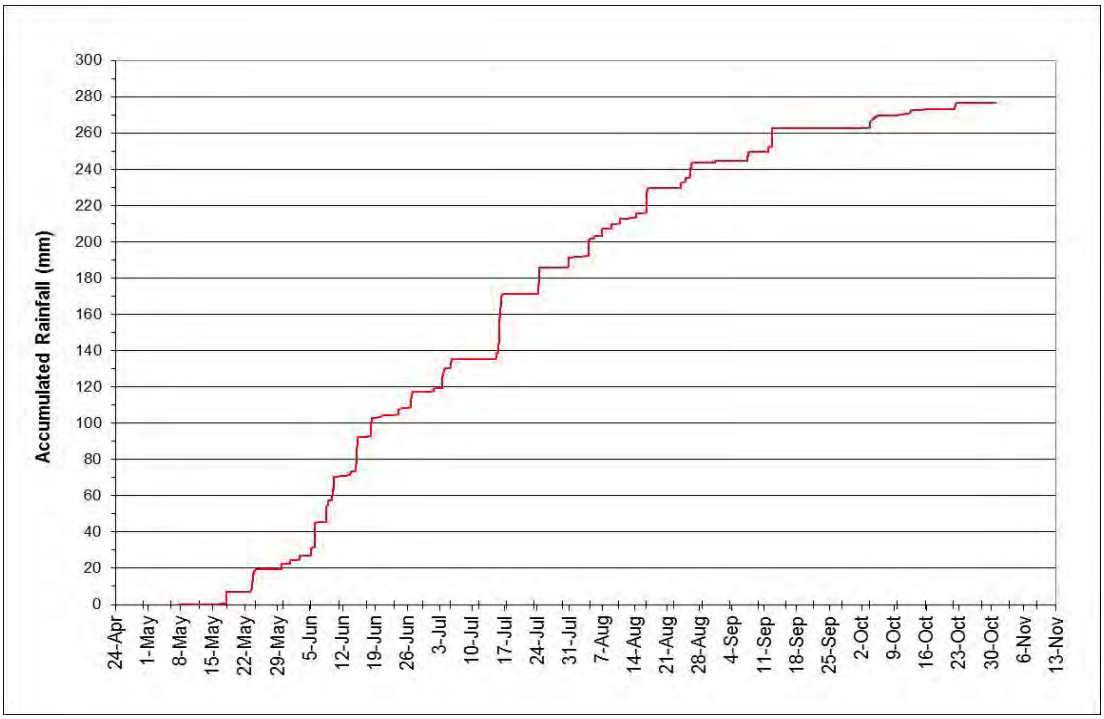
The dry weather diurnal curve, the assigned flow to the nodes, the wastewater to water ratio and base flow are accepted as the basis of the PCSWMM model. For reference, the composite per capita flow rate in the calibrated model is about 210 litres per capita per day (lcpd).

Note that since there is no monitored flow data on gravity sections available in this study, the metered flow in the LS1 forcemain was adopted and converted as the one and only monitoring data in the last gravity section to assist with model calibration. The assumption behind this practice is that the sewer sheds in the Town behave the same. Additional monitored flow data is needed to calibrate the upstream sewer shed and it is recommended that the Town carry out a monitoring program to provide more flow data sets for model calibration as the Town adds more sewer sheds in the coming years.

3.2.2 Wet Weather Calibration

The wet weather flow (WWF) calibration is based on the calibrated model and the recorded rainfall events. The available 2012 rain gauge data was reviewed to pick the most significant event for the WWF calibration.

Figure 3-4 Rain Gauge Data from CRD Northside Station



As shown in the above figure, July 15 -16, 2012 was the most significant event in the three years in terms of wet weather flow generation.

The WWF model was calibrated using the "Unit Hydrograph" method with a set of three triangular unit hydrographs (UH) to represent the fast-response, medium-response, and slow-response of the rainfall dependent inflow and infiltration (RDII). Each UH is represented by three parameters, R, T, and K, which are used to calculate the intensity, duration, and rate of recession

of the hydrograph. The major task in the WWF calibration is to estimate the values of these three parameters.

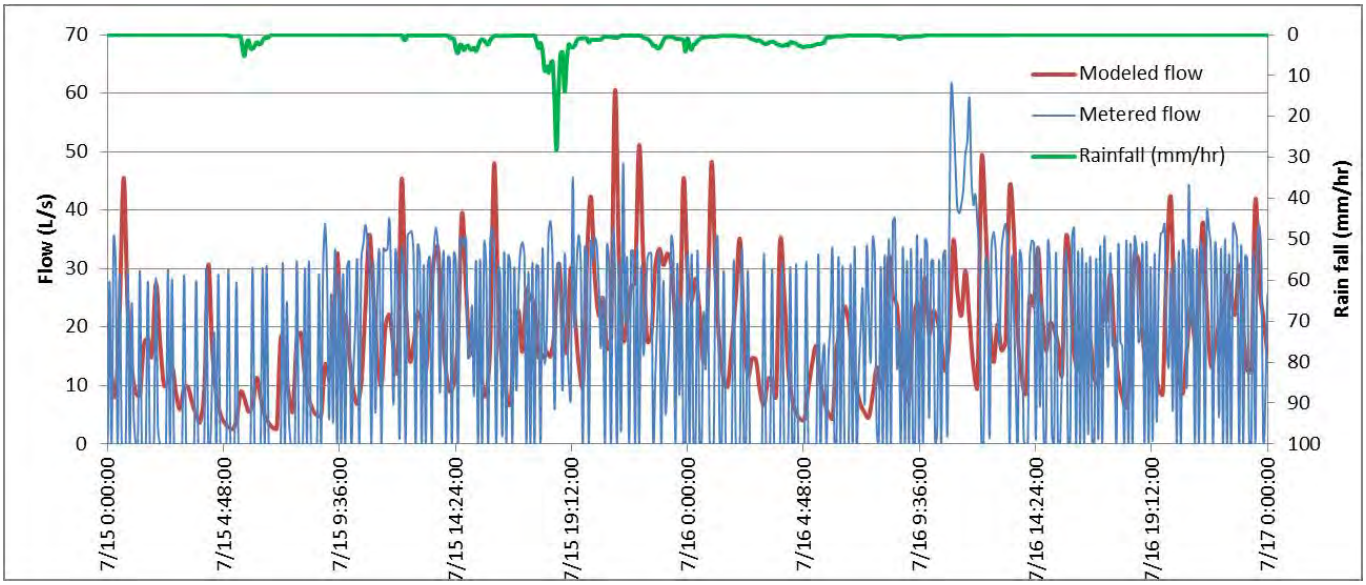
The calibrated DWF model and the rain gauge rainfall data were input into the model for RTK value estimations. Initial estimates were made by comparing the DWF and WWF total flows. Using the SRTC (Sensitivity-based Radio Tuning Calibration) function in the PCSWMM model to generate the hydrographs for visual comparison, the RTK values were estimated as follows:

Table 3-2 RTK Values in the WWF Model

Response	R	T	K
Fast	0.0006	0.4348	5
Medium	0.0011	2.6316	2.2
Slow	0.0012	10.9489	5.848

The modeled flows from the calibrated WWF model using the RTK values listed above are presented along with the metered flows and the rain gauge data in the following figure:

Figure 3-5 Wet Weather Flow Calibration Hydrograph



As seen from the hydrographs, the modeled flow generally followed the metered flow pattern with the modeled flow having slightly higher values overall.

It is not clear what caused the metered flow to be higher than the modeled value between 10 am and 12 am on July 16. One possible reason is that the rain gauge failed to catch and record all of the high rainfall in that period.

The statistics of the modeled flow and metered flow are presented in the following table:

Table 3-3 WWF Calibration Statistics

Flows	Modeled Data	Metered Data	Differential
Total flow (m^3/d)	3222.0	2970.0	7.82%
Max flow (l/s)	60.0	61.0	-1.67%
Mean flow (l/s)	18.5	17.1	7.57%
Min flow (l/s)	2.5	0	-

As shown in the hydrograph figure and the statistic table, the calibrated model overestimated the total flow and mean flow by approximately 7.5 - 7.8%, however the modeled peak flow is very close to the metered data. The estimated infiltration and inflow (I&I) is about 0.03 litres per second per hectare (l/s/ha) in this event, which is lower than the recommended service standard I&I allowance of 0.07 l/s/ha in the 2008 Mater Plan.

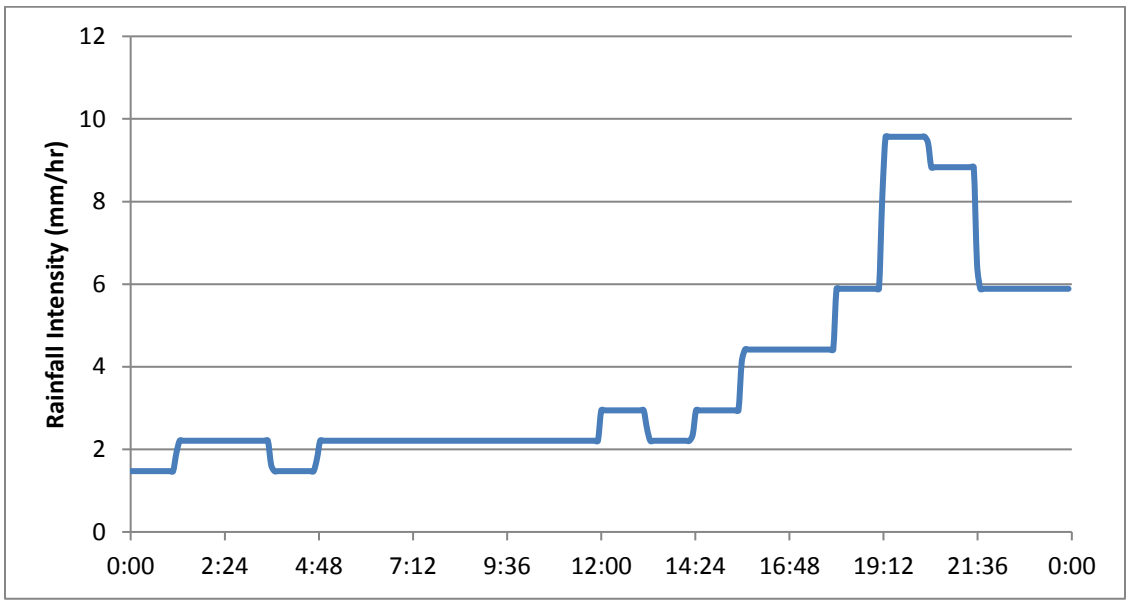
4.0 EXISTING SYSTEM EVALUATION

4.1 EVALUATION CRITERIA

4.1.1 Design Rainfall Event

A 4th quartile Huff 1 in 25 year design storm was selected as the design storm for the existing evaluation and future system design since it is commonly used in other municipalities' sewer system hydraulic models, e.g Calgary, Edmonton, Red Deer. It was chosen to provide a certain level of conservatism to the model results while keeping the sanitary system at a reasonable size. The start of the event was chosen to occur at 12:00 am to compare the peak RDII with the peak DWF in the diurnal curve.

Figure 4-1 Rainfall Hydrograph for 1:25 Year 24 Hour Huff Storm



This design storm was applied to the calibrated WWF model to evaluate the existing system performance based on the level of service criteria described in the following section.

4.1.2 Level of Service Criteria

The Level of Service Criteria are the acceptable service standards that do not cause adverse effects on the sanitary sewer system. Many municipalities adopt these criteria to service the developments within their boundaries while keeping construction and maintenance costs of the sewer system at a reasonable level.

Allowable Surcharge:

The maximum allowable surcharge hydraulic grade line (HGL) in the gravity portion of the wastewater sewer system must remain at least 2.5 m from the ground surface (at least 2.5 m of freeboard is required) during a design storm scenario.

Exceptions to this rule of thumb are:

- Proposed infrastructure is to be designed to have sufficient pipe capacity to carry peak flows without surcharging;
- Designing to maintain 2.5 m freeboard under peak flow conditions is not acceptable; and
- In shallow sewers that have less than 2.5 m cover, there should be no surcharge.

Lift Stations:

For existing lift stations the inflow hydrograph is compared to the pumping capacity of the lift station to identify potential capacity constraints that would not be identified by the surcharging criteria, due to the typical depth of lift station wet well structures.

Forcemains:

Existing forcemains are to be assessed and new forcemains to be sized to maintain a minimum velocity of 1.0 meter per second (m/s) or reach 1.0 m/s at least two times daily. Maximum forcemain velocities are not to exceed 3.0 m/s.

4.2 EXISTING SANITARY SYSTEM PERFORMANCE

The existing system with the design 1 in 25 year 24-hour Huff storm modeling results are presented in Figures 4.2 - 4.4. These figures show that the level of service criteria are met and no major issues are identified from the modeling results.

Township Road 400
Township Road 400
Highway 2A
Range Road 271A
Township Road 395A
Range Road 271
Township Road 395
Range Road 270
Range Road 265
N
Westbrooke Road
Broadway Avenue
NWLS
APLS
SSLS
BWLS
PNLS
LS1
Highway QE2
Highway 2 Service Road
Township Road 394
South Street
South Street
Township Road 394
Highway 597
Highway 597
Range Road 273

Legend

Existing Lift stations

Forcemains

Force Main

Municipal Boundary

Existing Pipe Max Flow (l/s)

<20
20-30
30-40
40-50
50-60
60-70
70-80
80-90
90-100
>100
Force Main

0 250 500 1,000 Meters

Project No.: 113929362

Completed By: BT
Date: Dec 2013

SaveDate: 11/25/2014 10:18:02 AM User: jke
V:\113\active\113929362-blkfds_ww_master_plan\05a_dwgs_func_dsgn\01_arcview\mxd\jke\2014huff-maxflow1.mxd

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Figure 4.2: Existing System Results Maximum Sewer Flows - Design Huff Storm

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Township Road 400
Range Road 272A
Township Road 400
Highway 2A
Range Road 271A
Township Road 395A
Range Road 271
Township Road 395
Range Road 270
N
Broadway Avenue
Westbrooke Road
NWLS
APLS
SSLS
BWLS
PNLS
LS1
Highway 2 Service Road
Highway QE2
Township Road 394
South Street
Highway 597
Range Road 273
Burbank Industrial Drive
Range Road 272A
Range Road 271A

Legend

- Existing Lift stations
- Municipal Boundary

Surcharge Pipes

- No
- Yes

Existing Junctions-Min Freeboard (m)

- <0.5
- 0.5-1.75
- 1.75-2.5
- >2.5
- Force Main

0 250 500 1,000 Meters

Completed By: BT
Date: Dec 2013

Project No.: 113929362

SaveDate: 2/13/2017 2:12:31 PM User: jke
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Figure 4.3: Existing System Results
Minimum Freeboard - Design Huff Storm
Wastewater Master Plan Update 2015
Town of Blackfalds

Stantec

Township Road 400
Range Road 272A
Township Road 400
Highway 2A
Range Road 271A
Township Road 395A
Range Road 271
Township Road 395
Range Road 270
N
Broadway Avenue
Westbrooke
Road
NWLS
Highway QE2
APLS
Highway 2 Service Road
Highway QE2
SSLS
Highway 2A
BWLS
PNLS
Township Road 394
Township Road 394
South Street
South Street
Township Road 394
Highway 597
LS1
Highway 2 Service Road
Range Road 273
Range Road 272A
Highway 597
Range Road 271A
Burbank
Industrial Drive

Legend

- Existing Lift stations
- Municipal Boundary

Forcemain

- Force Main

Existing Peak Pipe Utilization (%)

- <80%
- 80-100%
- 100-120%
- 120-200%
- >200%
- Force Main

0 250 500 1,000 Meters

Completed By: BT
Date: Dec 2013

Project No.: 113929362

SaveDate: 11/25/2014 10:23:04 AM User: jke
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Stantec

Figure 4.4: Existing System Results Peak Pipe Utilization - Design Huff Storm

Wastewater Master Plan Update2015

Town of Blackfalds

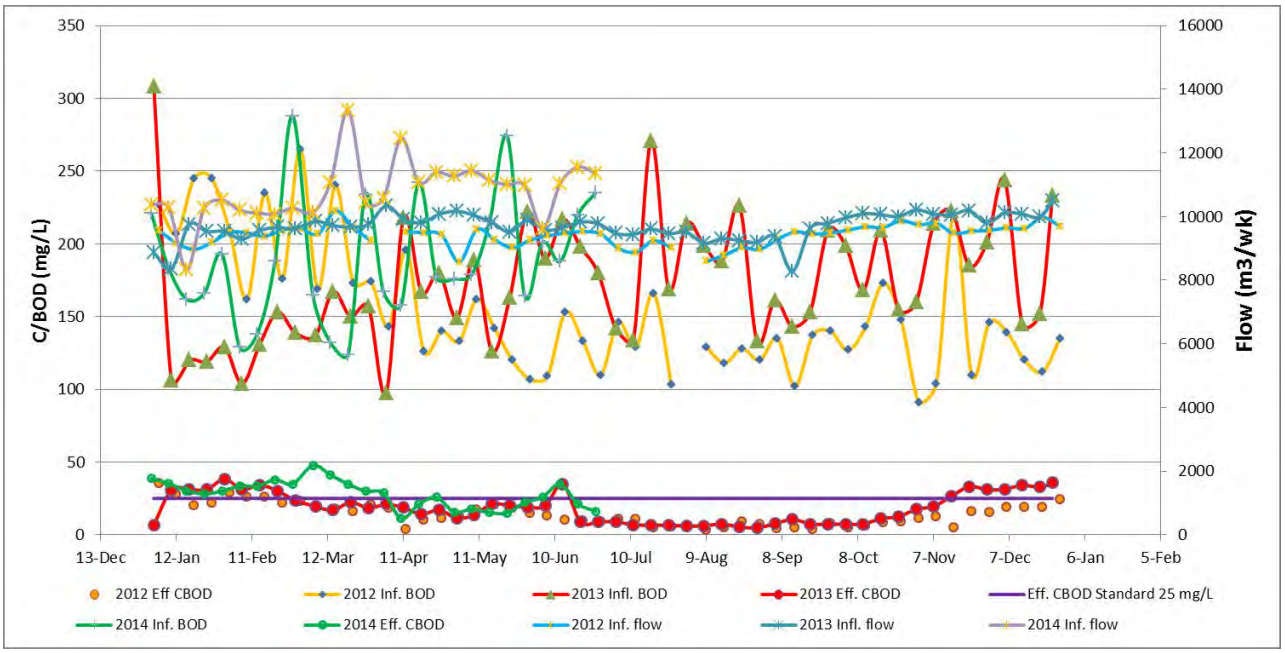
4.3 EXISTING TREATMENT SYSTEM PERFORMANCE

As required in the EPEA Approval, the treated effluent discharged from the lagoon system has to meet the monthly average CBOD standard of less than 25 mg/L. Currently, the effluent CBOD, total suspended solids (TSS) and pH are sampled weekly at the discharge lift station wet well.

4.3.1 Effluent Constituent Level

Figure 4-5 shows the influent biochemical oxygen demand (BOD) and effluent CBOD levels from 2012 to June 2014. The weekly influent flow rates are also plotted in the following figure.

Figure 4-5 Weekly Influent and Effluent C/BOD and Influent Flow Records



Several key observations from the figure are:

- The wastewater treatment facility (WWTF) has experienced difficulties in meeting the effluent monthly CBOD standard of 25 mg/L during the cold winter months. Low ambient temperature has a negative impact on the treatment efficiency, which is normal for a lagoon treatment system.
- In the warm weather months, the WWTF effluent meets the CBOD standard.
- The influent flow increases year by year. Compared to 2013, there was a significant flow increase in 2014 which can be attributed to the population growth .

- The seasonal fluctuation of the influent flow is not obvious with only a slight decline being observed during the summertime, Inflow and Infiltration is generally low within the Town.
- The majority of influent BOD fluctuates within the range of 100 - 300 mg/L and there is not a noticeable year by year BOD concentration increase.
- The increased BOD loading and the decreased retention time are the primary causes for the lower level of treatment and the elevated CBOD readings during the winter months.

To confirm the observations, the BOD loadings were calculated and presented in the following table:

Table 4-1 Influent Flow and BOD levels

Year	Flow (m^3/d)	BOD Loading (kg/d)	BOD Concentration (mg/L)
2014*	1540	291	189
2013	1385	241	174
2012	1343	207	154

Note: Data included to June 2014.

The composite per capita BOD loading is very low at 0.034 kilograms per capita per day (kg/cp/d) compared to other municipalities (e.g. Lacombe 0.091 kg/cp/d, Olds 0.084 kg/cp/d, Rocky Mountain House 0.086 kg/cp/d). It is recommended that the Town review the sampling protocol and collect grab samples to verify the BOD tests. In this study, a higher concentration of 250 mg/L was used as proposed by the treatment capacity assessment.

The influent flow in March 2014 was recorded to have an average daily flow of 1,607 cubic metres per day (m^3/day) with the worst CBOD level of 38 mg/L in the effluent. The hydraulic retention time (HRT) and the projected BOD from cells are presented in the following table:

Table 4-2 HRT And Projected Effluent BOD with 2014 March Flow

Cell #	Cell Name	Water Volume (m^3)	HRT (days)	Design HRT (days)	Projected Effl. BOD (mg/L)
1	Complete Mixing	5,448	3	2	176.3
2	Partial Mixing	16,643	26	28	87.6
3	Partial Mixing	25,878		-	34.0
4	Polishing Cell	2,393	1.5	5	34.0 [3]

Notes:
1. The influent BOD is assumed to be 250 mg/L.
2. The standard first order kinetic constant is set at 0.25 day^{-1} at 20°C for aerated lagoon cells. The average wastewater temperature in 2014 March is estimated at 0.5 °C.
3. The BOD in effluent from the polishing is assumed to be the same as at in the effluent from the partial mixing cell.

The above table shows that the polishing cell and the partially mixed aerated cells have exceeded their hydraulic capacities.

4.3.2 Aeration System

The aeration system consists of centrifuge blowers with coarse bubble diffusers, and positive displacement blowers with fine bubble diffusers. As per the original design calculation sheet the aeration system was sized for 817 kg BOD loading, which is sufficient for the estimated 402 kg BOD loading in 2014. However, since the hydraulic retention time in the cells is less than standard and the reaction kinetic is low, the BOD treatment is not fast enough to lower the BOD to the design level.

During a site visit to the lagoon in April 2014, Stantec identified that some of the laterals and diffusers in Cell 1 were off-set from the designed locations as shown in Figure 4-6. The loose tension cables on the on-shore anchor blocks could not keep the laterals in place, resulting in the misaligned laterals. Locations of the diffusers are very critical for the treatment process since it affects the mixing and dissolved oxygen (DO) distribution. After notification, Nelson Environmental had the issue fixed in May. It is recommended that the laterals be routinely examined and maintained before each winter to ensure they remain in their designed location.

Figure 4-6 Aeration Pipe Laterals in Cell 1

On June 3, 2014, Nelson Environmental conducted a DO measurement in the aeration cells; these the measurements are attached in Appendix D. The DO levels were higher than the 2.0 mg/L in Cells 1 and 3 (3a/3b) but were lower than 2.0 mg/L in Cell 2. Although the specific reasons that caused the low DO in Cell 2 could not be determined with the limited data, the possible causes are as follows:

- A slug of abnormally high BOD raw water entered the cell;
- Clogged diffusers lost efficiency; or
- The header leaking led to low cross membrane pressure and low oxygen transfer rate.

4.3.3 Polishing Cell

As presented in Table 2.5 the polishing cell has a high sludge deposit. The sludge, classified as being above 1% TSS, accounts for 44% of the design volume according to the sludge survey. Since the majority of the TSS is organic, live or dead bacteria from the upstream cells, endogenous bio-degradation occurs. As a result, when the ambient temperature is high and bacteria metabolism is active, carbon and nutrients are released from the cell. The release from the cell material leads to elevated BOD levels and excessive blooming of algae as shown in the following photo taken in June 2014.

Figure 4-7 Excessive Algae Growth in Polishing Cell

The excessive sludge in the polishing cell and the upstream cells was removed in the spring of 2015. The post removal sludge survey indicates that about 85% of the sludge in the lagoon cells has been removed from the lagoon cells.

5.0 FUTURE WASTEWATER SYSTEM

5.1 FUTURE SANITARY SYSTEM

5.1.1 Future Servicing Criteria

The Town's sanitary sewer system will expand into the planned development areas as more subdivisions are developed. Additional lift stations, forcemains and gravity sewer mains will be added to service these new subdivisions. Although the primary goal is to service the new areas with gravity sewer the "rolling" topography will dictate the need for lift stations in specific areas. The following principles should be followed when planning the future sanitary system:

1. The new subdivisions should be serviced by gravity sewer whenever reasonably possible;
2. The maximum depth for gravity mains should be approximately 8 - 9 m. Due to the many wetlands and high ground water table in the area, deeper gravity mains may not be recommended in some areas; and
3. Without a planned road network in some areas, the gravity trunks proposed in this study follow conceptual potential routes to maximize the area serviced by gravity trunks.

The future servicing criteria are listed as followed:

- The population density is 45 people/ha for the residential area;
- Average daily per capita wastewater generation rate is 320 L/cp/day;
- ICI average daily wastewater generation rate is 0.208 L/ha/s;
- Light industrial area water generation rate is 0.1 L/ha/s;
- The calibrated diurnal curve is adapted as the future diurnal curve;
- I&I allowance is 0.07 L/ha/s as per the 2008 master plan report;
- The new lift stations should have sufficient capacities higher than the influent peak flows;
- Forcemain maximum velocity is 3 m/s;
- Surcharge is not allowed in the new planned gravity sewers; and
- The LOS presented in Section 4.1.2 will remain for the existing sewer system.

5.1.2 Future Sewer Sheds

The available contours and DTM data were incorporated into the PCSWMM model to assist with the sewer shed delineation. The principles and assumptions of the sewer shed delineation are:

- All sewer pipes are to have a minimum of 2.7 m of buried depth;
- Grading work in future developments will level out the drastic terrain elevation changes;
- The future sewer system should be serviced by gravity sewer whenever reasonably possible;
- The future sewers should connect into the existing system further downstream whenever possible; and
- Residual capacity in the existing pipelines and lift stations should be considered for further connections.

The delineation resulted in 41 sewer sheds in the planned development areas within the Town boundaries. The proposed sewer shed boundaries are presented in Figure 5.1 and the details of the sewer shed are listed in the following Table 5-1:

Township Road 400
Range Road 272A
Township Road 400
Highway 2A
Range Road 271A
Township Road 395A
Range Road 271
Township Road 395
Range Road 270
Broadway Avenue
Westbrooke Road
Highway QE2
Highway 2 Service Road
Highway QE2
Township Road 394
Township Road 394
South Street
South Street
Township Road 394
Highway 597
Highway 2 Service Road
Range Road 273
Range Road 272A
Burbank Industrial Drive
Highway 597
Range Road 271A
Highway 2A

SS1
SS2
SS3
SS4
SS5
SS6
SS7a
SS7b
SS7c
SS8
SS9
SS10
SS11
SS12
SS13
SS14
SS15
SS16
SS17
SS19
SS20
SS21
SS22
SS23
SS24
SS25
SS26
SS27a
SS27b
SS28
SS29
SS30a
SS30b
SS30c
SS30d
SS31
SS32
SS33
SS34
SS35

N

Legend

- Existing Lift stations
- Existing Pipes (mm)
- Open Space
- Commercial
- Industrial
- Public
- Residential
- Municipal Boundary
- Future Sewershed Boundary

0 250 500 1,000 Meters

Completed By: BT
Date: Dec 2013

Project No.: 113929362

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Figure 5.1: Future Sanitary Sewershed

Table 5-1 Future Sewer Sheds within Town Boundaries

No.	Name	Area (Ha)	Residential Area (Ha)	Eq. ICI Area (Ha)	Design Population	Average Flow from Residential Area (L/s)	Average Flow from ICI Area (L/s)	Total Average Sanitary Flow (L/s)
1	SS1	51.0	10.2	29.1	459	1.70	6.05	7.75
2	SS2	62.3	6.2	31.8	280	1.04	6.61	7.64
3	SS3	17.0	0.0	7.0	0	0.00	1.45	1.45
4	SS4	7.9	6.3	0.3	284	1.05	0.07	1.12
5	SS5	11.0	8.8	0.2	395	1.46	0.05	1.51
6	SS6	17.6	0.0	17.6	0	0.00	3.66	3.66
7	SS7a	3.9	2.8	0.0	124	0.46	0.00	0.46
8	SS7b	5.3	5.3	0.0	238	0.88	0.00	0.88
9	SS7c	26.0	23.4	0.0	1051	3.89	0.00	3.89
10	SS8	10.7	4.3	6.4	192	0.71	1.33	2.04
11	SS9	13.9	0.0	13.9	0	0.00	2.88	2.88
12	SS10	15.5	15.5	0.0	698	2.58	0.00	2.58
13	SS11	10.2	10.2	0.0	459	1.70	0.00	1.70
14	SS12	22.6	0.0	22.6	0	0.00	4.71	4.71
15	SS13	17.2	12.0	5.2	541	2.01	1.07	3.08
16	SS16	13.7	13.7	0.0	618	2.29	0.00	2.29
17	SS14	10.0	0.0	10.0	0	0.00	2.07	2.07
18	SS15	16.0	0.0	16.0	0	0.00	3.33	3.33
19	SS17	55.0	33.0	16.5	1485	5.50	3.43	8.93
20	SS19	26.2	21.0	0.0	944	3.50	0.00	3.50
21	SS20	9.4	9.3	0.1	421	1.56	0.02	1.58
22	SS21	28.8	28.8	0.0	1296	4.80	0.00	4.80
23	SS22	10.5	9.5	1.1	427	1.58	0.22	1.80
24	SS23	25.0	5.0	16.0	225	0.83	3.33	4.16
25	SS24	18.9	0.0	18.9	0	0.00	3.92	3.92
26	SS25	2.1	2.1	0.0	93	0.34	0.00	0.34
27	SS26	38.1	19.0	19.0	857	3.17	3.96	7.13
28	SS27a	34.7	34.7	0.0	1561	5.78	0.00	5.78
29	SS27b	15.9	15.9	0.0	716	2.65	0.00	2.65
30	SS28	88.9	8.9	71.1	400	1.48	14.79	16.27
31	SS29	112.5	112.5	0.0	5062	18.75	0.00	18.75
32	SS30a	36.5	21.9	0.0	987	3.65	0.00	3.65
33	SS30b	53.1	37.2	0.0	1673	6.20	0.00	6.20
34	SS30c	44.2	35.4	0.0	1591	5.89	0.00	5.89
35	SS30d	61.8	55.7	0.0	2504	9.28	0.00	9.28
36	SS31	17.3	17.3	0.0	779	2.89	0.00	2.89
37	SS32	65.4	32.7	19.6	1471	5.45	4.08	9.53
38	SS33	40.9	12.3	0.0	552	2.05	0.00	2.05
39	SS34	23.5	0.0	18.8	0	0.00	3.90	3.90
40	SS35	59.0	0.0	22.4	0	0.00	4.66	4.66
41	SS36	11.1	11.1	0.0	500	1.85	0.00	1.85
Total		1210.6	641.9	363.4	28,883	107	76	183

Notes:

- The planned open space areas are excluded from the sanitary flow calculation;
- The low area between SS15 and SS16, which is the extension of the existing wetland, is assumed not developable; and
- The infill development areas are also included in the sewer shed calculation table.

The total population in Blackfalds will reach approximately 37,000 when all the developments present in the above table are fully built, which is equivalent to 32 years (2046) of growth at an annual growth of 5%.

5.1.3 Future Sanitary Sewer and Lift Stations

The proposed future sanitary sewer system and lift stations are presented in Figure 5-2. The proposed upgrades to the existing system, required to accommodate the future flows, are also presented in the figure. The required lift stations' capacities are presented in the following table:

Table 5-2 Lift Stations in Future Sanitary Sewer

NO.	Lift Station name	Forcemain[1]		Pump Capacity (firm)		Notes
		Dia (mm)	L (m)	Q (l/s)	TDH (m)[2]	
1	Briarwood (BWLS)	250	740	57	17	Existing
2	North West (NWLS) to Broadway Ave.	250	590	49	13	Existing
	North West (NWLS) to Westridge St.	150	150	44	13	Existing/alternative pumping route
3	Panorama(PNLS)	200	505	93	19	Existing
4	Stanley (SSLS)	250	360	75	11	Existing/Upgraded forcemain
5	Lift Station1(LS1) [3]	400	70	160	11	Becomes a surge lift station
6	Aurora Height (AHLS)	200	875	43	22	New
7	FLS1	200	1,300	36	30	New
8	FLS2	100	200	10	15	New
9	FLS3	200	700	45	28	New
10	FLS4	150	350	21	27	New
11	McKay (MKLS)	350	1,280	140	23	New
13	FLS5	200	700	15	19	New
14	FLS6	300	2,310	65	31	New
15	Aspelund (APLS) [4]	350	365	148	13	Existing, pumps upgraded.

Notes:

1. Forcemain sizes are preliminary at this planning stage. Diameters are internal diameters.
2. Required TDH are preliminary at this planning stage.
3. Lift station#1 will become the peak shaving lift station when the regional lift station is in place. The design peak flow that will go into the future regional lift station is 520 l/s.
4. Aspelund lift station is outside the Town's boundary and is listed here for reference only.
5. The lagoon effluent discharge lift station will be decommissioned once the regional lift station is constructed.

Figures 5-2 to 5-5 present the modeling results of the future sanitary sewer system.

Recommended Upgrades to the Existing System to allow for Future Expansion:

1. Plug the gravity to the north and install new 675 mm trunk.
2. Upgrade the 250 to 300 mm pipe.
3. Twin the gravity main in Boardway Av. to Stanly LS.
4. Upgrade the 150 mm portion of the forcemain to 250mm.
5. Replace the Indiana Street 300 mm sewer pipes. Upgrade the gravity sewers along Hwy 2A between Indiana St. and South St. to 300mm.
6. Construct new foremain for Panorama LS.

Township Road 400
Range Road 272A
Township Road 400
Highway 2A
Range Road 271A
Township Road 395A
Range Road 271
Township Road 395
Range Road 270
Broadway Avenue
Westbrooke Road
Highway QE2
Highway 2 Service Road
Highway QE2
Township Road 394
Township Road 394
Township Road 394
Highway 597
Highway 2 Service Road
Range Road 273
Range Road 272A
Highway 597
Range Road 271A
Burbank Industrial Drive
South Street
South Street

FLS1
FLS2
FLS3
FLS4
FLS5
FLS6
AHLS
AHS
APLS
BWLS
LS1
MKLS
PNLS
SSLS
WLS

1
2
3
4
5
6

N

Legend

- Existing Lift stations
- Future Lift Stations

Junctions Depth (m)

- <2.5
- 2.5-3.5
- 3.5-4.5
- >4.5

Sanitary Sewer Pipes (Dia.mm)

- 150
- 200
- 250
- 300
- 375
- 400
- 450
- 500
- 525
- 600
- 675
- 750
- Proposed Sewershed Boundary
- Municipal Boundary
- Force Main

0 250 500 1,000 Meters

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Completed By: BT
Date: Dec 2013

Project No.: 113929339

Figure 5.2: Future Sanitary System

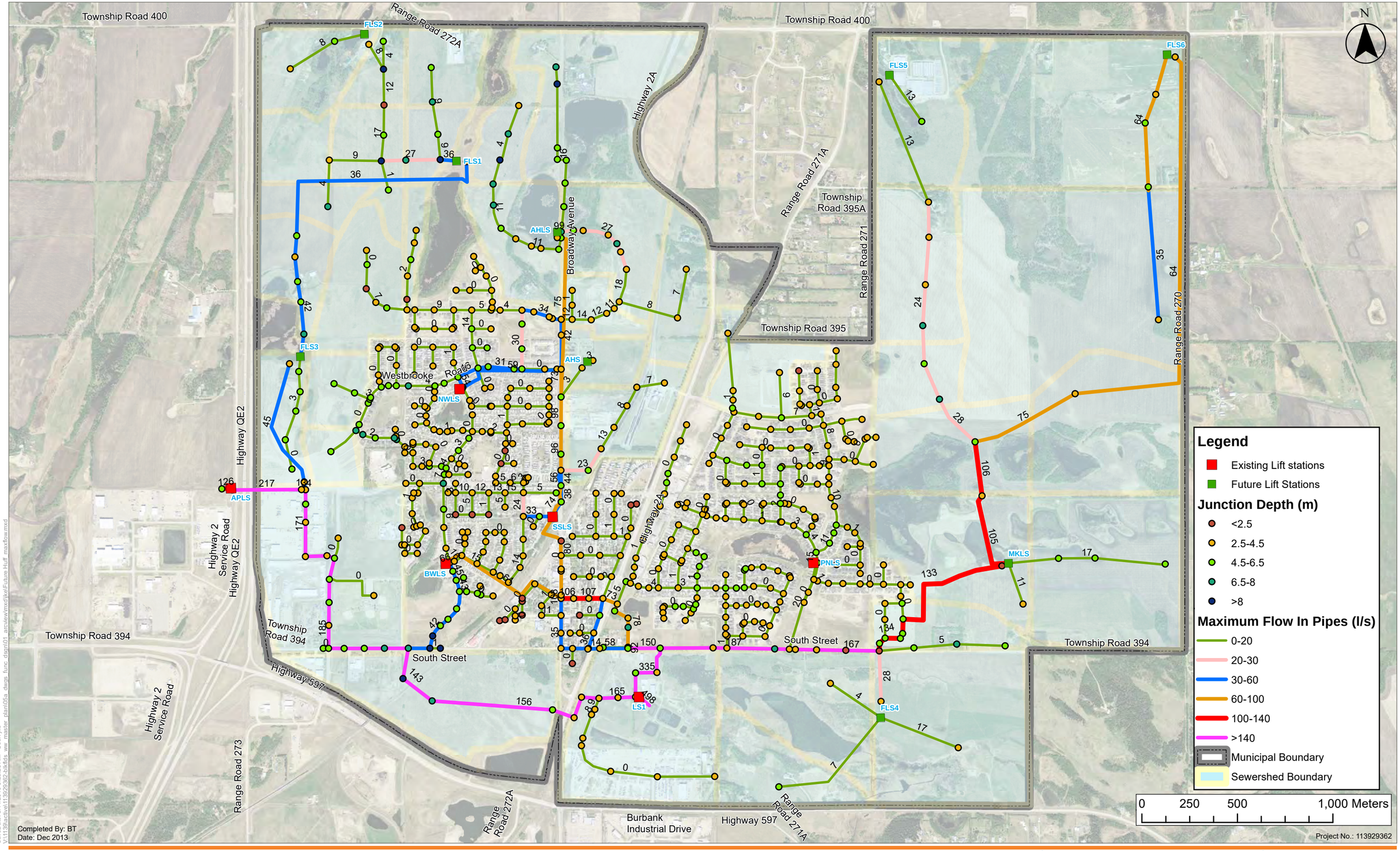

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Figure 5.3:Future Sanitary System Max Flow In Pipes

Wastewater Master Plan Update 2015

Town of Blackfalds

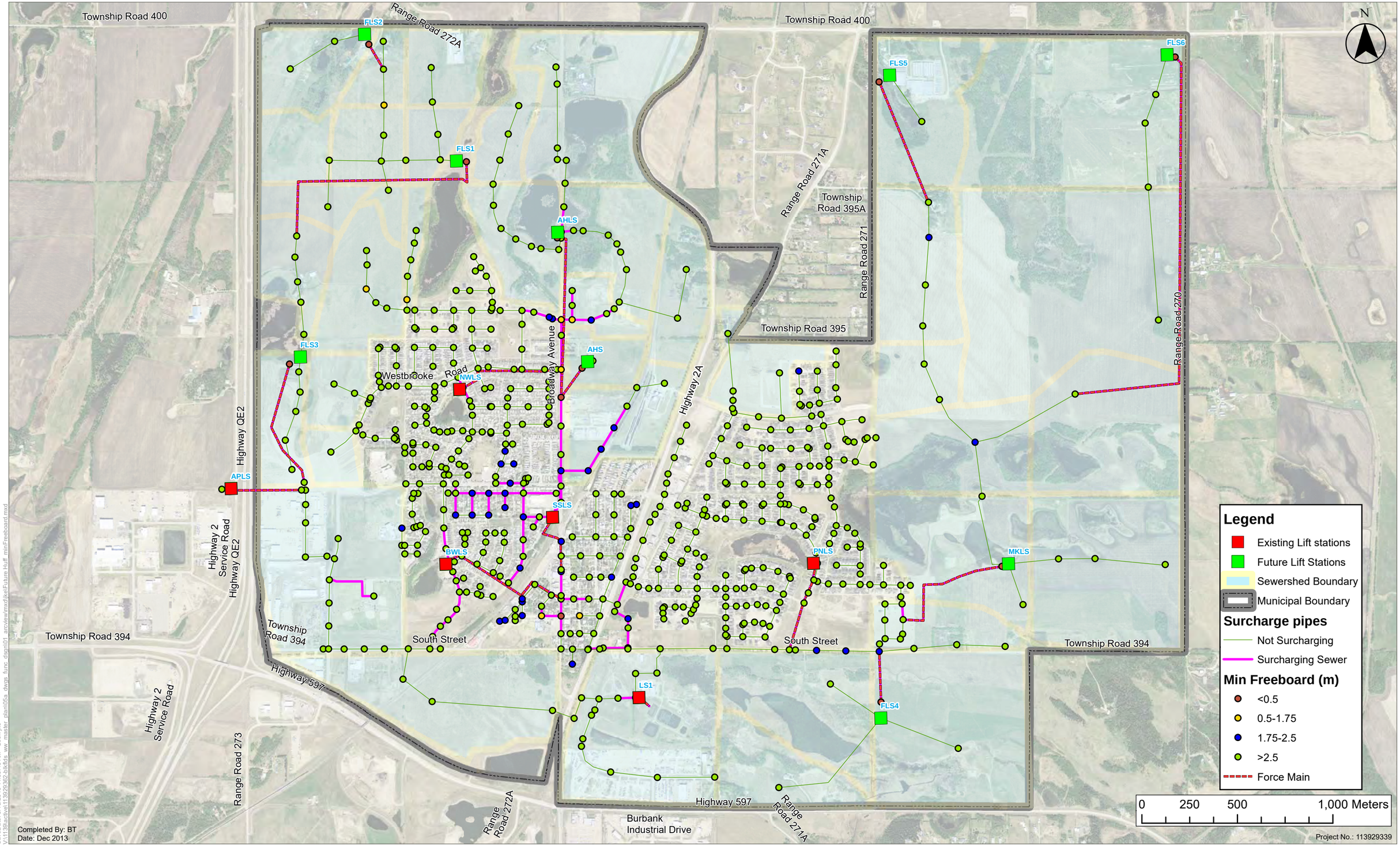

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Figure 5.4:Future Sanitary System Minimum Manhole Freeboard

Wastewater Master Plan Update 2015

Town of Blackfalds

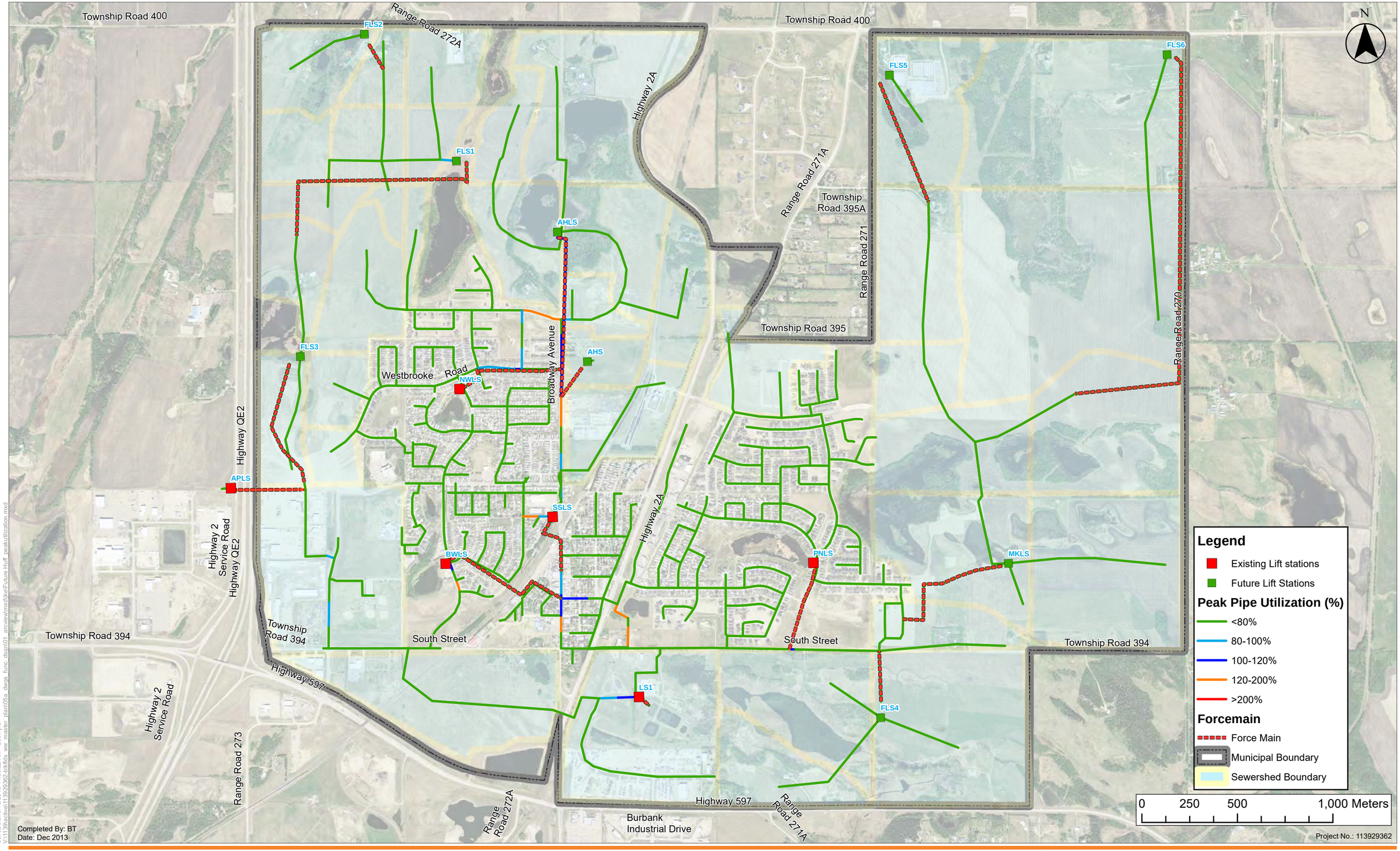

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Figure 5.5:Future Sanitary System Peak Pipe Utilization

Wastewater Master Plan Update 2015

Town of Blackfalds

5.2 SHORT-TERM TREATMENT OPTIONS

5.2.1 Short-Term Flow Projection

Before the Town joins the North Red Deer Regional Wastewater Commission (NRDRWWC) regional line, another interim expansion of the existing lagoon system is required to accommodate the rapid short-term growth in the Town. However, the existing lagoon will be taken off line and converted to peak shaving storage, and the associated treatment equipment will also be abandoned at that time. Therefore high capital upgrades to accommodate the short-term capacity are unfavorable. Therefore, it is necessary to investigate less costly short-term alternatives.

A 5-year design horizon was selected as the short-term plan to allow sufficient time for the regionalization plan to be implemented. The projected maximum monthly flow and the corresponding HRTs in the cells are presented in the following table:

Table 5-3 Maximum Monthly Flow and HRT's Projections

Year	Max Month Flow (m^3/d)	HRT in Complete Mixing Cell (day)	HRT in Partial Mixing Cells (day)	HRT in Polishing Cell (day)
2011	1507	3.6	28.2	1.6
2012	1454	3.7	29.2	1.6
2013	1476	3.7	28.8	1.6
2014	1707	3.2	24.9	1.4
2015	1768 [1]	3.0	23.7	1.3
2016	1882	2.9	22.6	1.3
2017	1976	2.8	21.5	1.2
2018	2074	2.6	20.5	1.2
2019	2178	2.5	19.5	1.1

Notes:
1. 2011-2015 max month flow data are calculated from the annual reports as per the flow records in the LS1.

As shown in the above table, the HRT in the partial mixing and polishing cell will be lower than the design HRT. If no interim upgrades are implemented to increase the treatment capacity the projected maximum effluent BOD level will reach 40-45 mg/L in cold winter weather, which is very high compared to the Approval effluent CBOD standard of 25 mg/L.

A possible solution is the addition of more reactor volume so that the HRT stays within the Alberta guidelines; however the existing lagoon site is limited in space for the necessary expansion. Furthermore, the lagoon system will be abandoned when the regional line is in place thus making the expansion a large throw away cost and not recommended. The focus when finding a solution was to either lower the influent loading or polishing the effluent to meet the Approval

standard. After a preliminary analysis, three options were selected as the most viable upgrade possibilities to the wastewater system and are described in more detail in the following sections.

5.2.2 In-Pipe Treatment

The Town of Olds also experienced a similar situation to the one that the Town of Blackfalds is currently facing: waiting for the regionalization pipeline when the Town's treatment facility needs a capacity upgrade. The Town of Olds selected the In-Pipe Treatment technology as a short-term solution to their system.

The In-Pipe treatment solution introduced bacteria found in the biological treatment process into the Town of Olds sanitary sewer and transformed the sewer system into a large bioreactor. The 20 battery-powered IPT dosing panels (12X12X6") installed in the sanitary manholes or lift stations throughout the Town injected the bacteria- rich solution into the system to form biofilm in the pipelines for pre-treatment. A station installed in a manhole is presented in the following figure for reference.

Figure 5-6 In-Pipe Dosing Station in a Manhole

The bioaugmentation process helped reduce the BOD and TSS loading to the WWTF and changed their compositions. The 2010 performance report on the Olds In-Pipe treatment recorded a 20% reduction in BOD and a 20% reduction in TSS in the influent stream. The In-Pipe treatment process could potentially reduce influent BOD to as low as 40% of the original in other systems.

For the Town of Blackfalds, In-Pipe technology with 10 dosing panels would cost approximately $4,000 per month. The scope of service includes:

- Select the locations of the dosing panels in the sanitary system;
- Supply, install and maintain the dosing panels;

- Supply the bacteria rich solutions for the dosing; and
- Review and report performances of the treatment process.

The service contract of the In-Pipe technology is normally signed for one year. More details on the In-Pipe treatment proposal and the background information are attached as Appendix **E**.

The In-Pipe treatment technology can be considered as only a very short-term (less than 1 year when the weather is not in favorite) solution due to the limited cell volume in the existing lagoon system. Although the In-Pipe pre-treatment can lower the influent TSS and BOD strength, the total loadings will increase because of the increasing population and flow. Currently there is no data from previous work that demonstrates that In-Pipe technology can improve the biological treatment process in an aeration lagoon system.

The treatment modeling predicts that even with the 20% influent BOD reduction, the lagoon system cannot treat the projected 2014 maximum month flow. However, if the reduction reaches a higher level of 40%, the 2014 maximum month flow can be treated to the 25 mg/L BOD limit.

5.2.3 SAGR Polishing Cell

The Submerged Attached Growth Reactor (SAGR) is a possible solution to polish the effluent to meet AEP Approval standards. The SAGR is an attached growth process that utilizes the submerged rock beds with aeration to increase the microorganisms' population to increase the speed of the biochemical reactions in wastewater treatment. Nelson Environmental has constructed some successful SAGR cells in Canada to date. The system is normally used to polish the effluent to obtain low BOD, TSS and ammonia effluent from the lagoon treatment system in cold climates which is applicable in this case. A typical SAGR system is presented in following figure.

Figure 5-7 A SAGR System in Construction

The design criteria of the SAGR polishing cell for the Town of Blackfalds are:

- SAGR influent BOD: 60 mg/L;
- Design water temperature: 0.5 ◦C;
- Design flow : 2,133 m^3/day (2019 maximum winter month flow); and
- Effluent CBOD: <25 mg/L.

A vertical flow SAGR polishing cell is proposed for the Blackfalds lagoon system. The proposed polishing cell will require a 4,800 m^3 SAGR cell constructed in the north area of the existing cell. The opinion of the probable costs of the SAGR polishing cell is presented in the following table:

Table 5-4 Opinion of Probable Costs for SAGR Polishing Cell Construction

Work Item	Units	Quantities	Unit Cost	Cost
A. Civil works				
Common excavation and fill	m^3	3,000	$12	$36,000
External and internal walls	m^2	500	$360	$180,000
HDPE Liner	m^2	2,092	$14	$29,288
Gravel supply and installation	m^3	4,500	$35	$157,500
Geotextile	m^2	2,092	$2	$4,184
Mulch for Insulation	m^2	1,600	$6	$9,600
Man Holes	EA	4	$4,000	$16,000
Inlet Structure	EA	1	$30,000	$30,000
Inter-cell piping	L.m	100	$65	$6,500
Recycle pumps	LS	2	$20,000	$40,000
Subtotal A				$509,072
B. Process	LS	1	$996,970	$996,970
Blowers (2X60HP)	Incl.			
Aeration piping	Incl.			
SAGR internal piping	Incl.			
SAGR distribution/collection piping	Incl.			
Commission and training	Incl.			
Subtotal B				$996,970
C. Electrical work				$300,000
Subtotal A+B+C				$1,806,042
Engineering and contingency		35%		$632,115
Total costs				$2,438,157

Notes:
- Costs are presented in 2015 and a USD to CAD exchange rate of 1.3.
- Proposed cell location has a low elevation and cell construction requires import material for berm construction.
- Electrical service needs expansion to accommodate the two 60 HP blowers for the SAGR process.

The proposed SAGR system for the Town of Blackfalds is attached in Appendix **F**.

5.2.4 Bio-Dome Polishing Cell

Wastewater Compliance System (WCS) Inc. developed the Bio-Dome technology as a modular, expandable wastewater polishing treatment process. The Bio-Dome process essentially utilizes the same attached growth process as the SAGR technology does, however Bio-Dome uses the 'Dome' (ABS plastic skinned dome) and the plastic growth medium packed inside and between the dome layers to allow the bacteria to grow and function when the Bio-Dome is submerged in the lagoon cell. Linear fine bubble diffusers introduce the oxygen into the Bio-Dome to support the treatment process. The Bio-Dome has a standard size of 1.8 meters in diameter and a total height of 1.5 m as shown in the following figure:

Figure 5-8 Bio-Dome Photo and Cross Section

The design criteria of the Bio-Dome polishing process for the Town of Blackfalds are:

- Influent BOD: 60 mg/L;
- Design water temperature: 0.5 ◦C;
- Design flow : 2,133 m^3/day (2019 maximum winter month flow); and
- Effluent CBOD: < 25 mg/L.

The above design criteria require 32 Bio-Domes with each dome enclosing 263.84 m^2 growth area. The 32 Bio-Domes can be deployed in the existing polishing cell to convert the cell into an aerated polishing reactor. The sludge depth in the cell should be less than 250 mm to allow the water to enter the Bio-Dome from the bottom of the dome.

The opinion of the probable costs of the Bio-Dome system installation is presented in the following table:

Table 5-5 Opinion of Probable Costs for BioDome System Installation

Work Item	Units	Quantities	Unit Cost	Cost
A. Bio-Dome				
Supply 32 Bio-Domes	LS	1	$173,888	$173,888
Bio-Dome Installation	LS	1	$19,500	$19,500
Subtotal A				$193,388
B. Aeration system Supply/Installation				
Blower (2X2 HP)	LS	1	$104,000	$104,000
Air piping supply and installation	Incl.	1		
Commission and training	Incl.	1		
Subtotal B				$104,000
C. Electrical work				$80,000
Subtotal A+B+C				$377,388
Engineering and contingency		35%		$132,086
Total costs				$509,474

- Costs are presented in 2015 Canadian Dollars and a USD to CAD exchange rate of 1.3.

The proposed system for the Blackfalds is presented as Appendix **G**.

5.3 REGIONALIZATION

The NRDRWWC will collect wastewater from the City of Lacombe and the Town of Blackfalds and convey it to the City of Red Deer sewer gravity trunks at the intersection of Hwy 2A and Hwy 11A. The NRDRWWC is currently in the initial design and construction stages and the construction is anticipated to finish this year with the full NRDRWWC system being operational in approximately 2-3 years depending on available funding.

In the Blackfalds Interim Lift Station (LS1) preliminary design report, LS1 will become the surge lift station. The design flow of 520 L/s presented in Table 5.2 is the design peak flow from the Town to the future regional lift station located in Blackfalds. The Regional Lift Station will be located in close proximity to the existing LS1 and lagoon Cell 1. The NRDRWWS forcemain from the Lacombe Regional lift station will connect to the proposed future Blackfalds Regional lift station.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 SANITARY SEWER SYSTEM

A PCSWMM sanitary model has been built to simulate the hydraulic performance of the existing sanitary sewer system in the Town. The model was calibrated with the water billing records, rain gauge data and the metered flow in LS1. The PCSWMM model does not identify capacity issues in the existing system.

As development proceeds, the sanitary system will be extended to the planned development areas to serve the future needs and the Town will have to upgrade several portions of the existing sanitary system to accommodate the additional flows from these future developments. With the presence of several wetlands throughout the Town, a high water table and deep sand layers, the long-term sanitary system will require 14 lift stations to serve the developments within the current Town boundaries. With 14 lift stations, the operational costs of the sanitary system will be high due to the high energy costs and physical maintenance of the numerous lift stations. In an attempt to minimize the operational and maintenance costs of the sanitary system, it is recommended that the Town focus on optimizing the existing lift station operations and design future lift stations with operational and maintenance costs in mind.

Recommendations for the sanitary system design and operation are as follows:

- Although the current calibration results are generally acceptable, future model calibrations will need additional calibration points and local rain gauge data to increase accuracy as the sanitary system continues to grow.

- Several future monitoring stations should be installed in the last manhole before the existing lift stations to record flow volumes. The Town can utilize the monitoring data collected from these stations for future model calibrations, and can also use the peak flows to adjust the pump speeds to lower energy costs. A typical three monitoring station program for three months will cost about $18,000 (2015 cost).

- The Town should continue to focus on optimizing the existing lift station operations and design future lift stations with operational and maintenance costs in mind. If the monitoring program data show the peak flow going into the lift station is lower than the design capacity, the running speed of the pumps can be reduced. Pumps run at low speed consume less energy and reduce the hardware wearing.

6.2 WASTEWATER TREATMENT

Due to the shorter than typical hydraulic retention time in the lagoon cell and low reaction kinetics in cold weather days, the lagoon system experienced difficulties in meeting the 25 mg/L CBOD standard over previous winter seasons. The removal of the sludge in the polishing cell was

finished in June 2015. The removal of the sludge, combined with the warm winter effects, the effluent CBOD levels were within the Approval level in 2015-2016 winter.

The expected rapid population growth in the coming years will add additional loadings and decrease the hydraulic retention time in the cells even more. The effluent quality will continue to deteriorate if the Town does not increase treatment capacity.

Conversely, regionalization that will divert wastewater to the Red Deer WWTP renders a major capital expansion or upgrade to the WWTF uneconomical. This study therefore focuses on short-term solutions in order to increase the treatment capacity. Three technologies, all which have successful applications across North America, have been identified as potential solutions:

- In-Pipe treatment to lower the loadings in the influent;
- SAGR as the polishing process; and
- Bio-Dome as another polishing process.

Based on the study findings and discussions in Sections 4.3 and 5.2, recommendations for the WWTF treatment improvements are as follows:

- The aeration piping and accessories should be checked routinely to ensure the laterals and diffusers are in their design locations. Potential issues such as loose tension cables should be fixed before winter months;
- Install the In-Pipe treatment technology to lower the influent loadings in 2017/18; and,
- Consider to install the Bio-Dome system/SAGR to polish the effluent in 2017/18 if the NRDRWWC project is not completed.

Appendix A EPEA APPROVAL 425-02-00

Alberta
ENVIRONMENT

APPROVAL

PROVINCE OF ALBERTA

ENVIRONMENTAL PROTECTION AND ENHANCEMENT ACT
R.S.A. 2000, c.E-12, as amended.

APPROVAL NO. 425-02-00

APPLICATION NO. 012-425

EFFECTIVE DATE: July 2, 2009

EXPIRY DATE: June 30, 2019

APPROVAL HOLDER Mayor

Town of Blackfalds

ACTIVITY: Construction, operation and reclamation of a wastewater system

for the Town of Blackfalds.

is subject to the attached terms and conditions.

Designated Director under the Act

Date Signed June 30, 2009

TERMS AND CONDITIONS ATTACHED TO APPROVAL

PART 1: DEFINITIONS

SECTION 1.1: DEFINITIONS

1.1.1 All definitions from the Act and the regulations apply except where expressly defined in this approval.

1.1.2 In all PARTS of this approval:

(a) "Act" means the *Environmental Protection and Enhancement Act*, R.S.A. 2000, c.E-12, as amended;

(b) "application" means the written submissions to the Director in respect of application number 012-425 and any subsequent applications for amendments of approval number 425-02-00;

(c) "approved laboratory" means laboratory accredited to the requirements of ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories,* for the wastewater tests methods specified by the Director;

(d) "arithmetic mean" means the sum of all the sample analysis results divided by the total number of samples per reporting period;

(e) "BOD_5" means the Biochemical Oxygen Demand in milligrams per litre measured at 20°C over a 5 day period;

(f) "CBOD" means the carbonaceous BOD_5 in milligrams per litre which is measured after the nitrogenous demand has been inhibited with an inhibitory chemical;

(g) chemical" means any substance that is added or used as part of the treatment process;

(h) "composite sample" means a composite of samples of the stream collected over a 24 hour period, which is representative of the stream sampled, collected every 15 minutes in a quantity proportional to the flow rate of the stream;

(i) "continuous monitoring" means sampling or flow measurement through equipment that creates an uninterrupted output of the analysis or flow measurement;

(j) "day" means calendar day;

TERMS AND CONDITIONS ATTACHED TO APPROVAL

(k) "Director" means an employee of the Government of Alberta designated as a Director under the Act;

(l) "geometric mean" means the calculated n^{th} root of the product of all the sample analyses within the reporting period, where n equals the total number of samples within the reporting period, as follows;

Geometric Mean: $\sqrt[n]{S_1 x S_2 x S_3 x ... x S_n)}$

where,
n = the total number of samples within the reporting period
S_1 = the 1st sample analysis value
S_n = the nth sample analysis value

(m) "grab sample" means an individual sample collected in less than 30 minutes and which is representative of the substance sampled;

(n) "regulations" means the regulations issued pursuant to the Act and as amended;

(o) "TSS" means the total suspended solids or non-filterable residue (NFR) measured in milligrams per litre;

(p) "uncommitted hydraulic reserve capacity" means the design capacity of the wastewater treatment plant minus the sum of the peak daily flow and the peak daily flow that would be used by development that is approved but not yet built;

(q) "wastewater treatment plant" means the physical components of the wastewater system that are used to treat wastewater including components associated with the management of any wastes generated during treatment and includes the land located within the NW ¼ of Section 23 Township 39 Range 27, West of the 4th Meridian, that is being or has been used or held for or in connection with the wastewater treatment plant;

(r) "week" means calendar week; and

(s) "year" means calendar year.

TERMS AND CONDITIONS ATTACHED TO APPROVAL

PART 2: GENERAL

SECTION 2.1: GENERAL

2.1.1 The approval holder shall immediately report by telephone any contravention of the terms and conditions of this approval to the Director at 1-780-422-4505.

2.1.2 In addition to reporting pursuant to 2.1.1, the approval holder shall submit, within 7 days from any contravention of the terms and conditions of this approval, a written report to the Director.

2.1.3 The terms and conditions of this approval are severable. If any term or condition of this approval or the application of any term or condition is held invalid, the application of such term or condition to other circumstances and the remainder of this approval shall not be affected thereby.

2.1.4 *Environmental Protection and Enhancement Act* Approval No. 425-01-00 is cancelled.

SECTION 2.2: RECORD KEEPING

2.2.1 The approval holder shall record and retain all the following information in respect of any sampling conducted or analyses performed for a minimum of three years:

(a) the place, date and time of sampling;

(b) the dates the analyses were performed;

(c) the analytical techniques, methods or procedures used in the analyses;

(d) the names of the persons who collected and analyzed each sample; and

(e) the results of the analyses.

SECTION 2.3: ANALYTICAL REQUIREMENTS

2.3.1 Collection, preservation, storage, handling and analysis of samples, and reporting shall be conducted in accordance with the following:

(a) the *Standard Methods for the Examination of Water and Wastewater* published jointly by the American Public Health Association, American Water Works Association, and the Water Environment Federation, as amended; or

(b) a method authorized in writing by the Director.

TERMS AND CONDITIONS ATTACHED TO APPROVAL

2.3.2 Effective July 1, 2011, the approval holder shall analyze all samples that are required to be obtained by this approval in an approved laboratory, or unless otherwise authorized in writing by the Director.

2.3.3 The term sample as used in clause 2.3.2 does not include samples directed to continuous monitoring equipment, until specifically required in writing by the Director.

2.3.4 The approval holder shall comply with the terms and conditions of any written authorization issued by the Director under 2.3.2.

PART 3: CONSTRUCTION AND UPGRADING REQUIREMENTS

Not used this time

PART 4: OPERATIONS

SECTION 4.1: DRAINAGE SYSTEMS

WASTEWATER COLLECTION AND TREATMENT

4.1.1 The approval holder shall not release any substances from the wastewater system to the surrounding watershed except as authorized by this approval.

4.1.2 The approval holder shall operate a wastewater system which shall include:

(a) a wastewater collection system; and

(b) an aerated lagoon facility which includes all of the following:

(i) one (1) complete mix cell,

(ii) two (2) partially mix cells,

(iii) one (1) polishing cell, and

(iv) treated wastewater outfall discharging directly to the Red Deer River located in the NE 13-39-27-W4M.

SECTION 4.2: CERTIFIED OPERATOR REQUIREMENTS

4.2.1 At all times, the operation of the:

(a) wastewater treatment plant shall be performed by, or under the direction of a person who holds a valid wastewater treatment certificate of qualification at a minimum of Level I Wastewater Treatment (WWT) Operator; and

TERMS AND CONDITIONS ATTACHED TO APPROVAL

(b) the wastewater collection system shall be performed by, or under the direction of a person who holds a valid wastewater collection certificate of qualification at a minimum of Level II Wastewater Collection (WWC) Operator.

SECTION 4.3: SLUDGE DISPOSAL

4.3.1 The approval holder shall only dispose of sludge at a registered or approved landfill, or as otherwise authorized in writing by the Director.

SECTION 4.4: CHEMICALS USED

4.4.1 The approval holder shall not use any chemicals in the wastewater treatment process unless authorized in writing by the Director.

SECTION 4.5: IRRIGATION

4.4.1 The approval holder shall only dispose of treated wastewater by irrigation in accordance with the *Guidelines for Municipal Wastewater Irrigation*, as amended, or as otherwise authorized in writing by the Director.

PART 5: LIMITS

SECTION 5.1: WASTEWATER

5.1.1 The approval holder shall ensure that the treated wastewater discharge from the wastewater storage cell(s) complies with the limits specified in TABLE 5-1.

TABLE 5-1 LIMITS

Parameters	Limit
CBOD	$\leq$ 25 mg/L monthly arithmetic mean of weekly samples

5.1.2 Treated wastewater from the wastewater storage cell(s) shall be discharged, from the outfall, as follows:

(a) continuously to Red Deer River.

PART 6: MONITORING AND REPORTING

SECTION 6.1: WASTEWATER

6.1.1 The approval holder shall monitor the wastewater system as required in TABLE 6-1.

TERMS AND CONDITIONS ATTACHED TO APPROVAL

TABLE 6-1: MONITORING

Parameter	Frequency (Minimum)	Sample Type	Sampling Location
UNTREATED WASTEWATER			
BOD_5	Weekly	Grab (interim); Composite (by Dec 31, 2010)	Untreated wastewater entering the wastewater treatment plant.
TSS	Weekly	Grab (interim); Composite (by Dec 31, 2010)	Untreated wastewater entering the wastewater treatment plant.
Volume of flow	Continuous, recorded daily (by Dec 31, 2010)	Estimated (interim); Calculated (by Dec 31, 2010)	Untreated wastewater entering the wastewater treatment plant.
TREATED WASTEWATER (MECHANICAL TREATMENT PLANT/IRRIGATION)			
CBOD	Weekly	Grab	Treated wastewater being discharged
TSS	Weekly	Grab	Treated wastewater being discharged
UNAUTHORIZED RELEASES			
Release Volume	Total Volume	Estimated	Wastewater bypassing the wastewater treatment plant, accidental spills or overflows.
Release Volume	Total Volume	Estimated	Wastewater bypassing the lift station(s), accidental spills or overflows.
Release Volume	Total Volume	Estimated	Wastewater bypasses, accidental spills or overflows from the wastewater collection system.
BOD_5, TSS, Phosphorus, and Ammonia-Nitrogen	During the unauthorized discharge	Grab	At the release point.
SLUDGE DISPOSAL			
Sludge Volume	Total Volume	Estimated	Amount of sludge being trucked to a registered or approved landfill or as otherwise authorized in writing by the Director

GROUNDWATER MONITORING PROGRAM

6.1.2 The approval holder shall maintain the two groundwater monitoring wells located in NW 23-39-27-W4. Monitoring may be required as requested by the Director.

MONTHLY WASTEWATER REPORT

TERMS AND CONDITIONS ATTACHED TO APPROVAL

6.1.3 The approval holder shall compile a Monthly Wastewater Report which shall include the following:

(a) the values of each parameter monitored, as outlined in TABLE 6-1;

(b) the name of the supervising operator responsible for the operation of the wastewater system;

(c) a summary of any incidents which required reporting in accordance with 2.1.1; and

(d) a summary of any operational problems.

6.1.4 Submission of the Monthly Wastewater Report is not required unless notified in writing by the Director.

ANNUAL WASTEWATER REPORT

6.1.5 The approval holder shall compile an Annual Wastewater Report which shall include the following:

(a) the values of each parameter monitored, as outlined in TABLE 6-1;

(b) the analytical results, and recommendations, if any, of the **GROUNDWATER MONITORING PROGRAM**;

(c) the name of the supervising operator responsible for the operation of the wastewater system;

(d) a summary of any incidents which required reporting in accordance with 2.1.1;

(e) a calculation of the uncommitted hydraulic reserve capacity for the wastewater treatment plant; and

(f) a summary of any operational problems.

6.1.6 The approval holder shall submit one copy of the Annual Wastewater Report to the Director on or before February 28 of the year following the year in which the information on which the report is based was collected.

6.1.7 If the approval holder monitors for any substances or parameters which are the subject of operational limits as set out in this approval more frequently than is required and using procedures authorized in this approval, then the approval holder shall provide the results of such monitoring as an addendum to the Annual Wastewater report required by this approval.

TERMS AND CONDITIONS ATTACHED TO APPROVAL

PART 7: RECLAMATION AND DECOMMISSIONING

SECTION 7.1: GENERAL

7.1.1 Within six months of the wastewater treatment plant permanently ceasing operation, the approval holder shall:

(a) submit a decommissioning and land reclamation plan to the Director; and

(b) not commence reclamation or decommissioning until the approval holder has received written authorization from the Director.

DATED June 30, 2009

DESIGNATED DIRECTOR UNDER THE ACT

Appendix B BLACKFALDS LAGOON DISCHARGE LIFT STATION UPGRADES TECHNICAL MEMORADUM

Stantec

Memo

To:	Preston Weran Town of Blackfalds	From:	Johnny Qingsheng Ke Stantec (Red Deer)
File:	113929362.07	Date:	April 14, 2014

Reference: Blackfalds Lagoon Discharge Lift Station Upgrades

This tech memo presents the issues and the proposed upgrades for the Lagoon Discharge lift station in the town of Blackfalds.

Background

The Town of Blackfalds (the Town) Lagoon Discharge Lift Station (the Lift Station) was constructed and commissioned in 1975. As the effluent discharge infrastructure, the lift station conveys the treated wastewater from the last cell of the aerated lagoon to the Red Deer River. The Lift Station consists of a concrete vault containing an overflow weir and a 10HP submersible pump. The above ground control panel for the pump is installed adjacent to the concrete vault. The pump discharges to the 2 km long, 200 mm diameter Asbestos Cement (AC) forcemain and 1km long 250 mm diameter gravity pipe.

Operational Issues

After 39 years of service, there are several items to address relate to the lift station operation:

1. The lift station is equipped with only one submersible pump. There is no on-site standby capacity. When the pump is out of service, an on-self backup pump has to be carried from the Town's workshop to the concrete vault.

2. The pump, CP3126HT 10HP, ran for 23 hours per day in the snow melt season in the last few years, which confirms that the pumping system is reaching its design capacity.

3. The pump discharge connection experienced leakage and the decrease in pumping rate was observed in draw down tests.

4. The pump is controlled by float switches. There is no alarm sent from the system to inform the operator for high level warning.

To address the issues, relevant as-built drawings and flow data were reviewed to identify possible solutions. As a participant member of the North Red Deer Regional Wastewater Commission, the wastewater in the Town will be eventually transferred to the Regional WWTP for treatment. However, due to the current funding shortage, the regional line connecting the Town to the City of Red Deer might not be constructed in the next 5 years.

Proposed Upgrades

The following section addresses the issues listed above. The regionalization and its uncertainties have been taken into consideration.

Reference: Blackfalds Lagoon Discharge Lift Station Upgrades

1. On-site Standby

According to the as-built drawings (1975 Stanley Associates), the vault does not have sufficient space to accommodate a second pump. A new larger vault would be needed for a duplex pump installation. Since the Lift Station will be abandoned when the regional line is in place, the Town would like to stage upgrades and utilize the existing infrastructure to its fullest potentials.

With a single pump installation, an on-shelf stand by pump should be kept as a backup. Installation of a by-passing connection should be also considered.

2. Pump capacity expansion

Draw down tests have been conducted by the Town' s operator on the existing pump. The average pumping rate was measured to be 280 GPM (17.6 l/s, 63.6 m^3/hr) in 2010. A recent 2014 test came up with an average pumping rate of 253 GPM (16 l/s, 57.6 m^3/hr). The decreased pumping rate might be due to the leakage in the discharge connector within the vault.

The future influent flows coming into the lagoon system are projected as following:

Year	Population	Average Weekly Flow (m3/wk)	MW Flow (m3/wk)	Per Capita AA Flow (Lcpd)	AA Flow (l/s)	MW Flow (l/s)
2011	6399	8737	10549	195	14.4	17.4
2012	6767	9400	10181	198	15.5	16.8
2013	7275	9662	10333	190	16.0	17.1
2014	7639	10395	11643	194	17.2	19.3
2015	8021	10915	12225	194	18.0	20.2
2016	8422	11461	12836	194	18.9	21.2
2017	8843	12034	13478	194	19.9	22.3
2018	9285	12635	14152	194	20.9	23.4
2019	9749	13267	14859	194	21.9	24.6

Notes:

1. 2011-2013 data are from historical records.
2. The population growth rate is assumed at 5% in the next 5 years.
3. The average per capita flow rate from last three years of 194 Lcpd is used to project the flow in the next 5 years.
4. AA= Annual Average flow
5. MW=Max Week average flow. Based on the flow records, the MW to AA ratio is about 1.12.

Reference: Blackfalds Lagoon Discharge Lift Station Upgrades

Based on the flow projection, the existing pump does not have the capacity to convey the treated wastewater fast enough to the gravity trunk that goes to Red Deer River. Currently, the Aspelund Industrial Park to the west of the QE Hiway II is connecting to the Town's sanitary sewer system. Although it is hard to predict the growth of the area, the developments in the Park will possibly contribute AA flow of 2-4 l/s wastewater in the next five years, which is equivalent 20 to 40 Ha of development. Therefore, a new pump with a minimal flow rate of 28.6 l/s should be installed to replace the existing pump to handle the projected flow rate.

To keep the installation of the new pump as simple as possible, a new pump with similar physical dimensions, NP 3153 HT461 20HP is selected. With this new pump, the pumping rate can reach 28.8 l/s. The pump will run 23 hours in the Max Week flow in 2019, and 18-21 hours per day in an Average Day flow in 2019.

3. Discharge connection

The pump discharge connection will be replaced with the purchase and installation of the new pump. By-pass piping and valves could be constructed outside the vault.

Although the existing AC forcemain has a theoretical minimal pressure rating of 100PSI, which is much higher than the new pumps operation pressure (max 45 PSI), the pipe has been buried and in service for 40 years, the joints might have been weaken. It is suggested that the Town's maintenance team should have standby equipment ready for the possibly failure in the forcemain.

4. Electrical, Control and Communication

The existing electrical control panel and the associated power cables will be replaced to accommodate the proposed 20 hp pump. An ultrasonic level transmitter with the backup float level system should be installed to supply more data to the operators for operation reference. A telemetry system is required to send the level readings and alarms out to the operator.

Next Steps

1. The electrical and control, communication conditions should be reviewed in detail and designed to accommodate the new 20 HP pump.

2. Order the two (2) 20 HP pumps, one installed and one on-shelf standby, and have it installed in 2014.

3. Carry out the detailed design and construction of the proposed work.

Reference: Blackfalds Lagoon Discharge Lift Station Upgrades

Stantec

Johnny Qingsheng Ke
Project Engineer
Phone: 403 356 3391
Johnny.ke@stantec.com

Attachment: Budgetary quotation on the proposed pumps from Xylem

c. Todd Simenson, Brad Vander Heyden

xylem
Let's Solve Water

Proposal

Date: Sunday, April 6, 2014 Quotation #: 14-60-0037/2/1

Project Information

Company Name: TOWN OF BLACKFALDS

Project Name: BLACKFALDS - LAGOON PUMP

Xylem Representative: Carl Barg

Attention to: c/o JOHNNY KE

REVISED REPLACEMENT PUMP OPTION

Item#	Qty	Description
1.1	2	3153.181-YYYY FLYGT MODEL NP-3153 SUBMERSIBLE PUMP 460 VOLT 3/60 20HP/14.9KW 1760 RPM HT IMP 461 VOL 4" 16M 4G6+2X1,5 C/W FLS FLUSH VALVE READY
1.2	1	540 13 05 DISCHARGE CONNECTION4" X 4" FLANGE ANSI
1.3	1	13-00 93 68 AUTOMATIC SIMPLEX PUMP CONTROL PANEL WITH ALPHA 1 CONTROLLER. CONTROL TO BE SIMILAR TO SAMPLE ELECTRICAL SCHEMATIC E-202826 REV.0.
1.4	1	GL-9571 FREIGHT CHARGES

Total Price $ 43,838.00

Business Terms

Taxes ALL TAXES ARE EXTRA AND NOT INCLUDED IN THE ABOVE PRICES.

Prices PRICES ARE IN CANADIAN DOLLARS.

Validity THIS QUOTE IS VALID FOR THIRTY (30) DAYS.

Terms of payment 30 DAYS FROM INVOICE DATE.

Incoterms 2010 CPT - CARRIAGE PAID TO BUYERS SHOP/WAREHOUSE. PREPAID AND CHARGED BACK.

Terms of delivery STANDARD DELIVERY: 9-10 WEEKS (AFTER DRAWING APPROVAL).
EXPEDITING OPTIONS AVAILABLE, PLEASE CONTACT YOUR

FLYGT LEOPOLD SANITAIRE WEDECO
6704 30th Street, Calgary, AB T2C 1N9 Tel.: 403-279-8371 - Fax: 403-279-0948

xylem
Let's Solve Water

Date:	2014/04/06	Quotation #	14-60-0037/2/1
Company Name:	TOWN OF BLACKFALDS		

SALES REP.

Comments and Exceptions

THIS PROPOSAL IS IN ACCORDANCE WITH OUR INTERPRETATION OF THE PLANS AND SPECIFICATIONS PROVIDED TO US. ALL EQUIPMENT OFFERED IS SUBJECT TO THE ENGINEER'S/CUSTOMER'S ACCEPTANCE AND WE RESERVE THE RIGHT TO WITHDRAW OUR OFFER IF SUCH ACCEPTANCE IS NOT GRANTED. SHOULD ANY CHANGES HAVE TO BE MADE REGARDING THE QUANTITIES AND/OR CONSTRUCTION OF THE EQUIPMENT OFFERED, EXTRA CHARGES WILL APPLY ACCORDINGLY. COMMENTS AND EXCEPTIONS ARE PART OF THIS PROPOSAL AND MUST BE OBSERVED.

COMMENTS:
- SITE START UP IS NOT INCLUDED.
- FOR SITE START UP OUR RATE IS $1500-2500 PLUS TAXES PER MAN PER DAY IF REQUIRED, DEPENDING ON DISTANCE FROM CALGARY. PLEASE CONFIRM WITH YOUR SALES REP.
- SITE INSTALLATION IS NOT INCLUDED.
- QUOTATION IS BASED ON CLASS 1 DIV 2 UNLESS OTHERWISE STATED.

EXCEPTIONS TO REQUIREMENTS:
- NONE UNLESS OTHERWISE STATED.

Best regards,

Carl Barg
Sales Representative
Xylem Water Solutions
O: 403-279-8371
Carl.Barg@xyleminc.com
www.xylemwatersolutions.com/ca

Lori Lee
Technical Sales Coordinator
Xylem Water Solutions
O: 403-279-8371
lori.lee@xyleminc.com
http://www.xylemwatersolutions.com/ca

xylem
Let's Solve Water

Date: 2014/04/06 Quotation # 14-60-0037/2/1

Company Name: TOWN OF BLACKFALDS

General Conditions of Sale or Rental

1. Xylem Water Solutions, a division of Xylem Canada Company ("the Company") shall fulfill sales and rental orders ("orders") pursuant to the following General Conditions of Sale or Rental, which General Conditions will apply, notwithstanding all other terms and conditions, whether written or not, notwithstanding those set out on Buyer's Purchase Order.

2. Payment shall be due thirty (30) days following date of full or partial shipment, on approved credit. Interest on past due payments shall be calculated at a rate of eighteen per cent (18%) per annum (1.5% per month) on any overdue balance. Buyer shall pay all taxes as well as all additional charges resulting from modifications or errors in buyer-submitted design drawings. Shipping is FOB Company's factory. This order is not subject to hold back.

3. The Company will not be responsible for losses or delays arising from force majeure events or for consequential or indirect damages, however caused. In all cases, the liability of the Company for damages arising directly from late delivery shall be limited to five percent (5%) of contract value, regardless of cause. A claim for damages arising from delay shall not exist until the presentation to the Company of independently verified actual damages directly resulting from the delay.

4. The Company warrants products manufactured by the Company to the original user against defects in material and workmanship under normal operating conditions which comply with written Company operating instructions.

The warranty period is as follows:

- Flygt 2000 series pumps are warranted for eighteen (18) months from date of shipment.
- Flygt DS, HS and NS pumps are warranted for six (6) months from date of installation or twelve (12) month from date of shipment, whichever occurs first.
- All other Flygt products are warranted for twelve (12) months from date of installation or eighteen (18) months from date of shipment, whichever occurs first.
- Repairs carried out by the Company's service personnel are warranted for:
  - Twelve (12) months from date of repair, applicable only if genuine parts have been used or;
  - Ninety (90) days from date of repair, applicable if refurbished or reconditioned parts have been used.
- Flygt spare parts shipped separately and not installed by the Company are warranted for thirty (30) days from date of shipment.

This warranty shall not apply to products or parts which have been subjected to accidents, negligence, abuse, or use, installation, service, storage, handling or treatment in a manner contrary to the written instructions of the Company or to products on which the identification plates have been modified or removed. The Company must receive written notice of all claims during the warranty period. The Company will, at its sole discretion, decide whether to repair or replace defective goods. The buyer shall pay all other charges, including, but not limited to, shipping, handling and installation and removal charges. The Company does not warrant any equipment as fit for a particular purpose and does not provide any warranty of plans and designs supplied by buyer, or of parts or components provided by others. The Company warrants only that equipment manufactured and conforming to plans and specifications provided by the buyer will conform to those plans and specifications and not to any particular performance standard.

This warranty is in place and in lieu of all warranties whether provided by law or otherwise, of merchantability and/or fitness for any particular purpose. The obligation of the Company to repair or replace all defective parts is the sole recourse of the buyer and the value of the liability incurred thereby shall be limited to the lesser of the cost of the repair or the replacement of the part in question.

5. The Company will defend all claims or allegations that the goods violate any Canadian copyright, trademark, or other intellectual property rights, provided that the Company is promptly advised of such claims, that the buyer assists the Company as requested in such defense (in the preparation of the necessary documentation) and goods have been paid for in full. The liability of the Company shall not extend to goods manufactured to buyer's plans and/or specifications, for which the buyer will indemnify the Company for all costs or damages resulting from a violation of a patent or other similar claim.

6. The cumulative liability of the Company from all causes and as set out herein shall not exceed the total value of the sale or rental.

7. In the event that any part or portion of this contract is ruled invalid or unenforceable by competent authority, such provision shall be severed from the contract without affecting the validity or enforceability of the balance.

8. The sale or rental is governed by the laws of Canada and the province to which the goods are shipped, unless the shipping destination is outside Canada in which case the laws of Quebec shall apply.

9. The Company shall retain title to the goods until payment in full. Buyer shall not sell or transfer the goods to a third party before the Company has received full payment for the goods in question. Buyer acknowledges receipt and agrees to these general conditions and has had the opportunity to consult counsel in connection herewith. Buyer agrees and represents that the goods sold pursuant to these General Conditions will not be installed or used in a nuclear facility.

10. The use of a variable speed drive without proper sizing, harmonics, filtering, protection etc... could result in damages to the motor or to other equipment on this system. Using variable speed drive control without the express written agreement of the Company will void all warranties.

11. Ce contrat est rédigé en *anglais* à la demande expresse des parties aux présentes. This contract has been prepared in English at the specific request of the parties hereto.

This quotation is hereby accepted on _____ day of _____ 20_____.

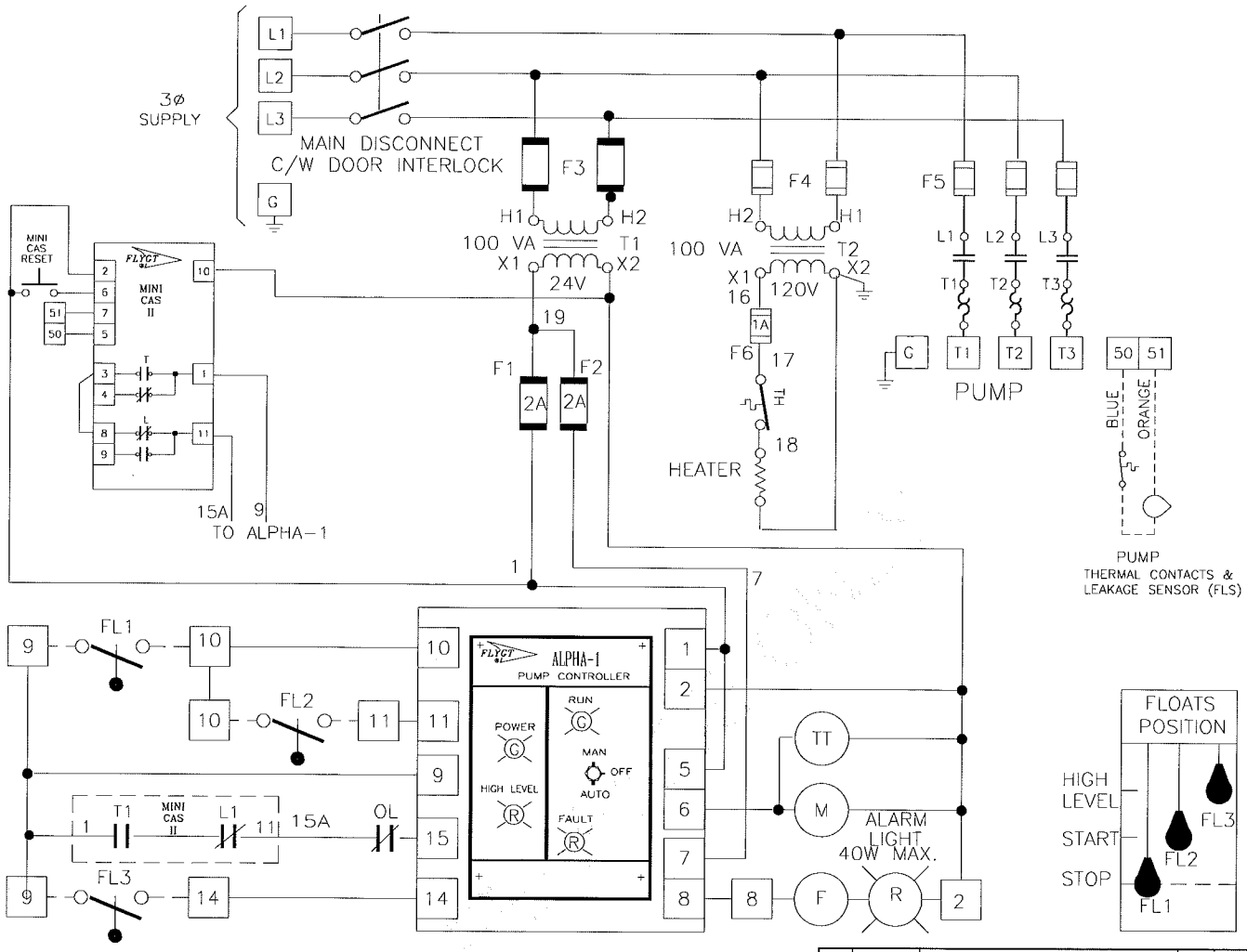
By:

_____ _____

Name of the Customer Signature of the Customer

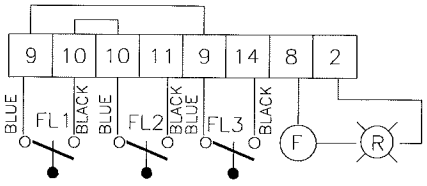
FLYGT LEOPOLD SANITAIRE WEDECO

6704 30th Street, Calgary, AB T2C 1N9 Tel.: 403-279-8371 - Fax: 403-279-0948



LEGEND :

OL : OVERLOAD RELAY
M : CONTACTOR
F : FLASHER
TH : THERMOSTAT



NOTE :

	QTY REQ'D
ALPHA–1 UNIT (P/N 13–50 61 61)	1
MINI CAS II KIT(P/N 13–70 20 00)	1

REV.	DATE	DESCRIPTION	BY	APP.

OPTIONS:
A6A;E7;V11

CIRCUIT No.. LAST NUMBER USED: ###

ITT | Water & Wastewater

TITLE:
ALPHA 1, EEMAC 3

PUMP MODEL:	HP:	VOLTAGE:
		460 V/ 3 PH/60 Hz

LOCATION:

CUSTOMER:

DRAWING BY:	DATE:	SCALE:	FORMAT:
Bozena Saczuk	10–06–10	1:1	A
APPROVED BY: Bozena Saczuk	DATE: 10–06–10	PROJECT No.:	

DWG NO. E-202826 REVISION 0

doc#: 202826version: 1 6/10/2010

ISSUED FOR: ☐ PURCHASING ☐ FABRICATION ☐ INSPECTION ☐ APPROVAL ☐ INFORMATION ☐ PLANNING ☐ QUOTATION

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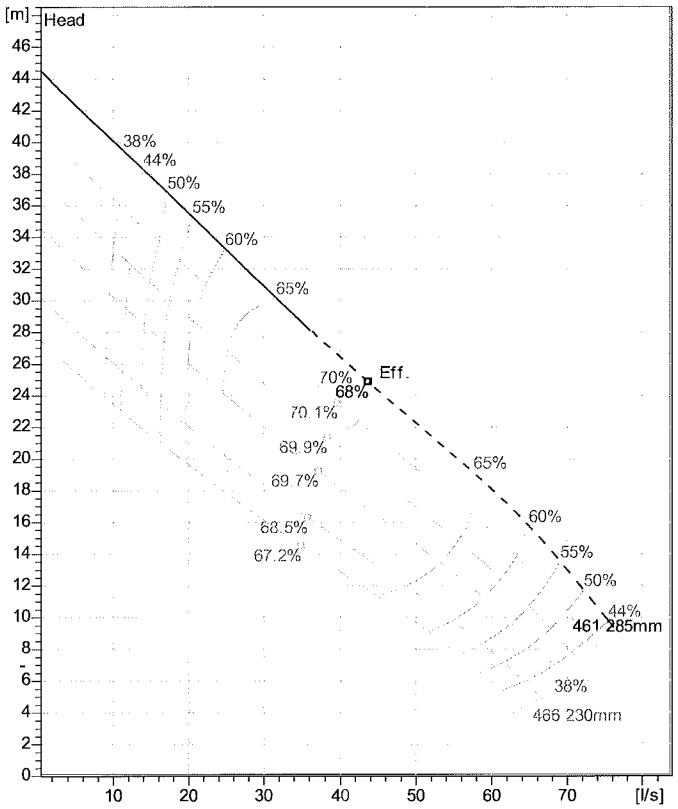
NP 3153 HT 3~ 461

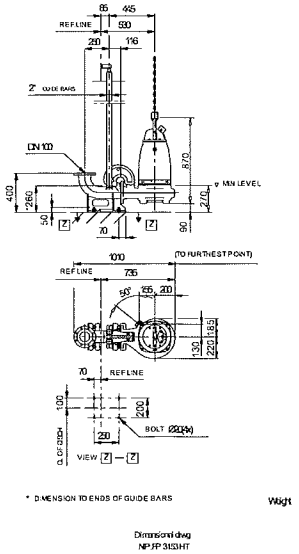
Technical specification



Water, pure

Curve according to: ISO 9906 grade 2 annex 1 or 2

Installation: P - Semi permanent, Wet



Note: Picture might not correspond to the current configuration.

General

Patented self cleaning semi-open channel impeller, ideal for pumping in waste water applications. Possible to be upgraded with Guide-pin® for even better clogging resistance. Modular based design with high adaptation grade.

Impeller

Impeller material	Grey cast iron
Outlet width	100 mm
Inlet diameter	100 mm
Impeller diameter	285 mm
Number of blades	2

Motor

Motor #	N3153.181 21-18-4AA-W 20hp
Stator variant	5
Frequency	60 Hz
Rated voltage	460 V
Number of poles	4
Phases	3~
Rated power	20 hp
Rated current	26 A
Starting current	148 A
Rated speed	1755 1/min
Power factor	
1/1 Load	0.83
3/4 Load	0.77
1/2 Load	0.66
Efficiency	
1/1 Load	87.5 %
3/4 Load	89.0 %
1/2 Load	89.0 %

Configuration

Project	Project ID	Created by	Created on	Last update
Blackfalds - Lagoon Pump	**14-60-0037**	**Carl Barg**	**2014-02-23**	**2014-04-06**

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Performance curve

Pump

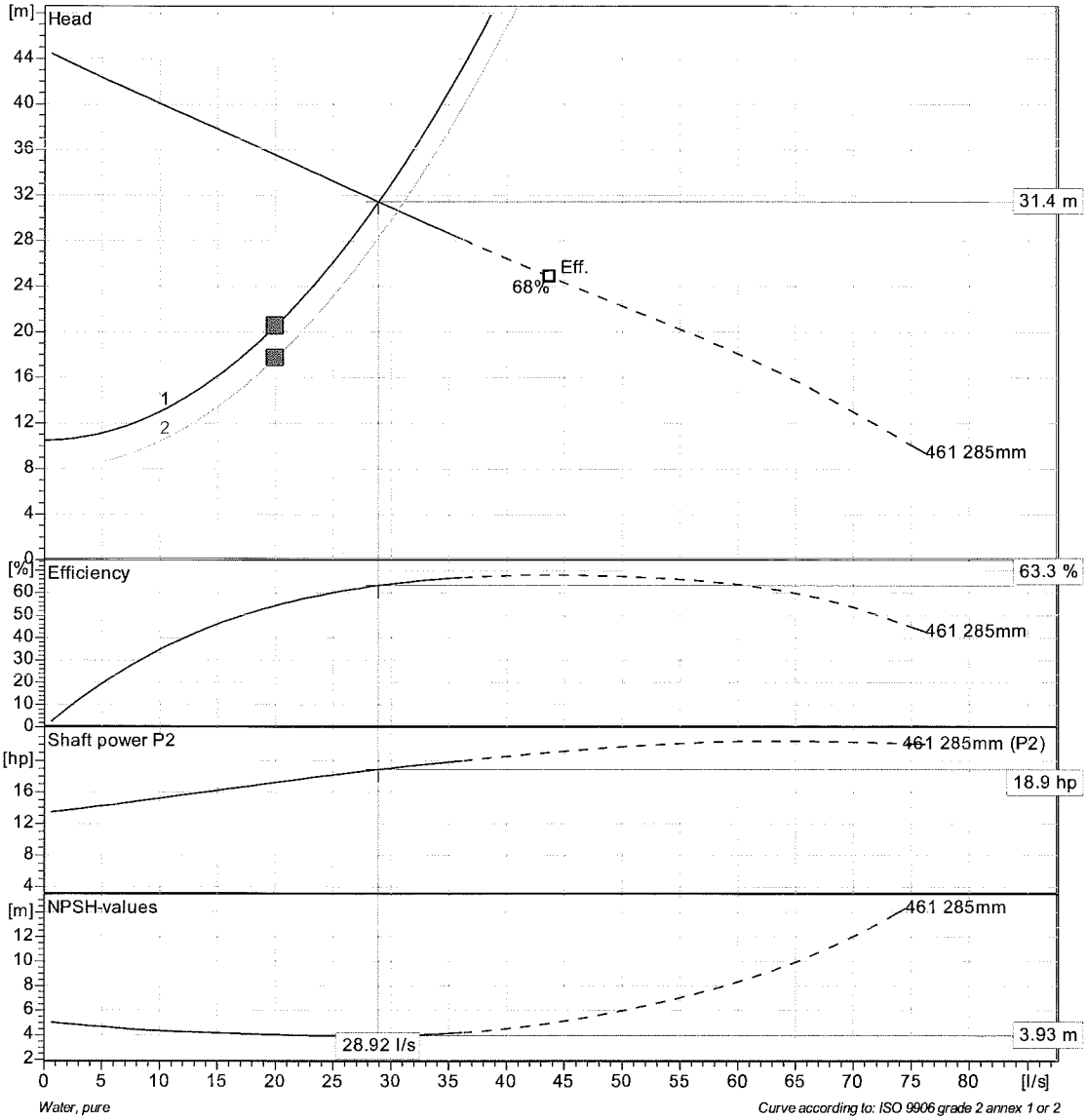
Outlet width	100 mm
Inlet diameter	100 mm
Impeller diameter	285 mm
Number of blades	2

Motor

Motor #	N3153.181 21-18-4AA-W 20hp
Stator variant	5
Frequency	60 Hz
Rated voltage	460 V
Number of poles	4
Phases	3~
Rated power	20 hp
Rated current	26 A
Starting current	148 A
Rated speed	1755 1/min

Power factor	
1/1 Load	0.83
3/4 Load	0.77
1/2 Load	0.66

Efficiency	
1/1 Load	87.5 %
3/4 Load	89.0 %
1/2 Load	89.0 %



Water, pure

Curve according to: ISO 9906 grade 2 annex 1 or 2

Project	Project ID	Created by	Created on	Last update
Blackfalds - Lagoon Pump	**14-60-0037**	**Carl Barg**	**2014-02-23**	**2014-04-06**

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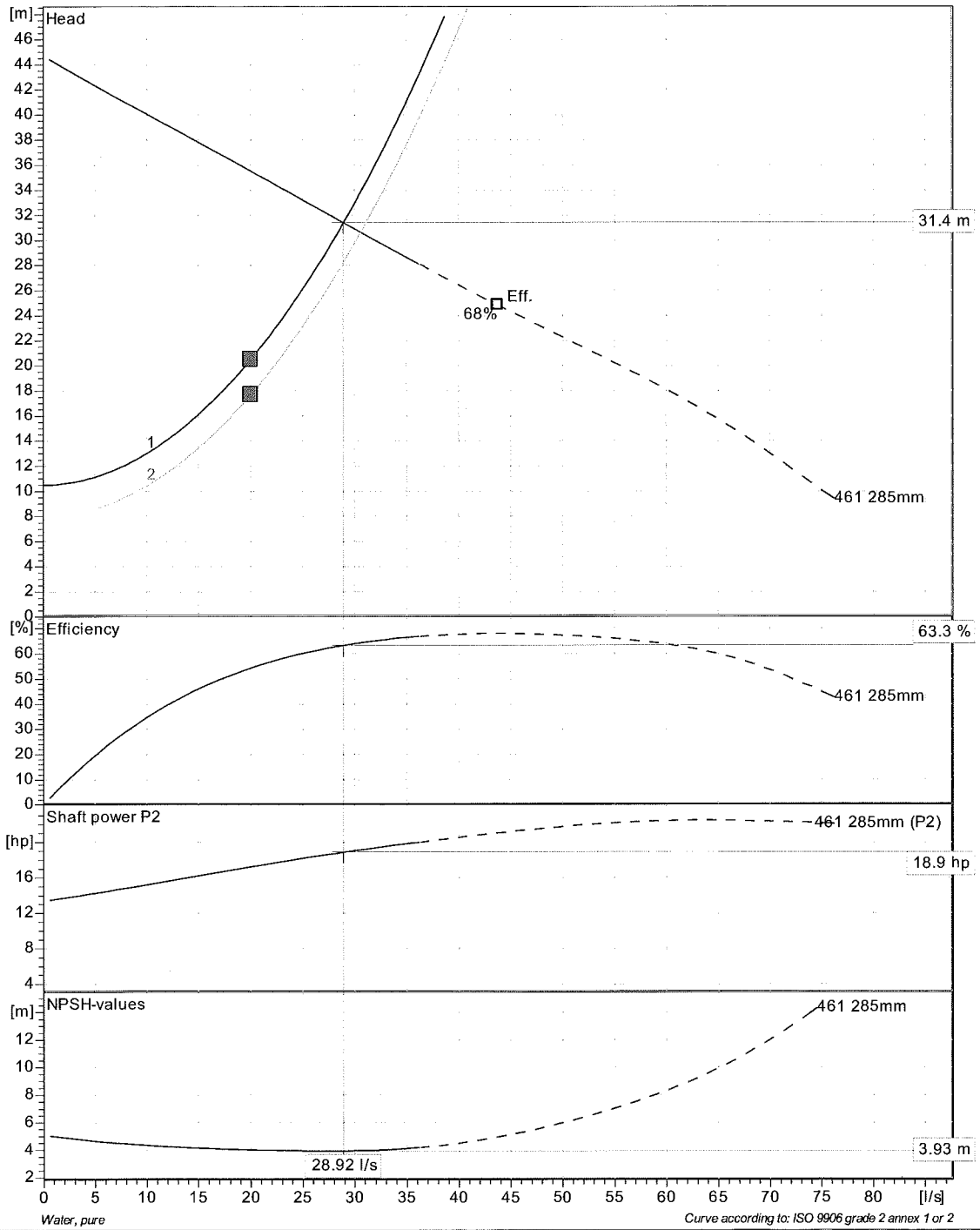
NP 3153 HT 3~ 461

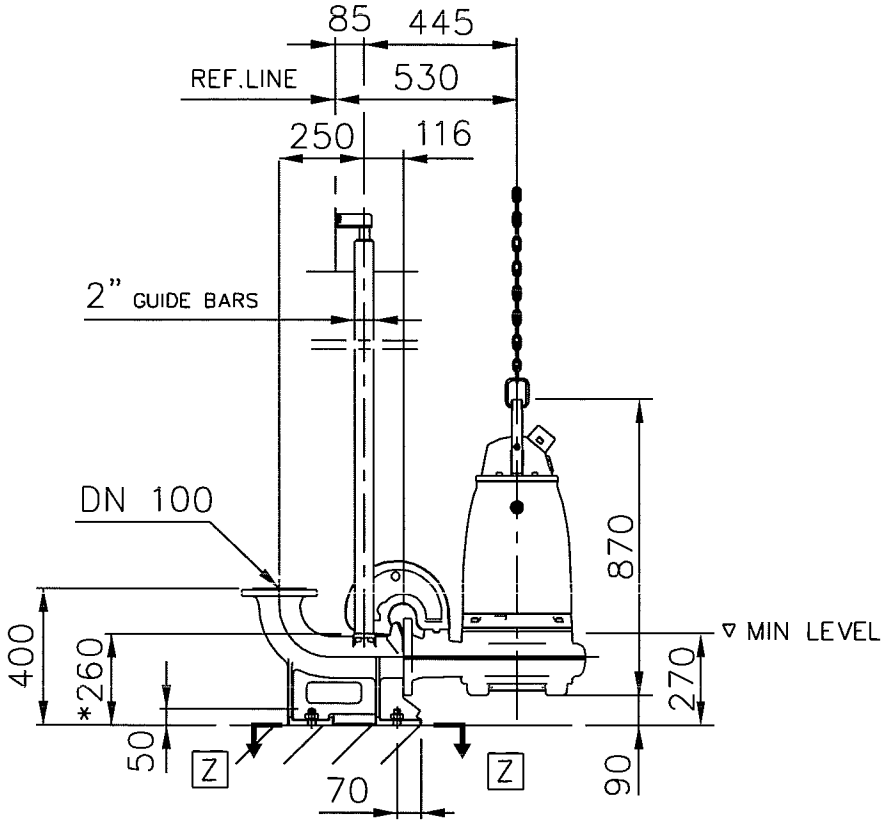
FLYGT

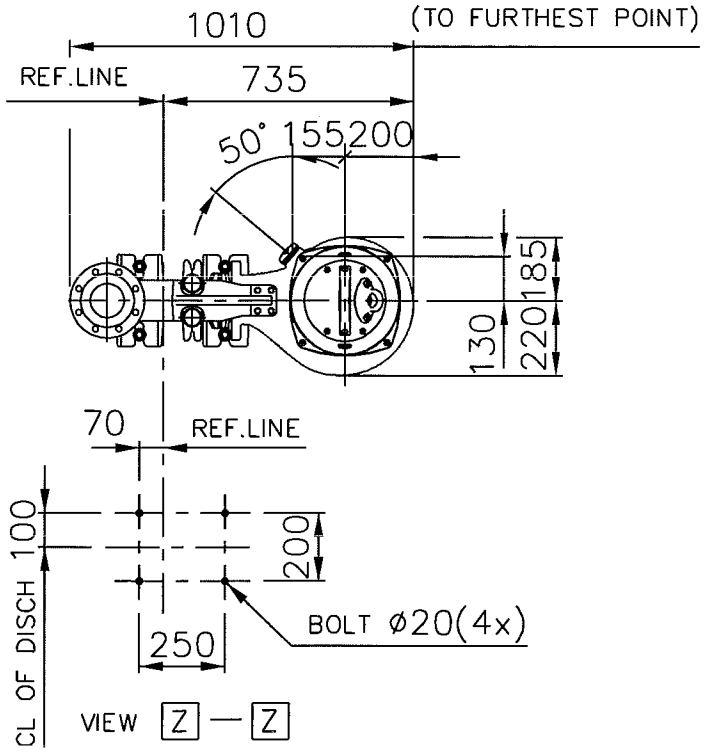
Duty Analysis



Pumps running /System	Individual pump Flow	Head	Shaft power	Total Flow	Head	Shaft power	Hyd eff.	Specific energy	NPSHre
2	30.6 l/s	30.7 m	19.1 hp	30.6 l/s	30.7 m	19.1 hp	64.4 %	0.147 kWh/m³	3.96 m
1	28.9 l/s	31.4 m	18.9 hp	28.9 l/s	31.4 m	18.9 hp	63.3 %	0.153 kWh/m³	3.93 m

Project	Project ID	Created by	Created on	Last update
Blackfalds - Lagoon Pump	**14-60-0037**	**Carl Barg**	**2014-02-23**	**2014-04-06**





* DIMENSION TO ENDS OF GUIDE BARS

Weight (kg)	
Pump	Stand
210	42

AUTOCAD DRAWING	Denomination: Dimensional drwg NP,FP 3153 HT DN 100	Drawn by: NK / Checked by: SB	Date: 081013
		Scale: 1:20	Reg no: 5399
		6504500	11

Appendix C BLACKFALDS LAGOON SLUDGE SURVEY REPORT

LAMBOURNE ENVIRONMENTAL Ltd.
51, 37337 Burnt Lake Trail, Red Deer County, T4S 2K5 Ph. (403) 348-8298 Fax (403) 348-8290

March 28, 2014

Stantec Consulting Ltd.
1100, 4900 – 50 Street
Red Deer, AB T4N 1X7
Attn: Brad Vander Heyden, P.Eng.

Re: Sludge Survey Report – Town of Blackfalds

Dear Brad;

As requested, we have completed our bio-solids survey of Cell #1 (North West Cell), Cell #2 (South West Cell) Cell #3 (North East Cell) and Cell #4 (East Cell). This onsite survey work was completed on March 12, 2014.

Methodology

Each of the cells was surveyed using a grid based on approximately 12m spacing.

Measurements were obtained by going out on a boat and probing for the bottom with a measuring pole or walking out onto the ice and drilling a hole first. This distance was measured thus establishing the depth from HWL to lagoon base.

The top of the sludge blanket was determined with the use of a photosensitive light tool that will identify sludge when the TSS is greater than 1%. It is lowered into the lagoon and gives an audible tone when the top of the sludge blanket has been located. The wire leading to the meter has been marked with measurements so that the distance between high water level and the top of the sludge can be measured. This process is repeated throughout each lagoon.

We were also able to confirm that these cells have a 3:1 slope.

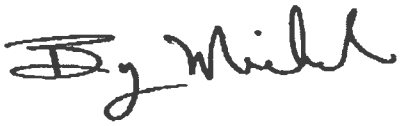
Please find following maps of the cells, grid locations, indicating depth to sludge and depth to bottom of cell.

Cell Sludge volume

Cell	Volume to HWL (m^3)	Sludge Volume (m^3)	Lagoon Depth (m)	Sludge Height (m)
#1 (North West)	5,450	950	3.92	1.23
#2 (South West)	16,650	3,200	4.58	1.28
#3 (North East)	25,875	4,300	4.09	0.9
#4 (East)	2,400	1,050	3.45	2.16
TOTAL	**50,375**	**9,500**		

Thank you for allowing us to help you with this project. Please let me know if we can be of any more help with your bio-solids management requirements. We look forward to working with you again in the future.

Yours truly,
Lambourne Environmental Ltd.



Byron Mickelson, CMA
President

Encl.

LAMBOURNE ENVIRONMENTAL Ltd.

Lagoon Survey Form

Project No. 1500 Survey completion date: March 12, 2014 Survey Crew Kevin

North

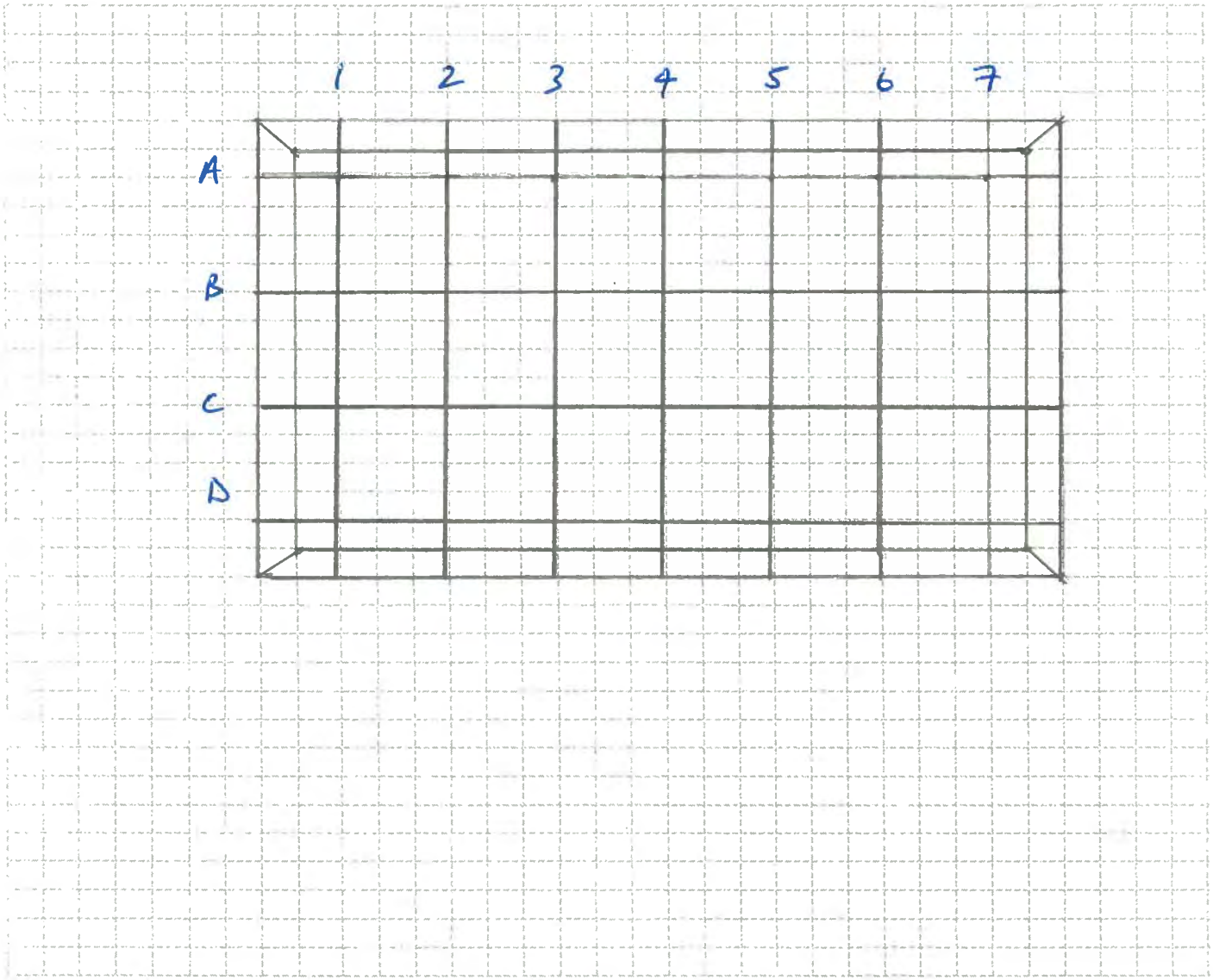
Client Name: Town of Blackfalds Lagoon ID: Cell #1 (North West Cell)

Lagoon Location: Avg. Total Depth (HWL to Base) 3.92 m

Lagoon dimensions at HWL 65m x 37m Avg. sludge depth (m) 1.23

Berm slope ratio 3:1

As-built drawings available (y/n) n Sludge sample taken (y/n) n



** Ensure lagoon dimensions are shown on map. **

Notes: Lagoon Measurement and drawing are to water level at time of survey.

** Map is not to scale **

LAMBOURNE ENVIRONMENTAL Ltd.

Project No. 1500 Survey completion date: 12-Mar-14 Completed by: Kevin

Town of Blackfalds - Cell #1 (North West Cell)

Grid Location	Total Depth	Depth to Sludge	Sludge Level
A1	3.92	1.60	2.32
A2	3.92	2.10	1.82
A3	3.92	2.20	1.72
A4	3.92	2.40	1.52
A5	3.92	2.20	1.72
A6	3.92	2.50	1.42
A7	3.92	1.90	2.02
B1	3.92	2.50	1.42
B2	3.92	3.50	0.42
B3	3.92	3.60	0.32
B4	3.92	3.60	0.32
B5	3.92	3.60	0.32
B6	3.92	3.30	0.62
B7	3.92	1.70	2.22

Grid Location	Total Depth	Depth to Sludge	Sludge Level
C1	3.92	1.90	2.02
C2	3.92	3.50	0.42
C3	3.92	3.70	0.22
C4	3.92	3.60	0.32
C5	3.92	3.60	0.32
C6	3.92	3.40	0.52
C7	3.92	1.30	2.62
D1	3.92	1.40	2.52
D2	3.92	3.20	0.72
D3	3.92	2.20	1.72
D4	3.92	3.50	0.42
D5	3.92	3.50	0.42
D6	3.92	2.60	1.32
D7	3.92	1.10	2.82
Average	3.92	2.69	1.23

Notes:

LAMBOURNE ENVIRONMENTAL Ltd.

Lagoon Survey Form

Project No. 1500 Survey completion date: March 12, 2014 Survey Crew Kevin

North

Client Name: Town of Blackfalds

Lagoon ID: Cell #2 (South West Cell)

Lagoon Location:

Avg. Total Depth (HWL to Base) 4.58 m

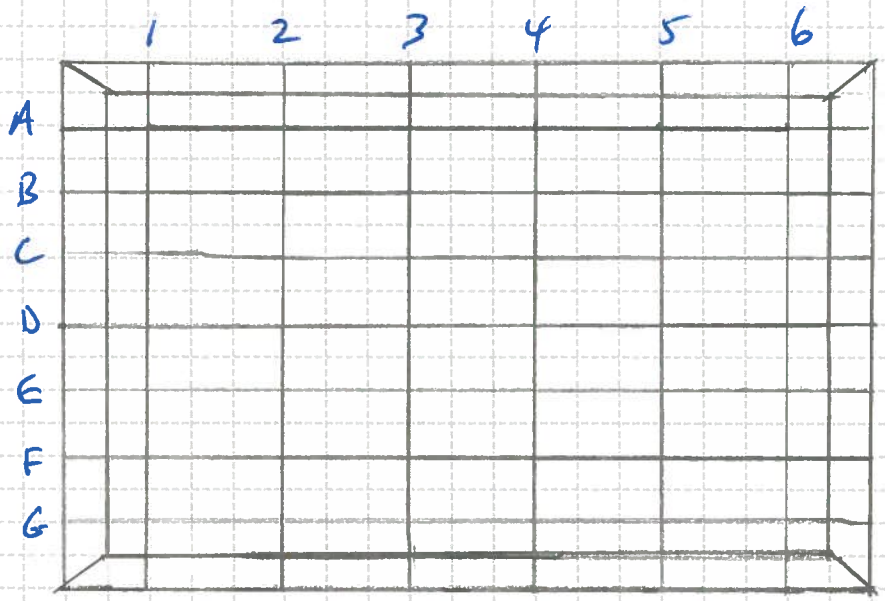
Lagoon dimensions at HWL 74m x 73m

Avg. sludge depth (m) 1.28

Berm slope ratio 3:1

As-built drawings available (y/n) n

Sludge sample taken (y/n) n



**** Ensure lagoon dimensions are shown on map. ****

Notes: Lagoon Measurement and drawing are to water level at time of survey.

** Map is not to scale **

LAMBOURNE ENVIRONMENTAL Ltd.

Project No. 1500 Survey completion date: 12-Mar-14 Completed by: Kevin

Town of Blackfalds - Cell #2 (South West Cell)

Grid Location	Total Depth	Depth to Sludge	Sludge Level
A1	4.58	0.80	3.78
A2	4.58	2.20	2.38
A3	4.58	3.10	1.48
A4	4.58	3.30	1.28
A5	4.58	3.60	0.98
A6	4.58	1.60	2.98
B1	4.58	1.90	2.68
B2	4.58	4.20	0.38
B3	4.58	4.30	0.28
B4	4.58	4.40	0.18
B5	4.58	4.40	0.18
B6	4.58	1.70	2.88
C1	4.58	1.90	2.68
C2	4.58	4.20	0.38
C3	4.58	4.40	0.18
C4	4.58	4.30	0.28
C5	4.58	4.40	0.18
C6	4.58	2.00	2.58
D1	4.58	2.20	2.38
D2	4.58	4.30	0.28
D3	4.58	4.40	0.18
D4	4.58	4.30	0.28
D5	4.58	4.40	0.18
D6	4.58	2.70	1.88

Grid Location	Total Depth	Depth to Sludge	Sludge Level
E1	4.58	1.80	2.78
E2	4.58	4.40	0.18
E3	4.58	4.30	0.28
E4	4.58	4.40	0.18
E5	4.58	4.40	0.18
E6	4.58	2.40	2.18
F1	4.58	1.60	2.98
F2	4.58	4.30	0.28
F3	4.58	4.40	0.18
F4	4.58	4.20	0.38
F5	4.58	4.10	0.48
F6	4.58	2.10	2.48
G1	4.58	1.00	3.58
G2	4.58	3.70	0.88
G3	4.58	3.60	0.98
G4	4.58	3.60	0.98
G5	4.58	3.80	0.78
G6	4.58	1.50	3.08
Average	4.58	3.30	1.28

Notes:

LAMBOURNE ENVIRONMENTAL Ltd.

Lagoon Survey Form

Project No. 1500 Survey completion date: March 12, 2014 Survey Crew Kevin

North

Client Name: Town of Blackfalds

Lagoon ID: Cell #3 (North East Cell)

Lagoon Location:

Avg. Total Depth (HWL to Base) 4.09 m

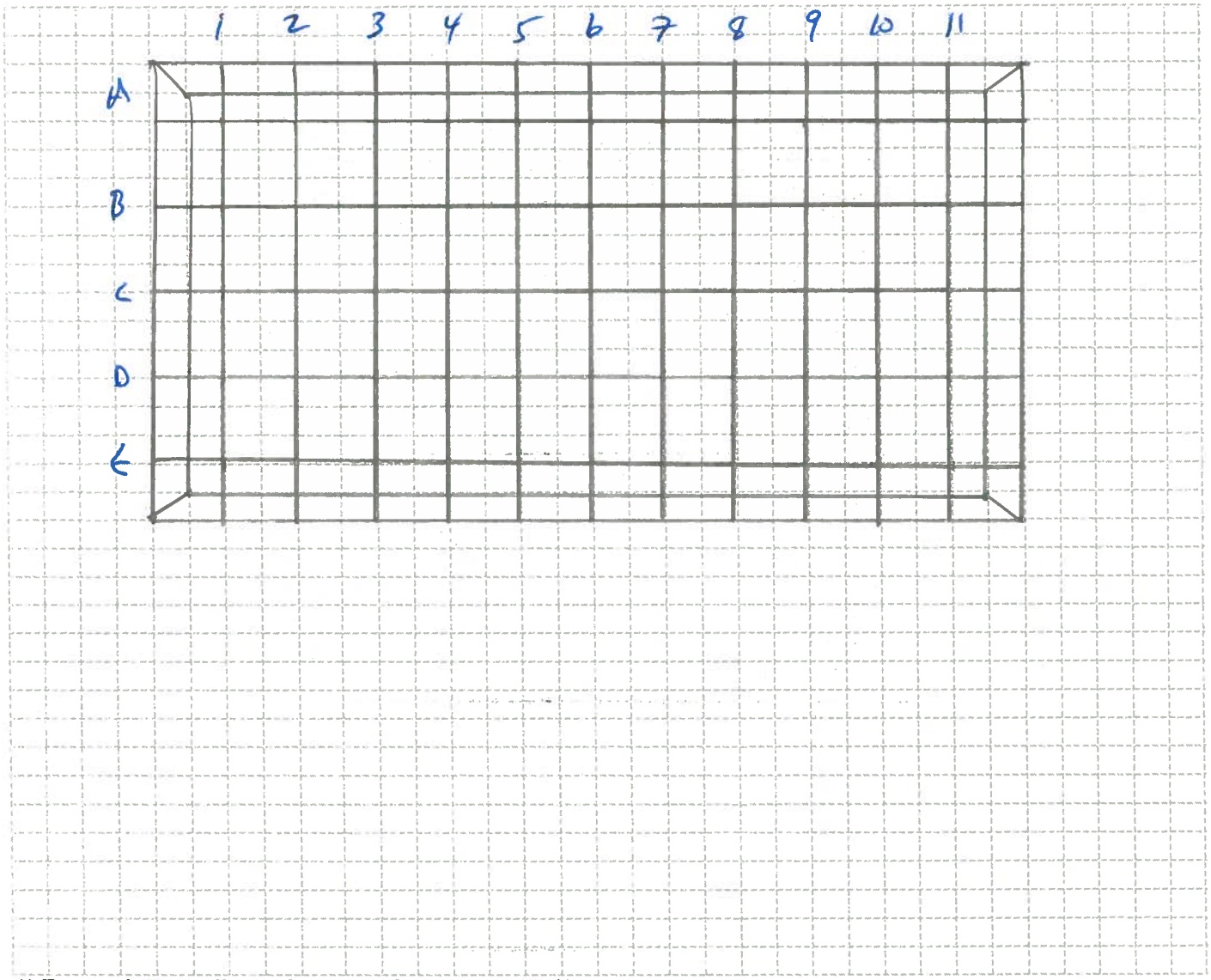
Lagoon dimensions at HWL 121m x 70m

Avg. sludge depth (m) 0.9

Berm slope ratio 3:1

As-built drawings available (y/n) n

Sludge sample taken (y/n) n



** Ensure lagoon dimensions are shown on map. **

Notes: Lagoon Measurement and drawing are to water level at time of survey.

** Map is not to scale **

LAMBOURNE ENVIRONMENTAL Ltd.

Project No. 1500 Survey completion date: 12-Mar-14 Completed by: Kevin

Town of Blackfalds - Cell #3 (North East Cell)

Grid Location	Total Depth	Depth to Sludge	Sludge Level
A1	4.09	1.90	2.19
A2	4.09	2.10	1.99
A3	4.09	2.20	1.89
A4	4.09	1.90	2.19
A5	4.09	2.20	1.89
A6	4.09	2.20	1.89
A7	4.09	1.80	2.29
A8	4.09	2.50	1.59
A9	4.09	2.10	1.99
A10	4.09	2.30	1.79
A11	4.09	1.50	2.59
B1	4.09	3.20	0.89
B2	4.09	3.90	0.19
B3	4.09	3.80	0.29
B4	4.09	3.90	0.19
B5	4.09	3.80	0.29
B6	4.09	3.90	0.19
B7	4.09	3.90	0.19
B8	4.09	3.90	0.19
B9	4.09	4.00	0.09
B10	4.09	3.10	0.99
B11	4.09	2.50	1.59
C1	4.09	2.90	1.19
C2	4.09	3.80	0.29
C3	4.09	3.90	0.19
C4	4.09	3.90	0.19
C5	4.09	3.80	0.29

Grid Location	Total Depth	Depth to Sludge	Sludge Level
C6	4.09	3.90	0.19
C7	4.09	3.90	0.19
C8	4.09	3.50	0.59
C9	4.09	3.20	0.89
C10	4.09	2.70	1.39
C11	4.09	2.50	1.59
D1	4.09	2.90	1.19
D2	4.09	3.90	0.19
D3	4.09	3.50	0.59
D4	4.09	3.90	0.19
D5	4.09	4.00	0.09
D6	4.09	3.90	0.19
D7	4.09	3.90	0.19
D8	4.09	3.60	0.49
D9	4.09	3.10	0.99
D10	4.09	2.90	1.19
D11	4.09	2.50	1.59
E1	4.09	2.20	1.89
E2	4.09	3.50	0.59
E3	4.09	3.60	0.49
E4	4.09	3.10	0.99
E5	4.09	3.10	0.99
E6	4.09	3.40	0.69
E7	4.09	3.60	0.49
E8	4.09	3.80	0.29
E9	4.09	4.00	0.09
E10	4.09	3.30	0.79
Average	4.09	3.19	0.90

Notes:

LAMBOURNE ENVIRONMENTAL Ltd.

Lagoon Survey Form

Project No. 1500 Survey completion date: March 12, 2014 Survey Crew Kevin

North

Client Name: Town of Blackfalds

Lagoon ID: Cell #4 (East Cell)

Lagoon Location:

Avg. Total Depth (HWL to Base) 3.45 m

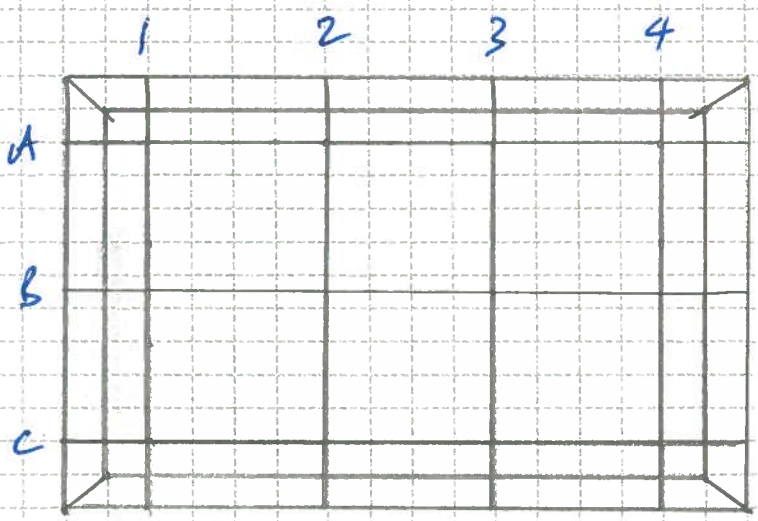
Lagoon dimensions at HWL 36m x 36m

Avg. sludge depth (m) 2.16

Berm slope ratio 3:1

As-built drawings available (y/n) n

Sludge sample taken (y/n) n



** Ensure lagoon dimensions are shown on map. **

Notes: Lagoon Measurement and drawing are to water level at time of survey.

** Map is not to scale **

LAMBOURNE ENVIRONMENTAL Ltd.

Project No. 1500 Survey completion date: 12-Mar-14 Completed by: Kevin

Town of Blackfalds - Cell #4 (East Cell)

Grid Location	Total Depth	Depth to Sludge	Sludge Level
A1	3.45	1.20	2.25
A2	3.45	2.00	1.45
A3	3.45	1.50	1.95
A4	3.45	1.10	2.35
B1	3.45	1.10	2.35
B2	3.45	2.00	1.45
B3	3.45	1.80	1.65
B4	3.45	1.30	2.15
C1	3.45	0.90	2.55
C2	3.45	0.85	2.60
C3	3.45	0.80	2.65
C4	3.45	0.90	2.55

Grid Location	Total Depth	Depth to Sludge	Sludge Level
Average	3.45	1.29	2.16

Notes:

Appendix D BLACKFALDS LAGOON DO MEASUREMENT REPORT

Nelson Environmental Inc

Date: June 12, 2014
Project: Town of Blackfalds
Report No: 1

RE: Dissolved Oxygen Profiling of Cells 1, 2, & 3 Wastewater Treatment Lagoons.

Summary

A profile of Dissolved Oxygen (DO) was carried out on June 3, 2014 at the Town of Blackfalds' wastewater treatment lagoons. The goal of testing was to determine the current state of the lagoons in terms of dissolved oxygen concentration. Strategic locations were chosen to provide a complete picture of the DO concentrations over the entire area of each lagoon.

DO readings were taken at 24, 21, and 21 well-spaced locations in Cells 1, 2, and 3, respectively. Cell 3 was subdivided into two Cells, 3a and 3b, according to the sectioning done by the baffle curtain in this Cell. Duplicate sampling at each location was conducted to ensure accuracy (i.e. two DO meters were used simultaneously at each location). The DO measurements averaged 3.4±0.3 mg/L, 1.4±0.4 mg/L, 4.5±0.1 and 2.5±0.2 mg/L in Cells 1, 2, 3A and 3B respectively at average water temperatures of 15.4±0.0 °C, 17.3±0.1 °C, 18.3±0.2 °C, and 18.4±0.1 °C.

Introduction

DO measurement in all three cells was performed with two objectives in mind:

a. To get a detailed snapshot of the DO profile of all three Cells given the current operating conditions (i.e. loads, flow, and settled sludge).
b. Establish a baseline for future comparison of aeration system performance in the event that the operating conditions and/or changes to the aeration system are made.

DO testing was conducted on June 3, 2014 by Nelson Environmental Inc. staff. Before testing was started, strategic locations were identified (and agreed upon with Stantec) so as to give the most representative data. This report presents the protocol used and the results of the testing.

Equipment:

1. Two (2) YSI Pro ODO Dissolved Oxygen Meters
2. Boat equipped with a Motor

Procedure

Two dissolved oxygen meters, with probes bound together, were used to carry out the testing (two meters to ensure accuracy and repeatability). Each meter was calibrated in water saturated air according to the manufacturer's recommendations (see YSI ProODO user manual) prior to testing. The DO concentration at each of the predetermined locations was measured at approximately 1.2 m below the water surface. The protocol followed is as follows:

- Cell 1 – Took three (3) measurements between each pair of laterals (each side and centre). Total of 24 measurements
- Cell 2 – Took three (3) measurements between each pair of laterals (each side and centre). Total of 21 measurements
- Cell 3a – took three (3) measurements between every other pair of laterals (each side and centre). Total of 12 measurements
- Cell 3b – Took nine (9) measurements in a grid pattern between the baffle and berm

Results

Fig. 1 below shows the variation in DO within (and between) each of the three cells. The DO measurements averaged 3.4±0.3 mg/L, 1.4±0.4 mg/L, 4.5±0.1 and 2.5±0.2 mg/L in Cells 1, 2, 3a and 3b respectively at average water temperatures of 15.4±0.0 ^{o}C, 17.3±0.1 ^{o}C, 18.3±0.2 ^{o}C, and 18.4±0.1 ^{o}C.

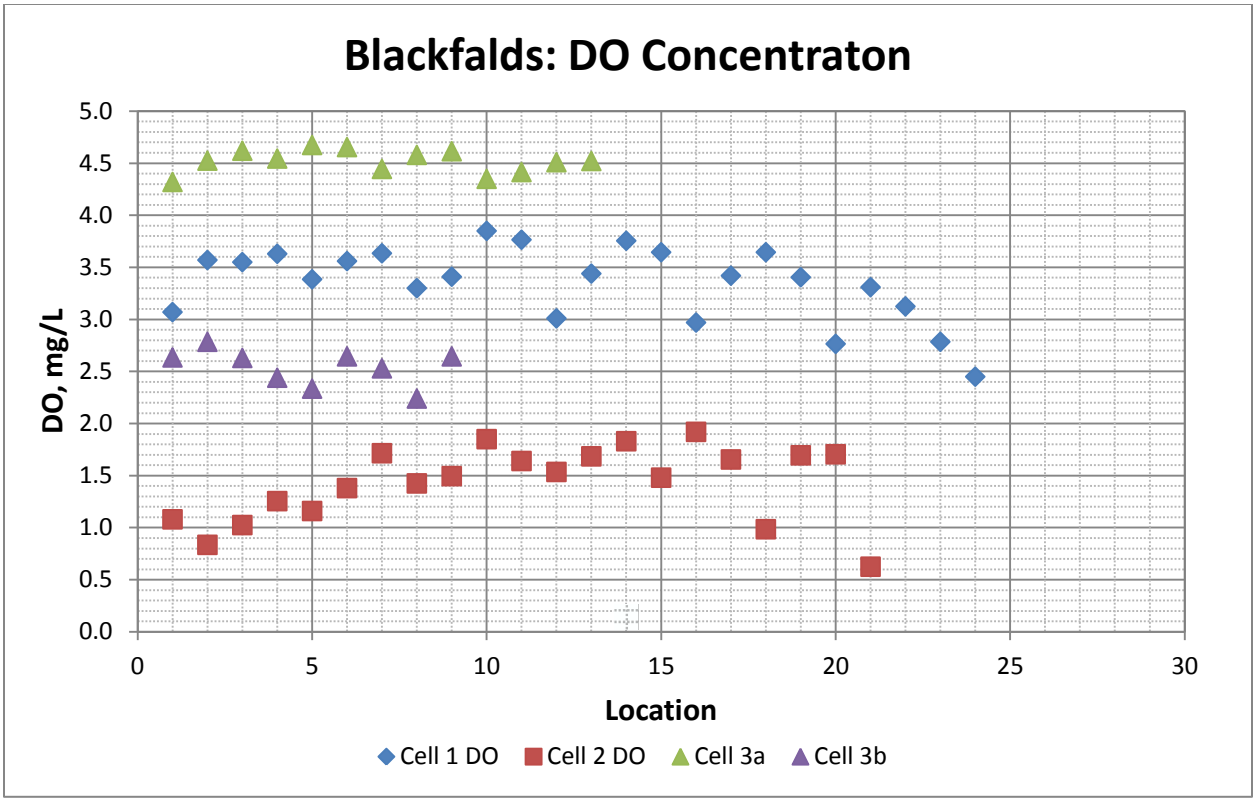


Figure 1: DO variation with location (Refer to Appendix for map of locations)

Fig. 2 shows the temperature profile for each lagoon. The difference in temperature between Cell 1 and Cells 2 & 3 is attributed to the time of day the testing was conducted. DO and temperature testing in Cell 1 were done in the morning and that of Cells 2 & 3 in the afternoon when ambient temperature was significantly higher.

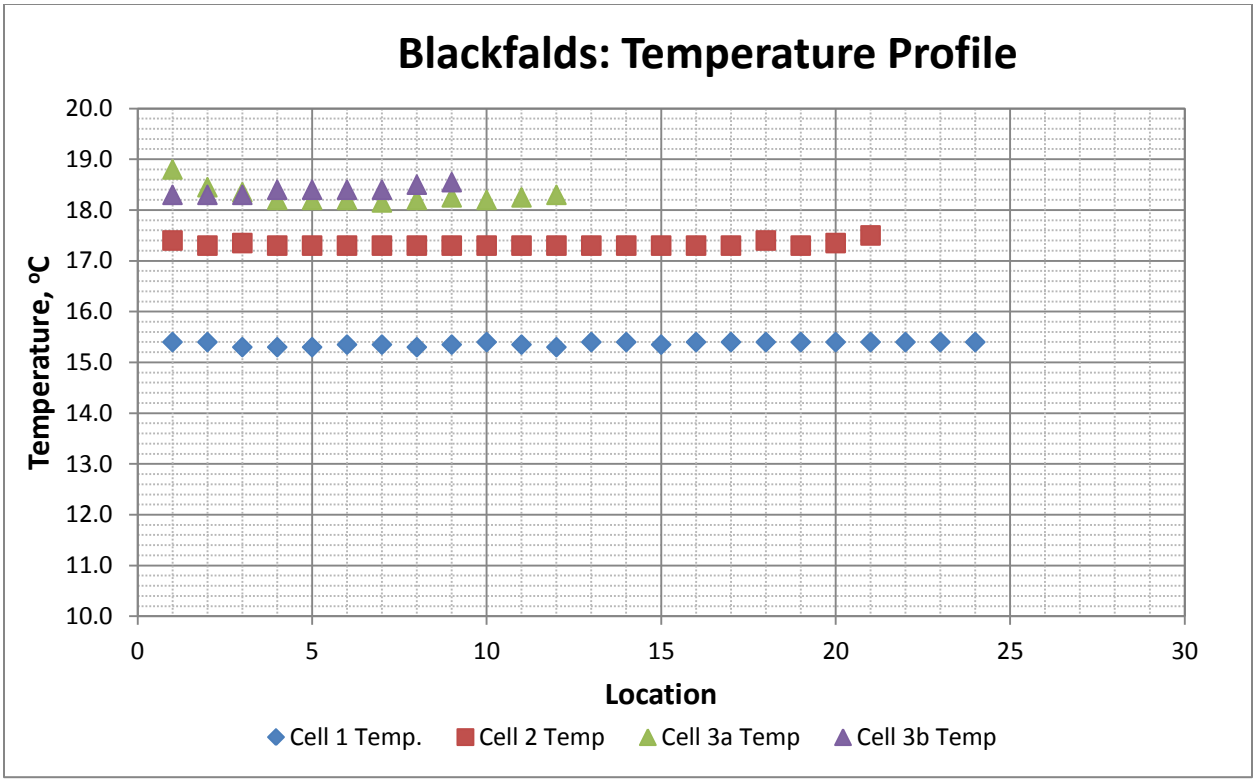
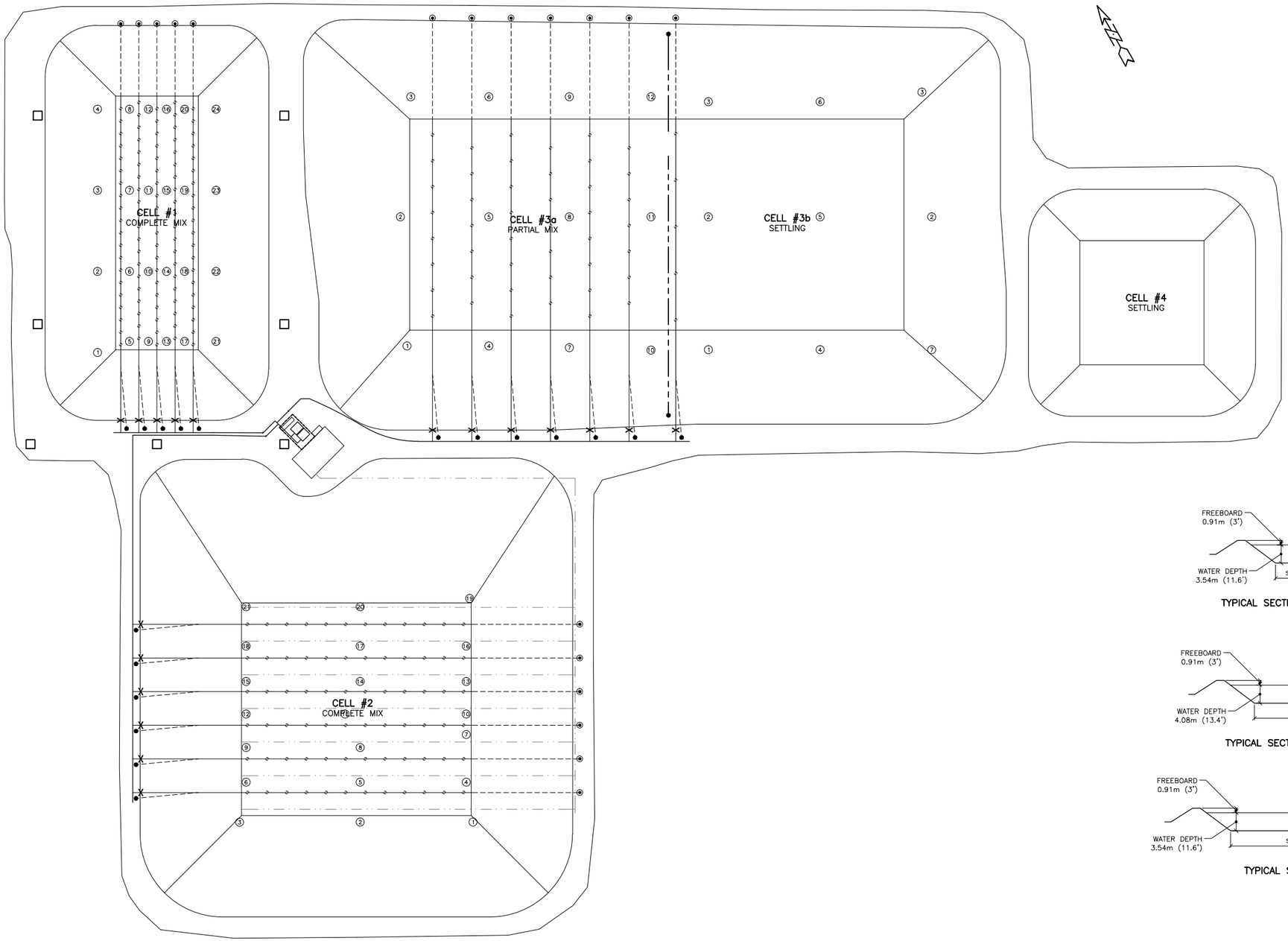


Figure 2: Temperature variation with location (Refer to Appendix for map of locations)

APPENDIX 1
DO Testing Locations

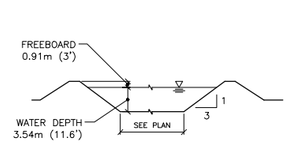
PLOT SIZE: 610mm x 914mm (24" x 36")

REDUCED SIZE PLOT - DO NOT SCALE

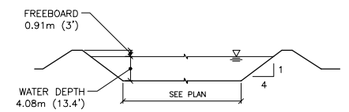


AERATION LAYOUT

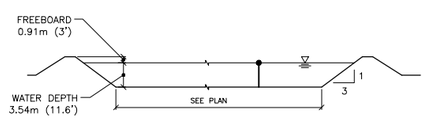
SCALE: 1:400



TYPICAL SECTION – CELL #1



TYPICAL SECTION – CELL #2



TYPICAL SECTION – CELL #3

NELSON ENVIRONMENTAL INC.

5 BURKS WAY
WINNIPEG, MANITOBA
CANADA R2J 3R8

Ph: (204) 949-7500
Fax: (204) 237-0660
www.nelsonenvironmental.com

PROJECT: TOWN OF BLACKFALDS, AB AERATION SYSTEM UPGRADE					
TITLE: DISSOLVED OXYGEN MEASUREMENTS LOCATION PLAN					
DRAWN BY: JG	APPROVED BY: LE	SCALE: AS NOTED	DRAWING NO. NE01	SHT. 1 of 1	REV. 0
DATE: 2014/06/04	FILE # 57654.3				

APPENDIX 2
DO Testing Raw Data

Date	Time	Barometer (kPA)	Dissolved Oxygen (mg/L)	Temperature (C)	Site	Unit ID
3-Jun-14	11:46 AM	90.84	1.06	17.4	Town of Blackfalds Cell 2-1	NEI PRO ODO 002
3-Jun-14	11:47 AM	90.85	0.82	17.3	Town of Blackfalds Cell 2-2	NEI PRO ODO 002
3-Jun-14	11:48 AM	90.86	1.01	17.3	Town of Blackfalds Cell 2-3	NEI PRO ODO 002
3-Jun-14	11:50 AM	90.85	1.26	17.3	Town of Blackfalds Cell 2-4	NEI PRO ODO 002
3-Jun-14	11:52 AM	90.86	1.15	17.3	Town of Blackfalds Cell 2-5	NEI PRO ODO 002
3-Jun-14	11:53 AM	90.85	1.37	17.3	Town of Blackfalds Cell 2-6	NEI PRO ODO 002
3-Jun-14	11:55 AM	90.85	1.71	17.3	Town of Blackfalds Cell 2-7	NEI PRO ODO 002
3-Jun-14	11:57 AM	90.85	1.43	17.3	Town of Blackfalds Cell 2-8	NEI PRO ODO 002
3-Jun-14	11:58 AM	90.86	1.51	17.3	Town of Blackfalds Cell 2-9	NEI PRO ODO 002
3-Jun-14	12:00 PM	90.85	1.83	17.3	Town of Blackfalds Cell 2-10	NEI PRO ODO 002
3-Jun-14	12:01 PM	90.86	1.64	17.3	Town of Blackfalds Cell 2-11	NEI PRO ODO 002
3-Jun-14	12:05 PM	90.85	1.53	17.3	Town of Blackfalds Cell 2-12	NEI PRO ODO 002
3-Jun-14	12:07 PM	90.85	1.85	17.3	Town of Blackfalds Cell 2-13	NEI PRO ODO 002
3-Jun-14	12:08 PM	90.86	1.83	17.3	Town of Blackfalds Cell 2-14	NEI PRO ODO 002
3-Jun-14	12:10 PM	90.86	1.47	17.3	Town of Blackfalds Cell 2-15	NEI PRO ODO 002
3-Jun-14	12:12 PM	90.86	1.93	17.3	Town of Blackfalds Cell 2-16	NEI PRO ODO 002
3-Jun-14	12:13 PM	90.85	1.66	17.3	Town of Blackfalds Cell 2-17	NEI PRO ODO 002
3-Jun-14	12:15 PM	90.87	1	17.4	Town of Blackfalds Cell 2-18	NEI PRO ODO 002
3-Jun-14	12:17 PM	90.86	1.68	17.3	Town of Blackfalds Cell 2-19	NEI PRO ODO 002
3-Jun-14	12:18 PM	90.87	1.69	17.3	Town of Blackfalds Cell 2-20	NEI PRO ODO 002
3-Jun-14	12:19 PM	90.86	0.62	17.5	Town of Blackfalds Cell 2-21	NEI PRO ODO 002

Date	Time	Barometer (kPA)	Dissolved Oxygen (mg/L)	Temperature (C)	Site	Unit ID
3-Jun-14	11:47 AM	90.94	1.1	17.4	Town of Blackfalds Cell 2-1	NEI PRO ODO 001
3-Jun-14	11:48 AM	90.94	0.85	17.3	Town of Blackfalds Cell 2-2	NEI PRO ODO 001
3-Jun-14	11:49 AM	90.94	1.04	17.4	Town of Blackfalds Cell 2-3	NEI PRO ODO 001
3-Jun-14	11:51 AM	90.93	1.25	17.3	Town of Blackfalds Cell 2-4	NEI PRO ODO 001
3-Jun-14	11:53 AM	90.94	1.17	17.3	Town of Blackfalds Cell 2-5	NEI PRO ODO 001
3-Jun-14	11:54 AM	90.93	1.39	17.3	Town of Blackfalds Cell 2-6	NEI PRO ODO 001
3-Jun-14	11:56 AM	90.94	1.72	17.3	Town of Blackfalds Cell 2-7	NEI PRO ODO 001
3-Jun-14	11:58 AM	90.94	1.42	17.3	Town of Blackfalds Cell 2-8	NEI PRO ODO 001
3-Jun-14	11:59 AM	90.94	1.48	17.3	Town of Blackfalds Cell 2-9	NEI PRO ODO 001
3-Jun-14	12:01 PM	90.94	1.87	17.3	Town of Blackfalds Cell 2-10	NEI PRO ODO 001
3-Jun-14	12:02 PM	90.94	1.64	17.3	Town of Blackfalds Cell 2-11	NEI PRO ODO 001
3-Jun-14	12:08 PM	90.93	1.54	17.3	Town of Blackfalds Cell 2-13	NEI PRO ODO 001
3-Jun-14	12:06 PM	90.85	1.52	17.3	Town of Blackfalds Cell 2-12	NEI PRO ODO 001
3-Jun-14	12:09 PM	90.93	1.83	17.3	Town of Blackfalds Cell 2-14	NEI PRO ODO 001
3-Jun-14	12:11 PM	90.94	1.49	17.3	Town of Blackfalds Cell 2-15	NEI PRO ODO 001
3-Jun-14	12:13 PM	90.94	1.91	17.3	Town of Blackfalds Cell 2-16	NEI PRO ODO 001
3-Jun-14	12:14 PM	90.94	1.65	17.3	Town of Blackfalds Cell 2-17	NEI PRO ODO 001
3-Jun-14	12:16 PM	90.94	0.97	17.4	Town of Blackfalds Cell 2-18	NEI PRO ODO 001
3-Jun-14	12:18 PM	90.94	1.71	17.3	Town of Blackfalds Cell 2-19	NEI PRO ODO 001
3-Jun-14	12:19 PM	90.94	1.72	17.4	Town of Blackfalds Cell 2-20	NEI PRO ODO 001
3-Jun-14	12:20 PM	90.94	0.63	17.5	Town of Blackfalds Cell 2-21	NEI PRO ODO 001

	Date	Time	Barometer (kPA)	Dissolved Oxygen (mg/L)	Temperature (C)	Site	Unit ID
1	3-Jun-14	10:16 AM	90.88	3.07	15.4	Town of Blackfalds Cell 1-1	NEI PRO ODO 002
2	3-Jun-14	10:17 AM	90.88	3.56	15.4	Town of Blackfalds Cell 1-2	NEI PRO ODO 002
3	3-Jun-14	10:21 AM	90.88	3.55	15.3	Town of Blackfalds Cell 1-3	NEI PRO ODO 002
4	3-Jun-14	10:22 AM	90.88	3.64	15.3	Town of Blackfalds Cell 1-4	NEI PRO ODO 002
5	3-Jun-14	10:27 AM	90.88	3.4	15.3	Town of Blackfalds Cell 1-4	NEI PRO ODO 002
6	3-Jun-14	10:30 AM	90.88	3.57	15.3	Town of Blackfalds Cell 1-6	NEI PRO ODO 002
7	3-Jun-14	10:31 AM	90.88	3.65	15.3	Town of Blackfalds Cell 1-7	NEI PRO ODO 002
8	3-Jun-14	10:33 AM	90.88	3.29	15.3	Town of Blackfalds Cell 1-8	NEI PRO ODO 002
9	3-Jun-14	10:37 AM	90.89	3.41	15.3	Town of Blackfalds Cell 1-9	NEI PRO ODO 002
10	3-Jun-14	10:38 AM	90.88	3.85	15.4	Town of Blackfalds Cell 1-10	NEI PRO ODO 002
11	3-Jun-14	10:39 AM	90.88	3.79	15.3	Town of Blackfalds Cell 1-11	NEI PRO ODO 002
12	3-Jun-14	10:42 AM	90.88	3.01	15.3	Town of Blackfalds Cell 1-12	NEI PRO ODO 002
13	3-Jun-14	10:45 AM	90.88	3.43	15.4	Town of Blackfalds Cell 1-13	NEI PRO ODO 002
14	3-Jun-14	10:46 AM	90.89	3.77	15.4	Town of Blackfalds Cell 1-14	NEI PRO ODO 002
15	3-Jun-14	10:47 AM	90.88	3.64	15.3	Town of Blackfalds Cell 1-15	NEI PRO ODO 002
16	3-Jun-14	10:49 AM	90.89	2.97	15.4	Town of Blackfalds Cell 1-16	NEI PRO ODO 002
17	3-Jun-14	10:53 AM	90.88	3.4	15.4	Town of Blackfalds Cell 1-17	NEI PRO ODO 002
18	3-Jun-14	10:55 AM	90.87	3.63	15.4	Town of Blackfalds Cell 1-18	NEI PRO ODO 002
19	3-Jun-14	10:56 AM	90.88	3.43	15.4	Town of Blackfalds Cell 1-19	NEI PRO ODO 002
20	3-Jun-14	10:58 AM	90.88	2.75	15.4	Town of Blackfalds Cell 1-20	NEI PRO ODO 002
21	3-Jun-14	11:00 AM	90.89	3.32	15.4	Town of Blackfalds Cell 1-21	NEI PRO ODO 002
22	3-Jun-14	11:01 AM	90.89	3.12	15.4	Town of Blackfalds Cell 1-22	NEI PRO ODO 002
23	3-Jun-14	11:04 AM	90.89	2.78	15.4	Town of Blackfalds Cell 1-23	NEI PRO ODO 002
24	3-Jun-14	11:06 AM	90.88	2.44	15.4	Town of Blackfalds Cell 1-24	NEI PRO ODO 002

	Date	Time	Barometer (kPA)	Dissolved Oxygen (mg/L)	Temperature (C)	Site	Unit ID
1	3-Jun-14	10:17 AM	90.96	3.07	15.4	Town of Blackfalds Cell 1-1	NEI PRO ODO 001
2	3-Jun-14	10:18 AM	90.96	3.58	15.4	Town of Blackfalds Cell 1-2	NEI PRO ODO 001
3	3-Jun-14	10:22 AM	90.95	3.55	15.3	Town of Blackfalds Cell 1-3	NEI PRO ODO 001
4	3-Jun-14	10:23 AM	90.96	3.62	15.3	Town of Blackfalds Cell 1-4	NEI PRO ODO 001
5	3-Jun-14	10:28 AM	90.96	3.37	15.3	Town of Blackfalds Cell 1-4	NEI PRO ODO 001
6	3-Jun-14	10:31 AM	90.95	3.55	15.4	Town of Blackfalds Cell 1-6	NEI PRO ODO 001
7	3-Jun-14	10:32 AM	90.95	3.62	15.4	Town of Blackfalds Cell 1-7	NEI PRO ODO 001
8	3-Jun-14	10:34 AM	90.95	3.31	15.3	Town of Blackfalds Cell 1-8	NEI PRO ODO 001
9	3-Jun-14	10:38 AM	90.95	3.41	15.4	Town of Blackfalds Cell 1-9	NEI PRO ODO 001
10	3-Jun-14	10:39 AM	90.96	3.85	15.4	Town of Blackfalds Cell 1-10	NEI PRO ODO 001
11	3-Jun-14	10:40 AM	90.95	3.74	15.4	Town of Blackfalds Cell 1-11	NEI PRO ODO 001
12	3-Jun-14	10:43 AM	90.96	3.01	15.3	Town of Blackfalds Cell 1-12	NEI PRO ODO 001
13	3-Jun-14	10:46 AM	90.95	3.45	15.4	Town of Blackfalds Cell 1-13	NEI PRO ODO 001
14	3-Jun-14	10:47 AM	90.95	3.74	15.4	Town of Blackfalds Cell 1-14	NEI PRO ODO 001
15	3-Jun-14	10:48 AM	90.95	3.65	15.4	Town of Blackfalds Cell 1-15	NEI PRO ODO 001
16	3-Jun-14	10:50 AM	90.95	2.97	15.4	Town of Blackfalds Cell 1-16	NEI PRO ODO 001
17	3-Jun-14	10:54 AM	90.96	3.44	15.4	Town of Blackfalds Cell 1-17	NEI PRO ODO 001
18	3-Jun-14	10:56 AM	90.96	3.66	15.4	Town of Blackfalds Cell 1-18	NEI PRO ODO 001
19	3-Jun-14	10:57 AM	90.96	3.38	15.4	Town of Blackfalds Cell 1-19	NEI PRO ODO 001
20	3-Jun-14	10:59 AM	90.96	2.78	15.4	Town of Blackfalds Cell 1-20	NEI PRO ODO 001
21	3-Jun-14	11:01 AM	90.96	3.3	15.4	Town of Blackfalds Cell 1-21	NEI PRO ODO 001
22	3-Jun-14	11:02 AM	90.95	3.13	15.4	Town of Blackfalds Cell 1-22	NEI PRO ODO 001
23	3-Jun-14	11:05 AM	90.96	2.79	15.4	Town of Blackfalds Cell 1-23	NEI PRO ODO 001
24	3-Jun-14	11:07 AM	90.96	2.46	15.4	Town of Blackfalds Cell 1-24	NEI PRO ODO 001

Date	Time	Barometer (kPA)	Dissolved Oxygen (mg/L)	Temperature (C)	Site	Unit ID
3-Jun-14	1:34 PM	90.8	4.31	18.9	Town of Blackfalds Cell 3A-1	NEI PRO ODO 002
3-Jun-14	1:35 PM	90.8	4.53	18.5	Town of Blackfalds Cell 3A-2	NEI PRO ODO 002
3-Jun-14	1:36 PM	90.81	4.61	18.4	Town of Blackfalds Cell 3A-3	NEI PRO ODO 002
3-Jun-14	1:38 PM	90.81	4.54	18.2	Town of Blackfalds Cell 3A-4	NEI PRO ODO 002
3-Jun-14	1:39 PM	90.83	4.67	18.2	Town of Blackfalds Cell 3A-5	NEI PRO ODO 002
3-Jun-14	1:41 PM	90.83	4.66	18.2	Town of Blackfalds Cell 3A-6	NEI PRO ODO 002
3-Jun-14	1:43 PM	90.83	4.44	18.2	Town of Blackfalds Cell 3A-7	NEI PRO ODO 002
3-Jun-14	1:44 PM	90.82	4.58	18.2	Town of Blackfalds Cell 3A-8	NEI PRO ODO 002
3-Jun-14	1:45 PM	90.83	4.61	18.3	Town of Blackfalds Cell 3A-9	NEI PRO ODO 002
3-Jun-14	1:47 PM	90.82	4.33	18.2	Town of Blackfalds Cell 3A-10	NEI PRO ODO 002
3-Jun-14	1:49 PM	90.81	4.42	18.3	Town of Blackfalds Cell 3A-11	NEI PRO ODO 002
3-Jun-14	1:50 PM	90.82	4.51	18.3	Town of Blackfalds Cell 3A-12	NEI PRO ODO 002
3-Jun-14	1:53 PM	90.82	2.63	18.3	Town of Blackfalds Cell 3B-1	NEI PRO ODO 002
3-Jun-14	1:54 PM	90.82	2.8	18.3	Town of Blackfalds Cell 3B-2	NEI PRO ODO 002
3-Jun-14	1:55 PM	90.82	2.63	18.3	Town of Blackfalds Cell 3B-3	NEI PRO ODO 002
3-Jun-14	1:57 PM	90.81	2.45	18.4	Town of Blackfalds Cell 3B-4	NEI PRO ODO 002
3-Jun-14	1:58 PM	90.8	2.32	18.4	Town of Blackfalds Cell 3B-5	NEI PRO ODO 002
3-Jun-14	1:59 PM	90.8	2.65	18.4	Town of Blackfalds Cell 3B-6	NEI PRO ODO 002
3-Jun-14	2:01 PM	90.8	2.55	18.4	Town of Blackfalds Cell 3B-7	NEI PRO ODO 002
3-Jun-14	2:02 PM	90.8	2.25	18.5	Town of Blackfalds Cell 3B-8	NEI PRO ODO 002
3-Jun-14	2:03 PM	90.81	2.64	18.6	Town of Blackfalds Cell 3B-9	NEI PRO ODO 002

Date	Time	Barometer (kPA)	Dissolved Oxygen (mg/L)	Temperature (C)	Site	Unit ID
3-Jun-14	1:35 PM	90.91	4.33	18.7	Town of Blackfalds Cell 3A-1	NEI PRO ODO 001
3-Jun-14	1:36 PM	90.91	4.52	18.4	Town of Blackfalds Cell 3A-2	NEI PRO ODO 001
3-Jun-14	1:37 PM	90.9	4.63	18.3	Town of Blackfalds Cell 3A-3	NEI PRO ODO 001
3-Jun-14	1:39 PM	90.9	4.55	18.2	Town of Blackfalds Cell 3A-4	NEI PRO ODO 001
3-Jun-14	1:40 PM	90.91	4.68	18.2	Town of Blackfalds Cell 3A-5	NEI PRO ODO 001
3-Jun-14	1:42 PM	90.91	4.65	18.2	Town of Blackfalds Cell 3A-6	NEI PRO ODO 001
3-Jun-14	1:44 PM	90.89	4.45	18.1	Town of Blackfalds Cell 3A-7	NEI PRO ODO 001
3-Jun-14	1:45 PM	90.9	4.58	18.2	Town of Blackfalds Cell 3A-8	NEI PRO ODO 001
3-Jun-14	1:46 PM	90.9	4.62	18.2	Town of Blackfalds Cell 3A-9	NEI PRO ODO 001
3-Jun-14	1:48 PM	90.89	4.37	18.2	Town of Blackfalds Cell 3A-10	NEI PRO ODO 001
3-Jun-14	1:50 PM	90.9	4.41	18.2	Town of Blackfalds Cell 3A-11	NEI PRO ODO 001
3-Jun-14	1:51 PM	90.9	4.51	18.3	Town of Blackfalds Cell 3A-12	NEI PRO ODO 001
3-Jun-14	1:54 PM	90.89	2.64	18.3	Town of Blackfalds Cell 3B-1	NEI PRO ODO 001
3-Jun-14	1:55 PM	90.9	2.77	18.3	Town of Blackfalds Cell 3B-2	NEI PRO ODO 001
3-Jun-14	1:56 PM	90.89	2.63	18.3	Town of Blackfalds Cell 3B-3	NEI PRO ODO 001
3-Jun-14	1:58 PM	90.89	2.43	18.4	Town of Blackfalds Cell 3B-4	NEI PRO ODO 001
3-Jun-14	1:59 PM	90.89	2.35	18.4	Town of Blackfalds Cell 3B-5	NEI PRO ODO 001
3-Jun-14	2:00 PM	90.88	2.64	18.4	Town of Blackfalds Cell 3B-6	NEI PRO ODO 001
3-Jun-14	2:01 PM	90.89	2.51	18.4	Town of Blackfalds Cell 3B-7	NEI PRO ODO 001
3-Jun-14	2:03 PM	90.89	2.23	18.5	Town of Blackfalds Cell 3B-8	NEI PRO ODO 001
3-Jun-14	2:04 PM	90.9	2.65	18.5	Town of Blackfalds Cell 3B-9	NEI PRO ODO 001

Appendix E IN-PIPE TECHNOLOGY PROPOSAL

725 North Central Avenue
Wood Dale, IL 60191
Tel: 630.509.2488

May 7, 2014

Johnny Qingsheng Ke, M.Sc., P.Eng.
Project Engineer
Stantec Consulting Ltd.
1100 - 4900 50th Street
Red Deer AB T4N 1X7

Re: In-Pipe Technology® Company, Inc. Proposal for the Town of Blackfalds, Alberta Canada
Proposal No. 2014-1424

Dear Mr. Ke,

On behalf of In-Pipe Technology Company, Inc., I am pleased to present our no capital investment proposal for your consideration.

Per the information provided by Stantec Consulting, Ltd. and our understanding of the issues at the Town of Blackfalds, Alberta, we have structured our proposal to address the following primary objectives for your operations:

- 20% reduction in influent CBOD with a commensurate decrease in effluent BOD especially during winter months.
- Increased volatile solids destruction in the lagoon sludge layer, reducing sludge dredging requirements.
- Reduced oxygenation required for effective waste treatment at the waste treatment lagoons.

Please contact either myself or Mike Belaire at Sewage Treatment Solutions with any questions or comments that you may have. We look forward to the opportunity to be of assistance to Stantec and the Town of Blackfalds.

Thank you for considering In-Pipe Technology.

Jim Elliott
Vice President of Sales

Cc: Mike Belaire – Sewage Treatment Solutions, Inc.
Andrew Newbold – In-Pipe Technology

Overview of In-Pipe Technology

In-Pipe is pleased to present this proposal for our collection system bioaugmentation program to Stantec Consulting for the Town of Blackfalds as a solution to improving the treatment performance of the lagoon wastewater treatment system. Our treatment, in use for over a decade, uses specially selected live, facultative, spore-forming bacteria to enhance the sewer microcosm as a pretreatment step prior to the WWTP. Our technology extends the waste treatment process into the wastewater collection system, reducing the organic loading to the wastewater treatment plant and improving the efficiency of the process.

In-Pipe Technology Company, Inc. (IPTC) introduces a specific blend of specialized facultative bacteria into the outer reaches of the collection system in order to dominate the sewer microcosm to provide effective pre-treatment throughout the entire sewer system. The continuous addition of microbes is achieved by installing numerous dosing units at strategic locations in the collection system. The dosing units, which are battery powered, self-contained units, are installed underground in manholes and/or in lift stations throughout the sewer system. The results of modifying the collection system microbiology with the In-Pipe program: the partial conversion of the wastewater constituents in the sewer system, the control of fats, oil and grease (FOG), and the improved microbiological population entering the WWTP with the wastewater, all contribute to enhancing the performance and efficiency of the wastewater treatment process.

Using the collection system maps and flow data, In-Pipe engineers locate each of the dosing panels in the collection system. The objective of engineering the dosing plan is to insure that the entire collection system will be treated with In-Pipe microbes sufficient for the individual flow rates and wastewater compositions. Microbes are applied to the largest and/or longest interceptors in each basin and the dosing locations are positioned as far upstream as possible, taking care to ensure that sufficient flow will be available at that location to transport the In-Pipe microbes downstream. Locating the panels as far upstream as possible gives In-Pipe treatment the highest available surface area of internal sewer piping to influence and convert to a beneficial biofilm for biosolids control and remedy of FOG and trapped organic material within the collection system.

In-Pipe Technology Qualifications

Founded in 1999, In-Pipe provides engineered wastewater treatment solutions that meet the escalating challenges facing municipalities today. In-Pipe's patented technology and engineered service solutions help customers reduce sludge production rates, achieve regulatory compliance, reduce noxious odors and corrosion, control collection system fats, oils and grease (FOG) problems, and reduce the cost of treating wastewater.

In-Pipe's patented process (US patent numbers 5,578,211 and 5,788,841 and Canada patent number 2,272,689) is a major breakthrough - representing a fundamental shift and substantial improvement in the methods and economics of wastewater treatment by facilitating the removal of wastewater pollutants in the collection system, before arriving at the wastewater treatment facility.
Our team of industry veterans includes microbiologists, licensed water and wastewater engineers, licensed collections system experts and experienced project managers. This collective experience makes IPT

uniquely qualified to apply specialized microbiology into the collection system in novel and innovative ways.

Introduction to the Technology

In-Pipe Technology's (IPT's) bioaugmentation process uses the sewer collection system as an active part of the wastewater treatment process. IPT converts the passive sewer system into a significant treatment step by utilizing miles of existing pipe as a biological pretreatment reactor to improve the performance of the WWTP. Biochemical processes (i.e., biodegradation and/or bioconversion based on the availability of the electron acceptor) in the collection system improves the efficiency of the existing wastewater treatment process and provides increased additional capacity within the plant to permit the deferral of costly upgrades and extend the life of existing infrastructure. IPT offers sustainable solutions to collection system and WWTP challenges without additional energy input or capital expansion.

IPT bacteria are common soil bacteria used in high concentrations (up to 10^{13} CFU/mL) that become introduced into the wastewater treatment system. These bacteria are also found to be present in wastewater from surface waste infiltration, but they are low in numbers compared to the intestinal bacteria that are introduced continually into the collection system. The predominant bacteria in the human intestinal tract are strict anaerobes (Clark, 1977). 99.9% of the human fecal bacteria consist of as many as 400 species of strict anaerobic bacteria (Eckburg et al., 2005). A recent study found that 51% of the total bacteria detected within stool and pooled mucosa samples were *Firmicutes* (low G+C Gram-positive bacteria). Of the *Firmicutes*, 95% belonged to the *Clostridia* class, while 4.5% and 0.2% were members of the *Mollicutes* and *Bacilli* classes, respectively (Eckburg et al., 2005). **The *Bacilli* class representatives were identified as *Streptococcus, Gemella,* and *Lactococcus* genera.** The other dominant phylum was that of *Bacteroidetes* (16% of total) containing *Bacteroides* and *Prevotellaceas* species. The *Proteobacteria* were found to be very minor constituents (~0.1%) of the samples and those found included *Desulfomonas*, *Bilophila*, *Escherichia*, *Camphylobacter* and *Sutterella* (Eckburg et al., 2005; van der Waaij et al., 1994; Gossling et al., 1974).

Bacteria that thrive continuously in a contained environment such as the intestinal tract tend to become specialized in that ecosystem (Casjens, 1998). In order to compete effectively, the expressed genomes of bacteria that grow within living hosts tend to become smaller, becoming specialized to that particular environment. When these bacteria are shed from this environment in feces, they are less capable than wild-type organisms of the same *Genus species* of adapting to the new environment and will not be as efficient as generalist organisms. It has been determined that some species of these bacteria do survive and proliferate in the new environment (Cho, 2000). In particular, the *Proteobacteria* which are found in extremely low quantities in the gut, seem to thrive in the wastewater environment. These include the various sulfate reducing bacteria and *Escherichia coli*. Under conditions without IPT treatment, the bacteria present in collection systems (and therefore entering WWTPs) are primarily from the intestinal tract and their preferred environment has similar conditions as the intestinal tract. These bacteria are not the most capable for metabolizing wastewater pollutants effectively nor have the least detrimental impact on controlling odors, corrosion, and FOG.

IPT bacteria are heterotrophic endogenous spore forming facultative anaerobes and delivered to the collection system as spores. They grow by a respiration process using i) oxygen as the electron acceptor

(aerobic respiration) in the presence of oxygen, ii) nitrite/nitrate as the electron acceptor (anoxic respiration) in the absence of oxygen but in the presence of available nitrate/nitrite. They grow by fermentation process using exogenous electron acceptors from organic substrate in the absence external electron acceptor such as oxygen and nitrate/nitrite. Thus, if they are added at a higher level than occurs under normal untreated conditions, they can have added benefits to the WWTP.

IPT facultative bacteria have a faster growth rate than the anaerobic intestinal bacteria mainly because of their ability to use oxygen as the final electron acceptor under aerobic conditions but also because of their flexibility under reduced-oxygen and anoxic conditions. As an example, under optimal conditions (aerobic in the presence of glucose as the carbon source), *Bacillus subtilis* has a generation time of 28 minutes. Under anaerobic conditions, using nitrate as the final electron acceptor, *B. subtilis* has a generation time of 132 minutes. Under fermentative conditions, *B. subtilis* has a generation time of 96 minutes (versus 180 – 500 minute generation times for the typical sulfate reducing bacteria (SRB). Finally, IPT formulated soil bacteria have many desirable qualities including excretion of enzymes to break down Fats, Oils and Greases (FOG's) and recalcitrant nutrient sources (cellulose, starch, protein, etc) thereby making them more bio-available to other organisms.

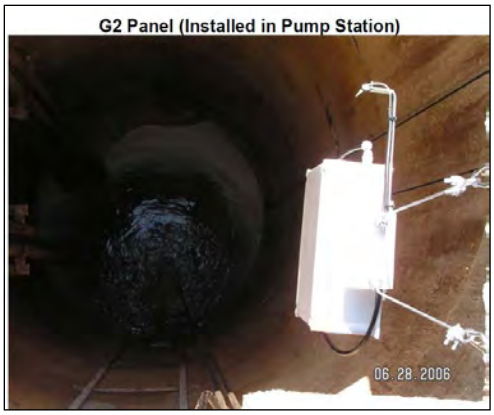
725 North Central Avenue
Wood Dale, IL 60191
Tel: 630.509.2488

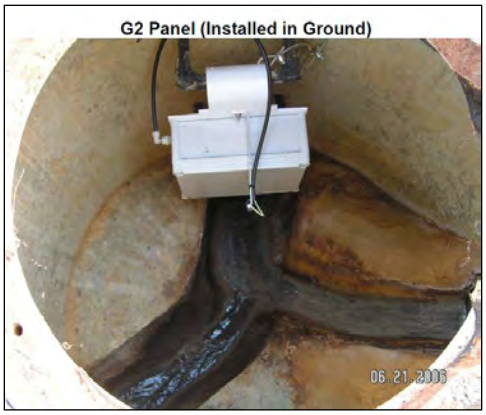
In-Pipe Dosing Units

The continuous introduction of In-Pipe microbes is achieved through numerous dosing panels (G2) located below ground, inside manholes and pump stations throughout the entire collection system. The dosing panel is approximately 12-inches x 12-inches x 6-inches. They require no external power and no above-ground liquid storage. The panels are certified by CSA International as intrinsically safe and the panels remain the property of In-Pipe for the duration of the project. Each panel contains a 30 day supply of In-Pipe microbial solution and the panels are inspected for functionality and reloaded at 30 day intervals by the In-Pipe service team. Further, with In-Pipe service neither the panel nor any other aspect of In-Pipe treatment requires any additional staffing or operating expense from the Town of Blackfalds.

During installation and subsequent microbe reloads, each dosing location is evaluated and its status is documented (i.e., accumulation of FOG, excessive odor, etc.). This information is used by the engineering team at In-Pipe to adjust the application during the project to achieve maximum performance. Additionally, we provide reports to our customers regarding potential problems that may be observed during our field service so that the Town of Blackfalds may be proactive in addressing potential problems before they occur.

A typical panel installation is shown below along with a G2 Dosing Panel with the cover removed.





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IPT Dosing Panel (Open)

Packaging and Product Safety

The material safety data sheet (MSDS) for the In-Pipe microbe blend is attached. In-Pipe manufactures the microbes. The bacteria are safe to handle and non-pathogenic. The bacteria will not harm the WWTP, the sewer cleaning equipment or plant, animal or marine life. The product is shipped in one-liter bottles only for installation into the G2 dosing panel.

In-Pipe Scope

Summary

- The supply, installation and maintenance of battery-powered IPT dosing panels installed at locations determined by In-Pipe engineering staff.
- Complete supply of IPT microbes for the duration of the contract.
- Engineering support to determine best application strategy (number/location of dosing nodes) to reduce FOG at any locations within the Blackfalds system that present persistent problems.
- Engineering service support provided throughout the project; periodic reports on project progress including analysis of lagoon operating data.
- Monthly service, maintenance, and review of the dosing panels and locations to ensure consistent dosing of microbes into the Blackfalds system.
- 6-month review meeting with Stantec and the Town of Blackfalds and summary report on program progress.

Project Management Organization Structure

Stantec shall have a single point of contact, the Project Manager (PM), with In-Pipe Technology Company for scheduling, information requests and logistics. The PM shall communicate directly with Stantec and direct internal company resources to meet the requirements as specified. The Senior Engineering Manager supervises project activities and provides technical support and oversight to the process to ensure best possible project results.

The In-Pipe PM shall coordinate with the In-Pipe Operations Coordinator to schedule the production and shipments of the monthly reload materials. The PM shall also coordinate between the Field Service Subcontractor and the town of Blackfalds to arrange the date, time and locations of the microbes to be reloaded each month.

The Field Service Subcontractor shall observe the conditions in each dosing location and targeted treatment location during each monthly reload. The observations shall be recorded on the service sheet and accompanied by photo-documentation where necessary. Each month, the PM shall review the service sheet and photo records to track and report progress periodically to Stantec.

Pricing

The total monthly fee for In-Pipe service is $3,850.00 per month. Please refer to the purchasing quote below for terms.

725 North Central Avenue
Wood Dale, IL 60191
Tel: 630.509.2488

Purchasing Quote

Proposal Number:	2014-1424
Date:	May 7, 2014
Reference:	City of Blackfalds
Availability:	6 Weeks, ARO
FOB:	Customer Site
Validity:	Proposal valid for 90 Days

To:
Stantec Consulting, Ltd.
1100 - 4900 50th Street
Red Deer AB T4N 1X7
Phone: (403) 356-3391
Fax: (403) 342-0969
Email: johnny.ke@stantec.com

Attn: Mr. Johnny Ke M.Sc., P.Eng.
Project Engineer

From:
In-Pipe Technology® Company, Inc.
725 North Central Avenue
Wood Dale, IL 60191
Phone: (630) 509-2488
Fax: (630) 509-2490
E-mail: jelliott@in-pipe.com

Attn: Jim Elliott, Vice President of Sales

Item	Qty	Item Code #	Description	Price
1	12 Months	IPT-BAB-1M	In-Pipe Technology Treatment & Service	$3,850.00/month

Terms

The initial term of the Contract shall be for a one (1) year period beginning upon the effective date of the Contract. The term of this Contract shall be automatically renewed for the like term thereafter unless either party shall give written notice of termination by certified or registered mail, return receipt requested or by fax with proof of receipt to the other party at least thirty (30) days prior to the termination of the initial term, or any renewal term.

Any expansion of services or modification of the contract is subject to future negotiation.
Please refer to attached IPTC Terms and Conditions below (Exhibit A) for additional information.

Thank you for your consideration. We look forward to reviewing the proposal with you.

725 North Central Avenue
Wood Dale, IL 60191
Tel: 630.509.2488

OFFERED BY:

IN-PIPE TECHNOLOGY COMPANY

Jim Elliott
Vice President of Sales

ACCEPTED BY:
Stantec Consulting, Ltd. (or the Town of Blackfalds)

Signature: _____

Name & Title: _____

Date: _____

725 North Central Avenue
Wood Dale, IL 60191
Tel: 630.509.2488

IN-PIPE TECHNOLOGY COMPANY, INC.
EXHIBIT A
TERMS AND CONDITIONS

1.0 ACCEPTANCE Sale of any products or services (hereafter, the "Products") by In-Pipe Technology Company, Inc. ("Seller") to Purchaser shall be subject to the terms and conditions of sale contained herein. No change in or addition to these terms shall be binding upon Seller unless specifically accepted in writing by Seller. Seller objects in advance to any additional or different terms proposed in Purchaser's order.

2.0 PRICING Prices shall be Seller's price in effect at time of shipment unless otherwise specified in Seller's written quotation. Quotations automatically expire 90 calendar days from quotation date and may be canceled at any time by written notice.

3.0 FORCE MAJEURE LIMITATION Seller shall not be liable for any loss, damage or expense resulting from delay or failure in the performance of Seller's obligations hereunder if such delay or failure is due to acts of God or the public enemy, strikes, labor troubles, fire, explosions, riots, war, governmental orders or restrictions, shortages of materials or labor, delay in transportation, theft, accidents or any other cause which is beyond Seller's reasonable control. Upon the occurrence of any such event preventing the Seller from performing all of its then outstanding contracts, the Seller shall then be entitled to perform such of its contracts as it may select and shall incur no liability to the Purchaser by reason of performing contracts other than this agreement. IN NO EVENT SHALL THE SELLER BE LIABLE FOR ANY LOSS BY REASON OF PLANT SHUTDOWN, NON-OPERATION OR INCREASE IN EXPENSE OF OPERATION OF OTHER EQUIPMENT OR FACILITIES.

4.0 DELIVERY Shipping dates are estimates only and are based on Seller's projected production schedules and commitments by suppliers. DELAY IN SHIPMENT OR VARIANCE FROM SHIPPING SCHEDULE SHALL NOT BE CAUSE FOR CANCELLATION OR CLAIM FOR DAMAGE. Receipt by the Purchaser of any Products or services shall constitute acceptance of delivery and waiver of any claims due to delay.

5.0 WARRANTY Supplier warrants that its labor, materials, and equipment supplied hereunder shall be free from defect and shall conform to the standards of care in effect in its industry at the time of performance of such labor, materials, and equipment for the time this contract is in effect.

5.1 Supplier's obligation is limited to repair or replacement F.O.B. Purchaser's facility when examination of any such equipment shall disclose them to Supplier's reasonable satisfaction to have been defective and Purchaser shall have promptly notified Supplier of the discovery of any such defect. Supplier will not be responsible for; work done, material or equipment furnished or repairs or alterations made by others.

5.2 For any breach hereunder, Supplier shall be liable to Purchaser for all damages (limited as stated in "Liability of Supplier") as shall be applicable under the law, except as otherwise provided in this agreement. Purchaser shall be entitled to pursue all rights and remedies available by law, except as otherwise provided in this agreement. THE ABOVE WARRANTY IS INLIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, WARRANTIES OR MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, WHICH ARE HEREBY DISCLAIMED.

6.0 LIABILITY OF SELLER SELLER SHALL DEFEND, INDEMNIFY, AND HOLD HARMLESS THE PURCHASER AND THEIR RESPECTIVE DIRECTORS, OFFICERS, EMPLOYEES, AGENTS AND ASSIGNS (THE "INDEMNIFIED PARTIES") FROM AND AGAINST ANY AND ALL CLAIMS, DEMANDS, OR CAUSES OF ACTION (AND ALL LOSSES, LIABILITIES, EXPENSES, AND JUDGMENTS INCURRED IN CONNECTION THEREWITH, INCLUDING BUT NOT LIMITED TO ATTORNEYS' FEES AND EXPENSES, COURT COSTS, AND OTHER EXPENSES INCURRED IN ENFORCING THIS INDEMNITY PROVISION) OR FROM ANY OTHER LOSS OR CLAIM ARISING FROM THIRD PARTY PERSONAL INJURY OR PROPERTY DAMAGE BROUGHT BY SELLER OR ANY OF SELLER'S EMPLOYEES, DIRECTORS, OFFICERS, AGENTS, OUTSIDE ADVISORY OR SUPPORT CONSULTANTS, OR REPRESENTATIVES, OR BY ANY THIRD PARTY, BASED UPON, OR IN CONNECTION WITH, RESULTING FROM, OR ARISING OUT OF, THE NEGLIGENT ACT OR, OMISSION, OR MISCONDUCT OF SELLER'S EMPLOYEES, DIRECTORS, OFFICERS, AGENTS, OUTSIDE ADVISORY OR SUPPORT CONSULTANTS, OR REPRESENTATIVES.

The Seller shall procure and maintain throughout the term of this Agreement, at its sole cost and expense, insurance of the types and in the minimum amounts set forth below. Upon execution of this Agreement, the Seller shall furnish to the Purchaser certificates of insurance and any endorsement required hereunder issued by the insurance carrier evidencing compliance with the insurance requirements hereof. Certificates shall list the Seller, the name of the insurance company, the policy number, the term of coverage, and the limits of coverage. Lapse of or cancellation of insurance, however caused, shall be deemed breach of this Agreement. In the event of lapse or cancellation of any required insurance it is

hereafter the specific responsibility of Seller to notify the Purchaser immediately and to immediately reinstate the lapsed or cancelled insurance or to purchase replacement insurance that meets the requirements of this Agreement. Additionally, all required insurance shall be endorsed to require that the Purchaser be provided with at least thirty (30) days

prior written notice of any reduction in the limit of liability by endorsement of the policy, cancellation, or non-renewal of the insurance
coverage required under this Agreement. If replacement insurance is purchased Seller is to deliver immediately to the Purchaser a replacement certificate and additional insured endorsement. The amounts and types of insurance set forth herein are minimums as required by the Purchaser. Seller, at its sole discretion, may purchase additional limits of insurance and coverage it deems necessary or prudent to protect itself and the work or operations to be performed under this Agreement. Seller shall require that all its subcontractors, of any and all tiers, to have insurance in compliance with the requirements of this Agreement; Seller shall secure and maintain subcontractors' certificates of insurance and additional insured endorsements as proof thereof. At its discretion, at any time, the Purchaser may require an audit of the required insurance documents and Contractor shall immediately deliver to the Purchaser all subcontractors' certificates and endorsements for review by the Purchaser.

The Seller shall obtain such insurance from such companies having a Bests rating of B+/VII or better, licensed to transact business in Alberta, Canada, and shall obtain such insurance of the following types and minimum limits:

1. Worker's Compensation insurance in accordance with the laws of the State of Louisiana, and Employer's Liability coverage with a limit of not less than $500,000 each employee for Occupational Disease; $500,000 policy limit for Occupational Disease; and Employer's Liability of $500,000 each accident.

2. Commercial General Liability insurance, including coverage for Products/Completed Operation, Blanket Contractual, Contractors' Protective Liability Broad Form Property Damage, Personal Injury/Advertising Liability, and Bodily Injury and Property Damage with limits of not less than

$2,000,000	general aggregate limit
$1,000,000	each occurrence, combined single limit
$1,000,000	aggregate Products, combined single limit
$1,000,000	aggregate Personal Injury/Advertising Liability

3. Business Automobile Liability coverage applying to owned, non-owned and hired automobiles, with limits of not less than $1,000,000 each occurrence combined single limit for Bodily Injury and Property Damage combined.

4. Umbrella Excess Liability insurance written as excess of Employer's Liability, with limits not less than $1,000,000 each occurrence combined single limit.

5. Professional Liability insurance with limits not less than $1,000,000 each claim/annual aggregate.

The Indemnified Parties shall be added as additional insureds to all coverages required under this Agreement, except for worker's compensation insurance and professional liability insurance, using ISO form CG 2010 (07 04) or equivalent. All policies written on behalf of the Seller shall contain a waiver of subrogation in favor of the Indemnified Parties, with the exception of professional liability insurance. In addition, all of the aforesaid policies shall be endorsed to provide that they are primary coverages and not in excess of any other insurance available to the Purchaser, and without rights of contribution or recovery against the Purchaser or from any such other insurance available to the Purchaser. The Seller, and not the Purchaser, shall be responsible for paying the premiums and deductibles, if any, that may from time to time be due under all of the insurance policies required of the Seller.

7.0 PAYMENTS Terms of payment are net 30 days. The lesser of the maximum legal rate or 8% per annum of interest and all costs of collection (including attorney's fees) shall be charged on past due accounts. All orders are subject to the continuing approval of Seller's credit department. If Purchaser is in default in any payment, Seller may declare all payments for work completed immediately due and payable, stop all further work until payments are brought current and/or require advance payment for future shipments. If the financial condition of the Purchaser at any time does not in the judgment of Seller justify continuance of production or shipment on the terms of payment set forth herein, Seller may require full or partial payment in advance or shall be entitled to cancel any order then outstanding and shall receive reimbursement for its reasonable and proper cancellation charges. In the event of bankruptcy or insolvency of the Purchaser or in the event any proceeding is brought against the Purchaser, voluntarily or involuntarily under the bankruptcy or any insolvency laws, Seller shall be entitled to cancel any order then outstanding at any time during the period allowed for filing claims against the estate and shall receive reimbursement for its reasonable and proper cancellation charges.

8.0 DRAWINGS If drawings are furnished with this proposal, they are submitted only to show the general style, arrangement and approximate dimensions of the equipment and services offered. No work is to be based upon proposal drawings. It is the Purchaser's responsibility to verify that the data given on certified drawings is suitable for applicable installation conditions. Any changes made after the order is released for manufacture will be subject to extra charges.

9.0 TITLE/RISK OF LOSS/DEFAULT Unless otherwise specified by Seller, delivery will be made F.O.B. point of shipment to Purchaser. Title to right of possession and ownership of equipment covered herein shall remain the property of the Seller. The Purchaser agrees to do all acts necessary to perfect and maintain such right and title in the Seller. In case of failure or refusal to make payments when due, then and in any such event the whole of the unpaid portion of the purchase price shall, at Seller's option, become immediately due and payable and in case of such default on Purchaser's part, Seller shall thereupon have the right to enter the premises

upon which such property shall be installed and take possession of and remove the same without legal process. This equipment shall retain its character as personal property regardless of its mode of attachment. Risk of loss or damage shall pass to Purchaser on delivery to carrier.

10.0 TAXES In addition to any price specified herein, Purchaser shall pay the gross amount of any present, or future sales, use, excess, value added or other similar tax applicable to the price, sale or delivery of any Products or their use by Seller or Purchaser, or Purchaser shall furnish Seller with a tax exempt certificate acceptable to the taxing authorities.

11.0 CANCELLATION Any order placed with Seller may be cancelled by the Purchaser only upon payment of reasonable cancellation charges, which shall take into account expenses already incurred and commitments made by the Seller. Upon delivery of such notice by the Purchaser to the Seller, the Seller shall discontinue all services in connection with the performance of this Agreement and shall proceed to cancel promptly all existing orders and contracts insofar as such orders or contracts are chargeable to this Agreement. As soon as practicable after receipt of notice of termination, the Seller shall submit a statement showing in detail the services performed under this Agreement to the date of termination. The Purchaser shall then pay the Seller promptly that proportion of the prescribed charges which the services actually performed under this Agreement bear to the total services called for under this Agreement, less such payments on account of charges that have previously been made.

12.0 PROPRIETARY IPT BULK MICROBE CULTURE The Client agrees that it will use prudent attempts to ensure that no analysis will be allowed on the IPT bulk microbe culture reagents without prior written authorization by In-Pipe Technology Company, LLC. In-Pipe Technology methodology is protected by US Patents (#5,578,211 and 5,788,841 and Canada Patent # 2,272,689) owned by the company.

13.0 DISPUTE RESOLUTION Any dispute or controversy arising out of, under, or in connection with, or in relation to, this Agreement and/or any amendments thereto, or the breach thereof, which is not resolved informally by prior mutual agreement of the Purchaser and Seller, shall be submitted to non-binding arbitration, unless otherwise waived and/or modified in writing by the Parties. The cost of such arbitration shall be paid by the Purchaser and Seller equally; however, the prevailing party in the arbitration shall be entitled to reimbursement of its attorneys fees and other costs and expenses incurred in connection therewith.

> If a dispute arises which is not resolved by arbitration pursuant to the above, and either party reasonably retains counsel for the purpose of enforcing any provision of this Agreement, including without limitation the institution of any action or proceeding to enforce any provision of this Agreement, or to recover damages if otherwise available hereunder, or to obtain injunctive or other relief by reason of any alleged breach of any provision of this Agreement, or for a declaration based on a demonstrated necessity of such Party's rights or obligations under this Agreement, or for any other judicial or equitable remedy, then if the matter is settled by judicial or quasi-judicial determination, the prevailing Party shall be entitled, in addition to such other relief as may be granted, to be reimbursed by the losing Party for all costs and expenses incurred including, without limitation, all attorneys' fees and costs for services rendered to the prevailing Party and any attorneys' fees and costs incurred in enforcing any judgment or order entered. The prevailing Party shall be as determined by the court in the initial or any subsequent proceeding.

14.0 GENERAL The terms and conditions hereof cancel and supersede all previous understandings or agreements relating to the Products covered hereunder, written or oral, between Seller and Purchaser and contain the entire understanding of the parties hereto. No waiver, alteration, deletion or modification of or addition to any of the provisions hereof shall be binding unless in writing and signed by a duly authorized representative of the Seller. If any term, provision or condition contained herein shall, to any expert, be invalid or unenforceable, the remainder of the terms, provisions and conditions hereof other than those which are invalid or unenforceable, shall not be affected thereby and each term, provision and condition of this order shall be valid and enforceable to the fullest extent permitted by law. This order and all rights and obligations of the parties shall be construed and interpreted under and pursuant to the laws of the State of Illinois.

Appendix F NELSON ENVIORNMENTAL SAGR PROPOSAL

Nelson Environmental Inc

OPTAER™

WASTEWATER TREATMENT SYSTEM

Proposal for:

Design, Supply, and Installation of

OPTAER Wastewater Treatment System

Blackfalds, AB

April 25, 2014

NE reference: cd2158.04

www.nelsonenvironmental.com

5 Burks Way, Winnipeg, Manitoba R2J 3R8

Toll Free: (888) 426-8180 • Tel: (204) 949-7500 • Fax: (204) 237-0660

1.0 Project Overview

An OPTAER Wastewater Treatment system is proposed for Blackfalds, AB. The proposed system would include a vertical flow SAGR (Submerged Attached Growth Reactor) sized to treat the design 2019 flow. As an interim measure prior to connecting to a regional treatment plant, this approach would improve effluent water quality without the capital cost of a complete system upgrade.

The proposed system would consist of the following process upgrades and technologies:

- Construct an aerated Vertical Flow Submerged Attached Growth Reactor (SAGR) for BOD and TSS polishing.
- Install new positive displacement blowers with weatherproof enclosures

2.0 System Design Parameters

SAGR design loads, flows and effluent requirements are summarized in the following tables:

		SAGR Influent	**SAGR Effluent**
Design Flow	m^3/day	2,133	
cBOD	mg/L	60	<25

SAGR aeration design parameters are summarized in the following table:

SAGR Aeration System	
	SAGR
Alpha	0.70
Beta	0.95
Theta	1.024
Site elevation (m)	869
Min. Dissolved Oxygen (mg/l)	3.0
SAGR Loading Rate (g BOD/m^2/day)	80.0
Total SCFM (design)	1,722

3.0 OPTAER Treatment Process

i. Submerged Attached Growth Reactor (SAGR)

The Submerged Attached Growth Reactor (SAGR) is designed to provide treatment in cold to moderate climates. The SAGR is essentially a clean aggregate media bed with evenly distributed wastewater flow across the surface of the cell and horizontal distributed collection chambers at the bottom of the bed. LINEAR aeration throughout the floor of the SAGR provides aerobic conditions within the bed. A layer of mulch or wood chips on the surface of the bed provides insulation.

4.0 Aeration Process Equipment

i. Main Air Supply & Distribution System

The air supply blowers are connected to a common galvanized metal discharge manifold. Galvanized metal piping continues underground, where an appropriate length of buried metal piping is used to dissipate the heat produced by the blowers. Shallow buried HDPE header piping connects to the galvanized metal header, and supplies air to the lateral connections. The main header has flanged outlets for each aeration lateral as shown on the drawings. Each lateral is individually valved for ease of maintenance.

SAGR aeration laterals run along the top of the bed on each side of the SAGR. The laterals are located in the top layer of insulating mulch. HDPE service saddles are thermally fused to the lateral piping for each drop leg. HDPE drop legs provide air to sets of individual diffuser lines.

All HDPE piping connections and fittings are thermally fused to ensure maximum strength and durability.

All header, lateral, and feeder piping is designed to accommodate increased airflow for high pressure and volume cleaning without increasing header friction losses by more than 1 psi. This allows for management of additional organic load, improved diffuser maintenance and additional odor control.

ii. Submerged Attached Growth Reactor (SAGR) LINEAR Aeration System

LINEAR coarse bubble diffusers are used to provide oxygen to the wastewater. Diffuser lines are manufactured from LDPE (Low Density Polyethylene) with reinforced air releases along the tubing. The diffuser tubing is designed for direct burial in the SAGR bed.

The diffusers are spaced according to the projected oxygen demand in the SAGR. The design diffuser distribution is critical to ensure that nitrification occurs. In addition to providing oxygen for nitrification the aeration system brings numerous other long-term performance benefits to this sub-surface flow system:

- Full aeration grid ensures that wastewater channeling cannot occur in the gravel layer maximizing retention time and media contact
- Sludge digestion in gravel layer is enhanced due to aerobic conditions
- Year-around odor-free operation

iii. Positive Displacement Blowers

Positive displacement blowers are used to provide air supply for the OPTAER treatment system. Blowers are designed to provide the required airflow at normal system operating pressure, and have the capability of operating at the maximum required pressure intermittently for diffuser purging. The blowers are equipped with sound attenuating enclosures. Blower requirements are summarized in the following table:

		SAGR Blowers
Number of blowers total		2
Number of blowers on duty		2
Number of blowers on standby		0
Motor nameplate horsepower		60
Design airflow per blower	SCFM	861
Normal operating pressure	psi	6.3
Maximum required pressure	psi	9.3
Actual Power Consumption per blower	bhp	41.5
Actual Sound level	dB(A)	73

5.0 Operation and Maintenance

Given that the existing lagoon system performance is adequate in summer, the SAGR could be run at a reduced rate during the warmer months. Anticipated operation and maintenance costs are presented below:

			*Electrical Rate:	**0.08**	$/kW-h		
		Operating	Total			Monthly	Unit	Annual
	Quantity	# Months	SCFM	bhp	kW	cost	cost	Cost
SAGR Blowers	**2**							
Summer Operating Conditions	1	6	**861**	41.5	31.0	$1,808	-	$10,848
Winter Operating Conditions	2	6	**1722**	83	61.9	$3,616	-	$21,696
Filters (6 months)	-	-	-	-	-	-	$80	$240
Oil (12 months)	-	-	-	-	-	-	$70	$105
Belts (24 months)	-	-	-	-	-	-	$250	$188
Total Operation & Materials								$33,077

* Electrical rate estimated by Nelson Environmental Inc

The OPTAER system will require one operator for approximately 0.5 - 1.0 hour per day for routine inspection & maintenance. Maintenance requirements may include:

- Blower maintenance – belt tensioning, oil changes, intake filters
- Condensate purging/operate blow-offs

6.0 Budgetary Capital Cost

Included in the Submerged Attached Growth Reactor (SAGR) budgetary capital cost are:

- NEI System Process Design (Alberta P. Eng. Stamped)
  - Process CAD drawings and specifications (Alberta P. Eng. Stamped)
- Two (2) 60 hp positive displacement blowers with:
  - Full weatherproof sound attenuating enclosure
  - Discharge air high temperature gauge/ switch
  - Drive motor high temperature thermistor protection
- Weatherproof Blower Control Panel
- Reinforced concrete blower pad
- Galvanized metal blower header and connection pipe (heat dissipation)
- HDPE shallow buried main aeration supply header
- Aeration lateral piping, feeder piping, diffusers, valves, and fittings as required
- SAGR influent distribution and effluent collection piping within the beds

- SAGR process equipment & Blower installation
- Process equipment installation within the SAGR bed
- **Start-up/ commissioning/ training**
- Operation and maintenance manuals
- As-built Drawings

Items specifically not included:

- Material offloading and on-site storage
- Power supply and wiring of blowers
- Civil works including berm design and construction, cell liner, geotextile fabric, transport piping, inter-cell piping, discharge piping, pumps, manholes, valves, access roads to site, site roads and landscaping, etc.

- SAGR flow splitter structure with integrated weirs
- Materials and construction required for the SAGR:
  - granular material
  - insulating peat or mulch
- Restoration

Budgetary capital cost for the *design, supply, and installation* of the SAGR system is:

$766,900.00 plus GST

As a cost savings measure, NEI is able to supply two previously used 60hp Kaeser blowers (5 years of service) with an outdoor control panel. The price deduction available for supplying used blowers is:

Deduction: $40,900.00 plus GST

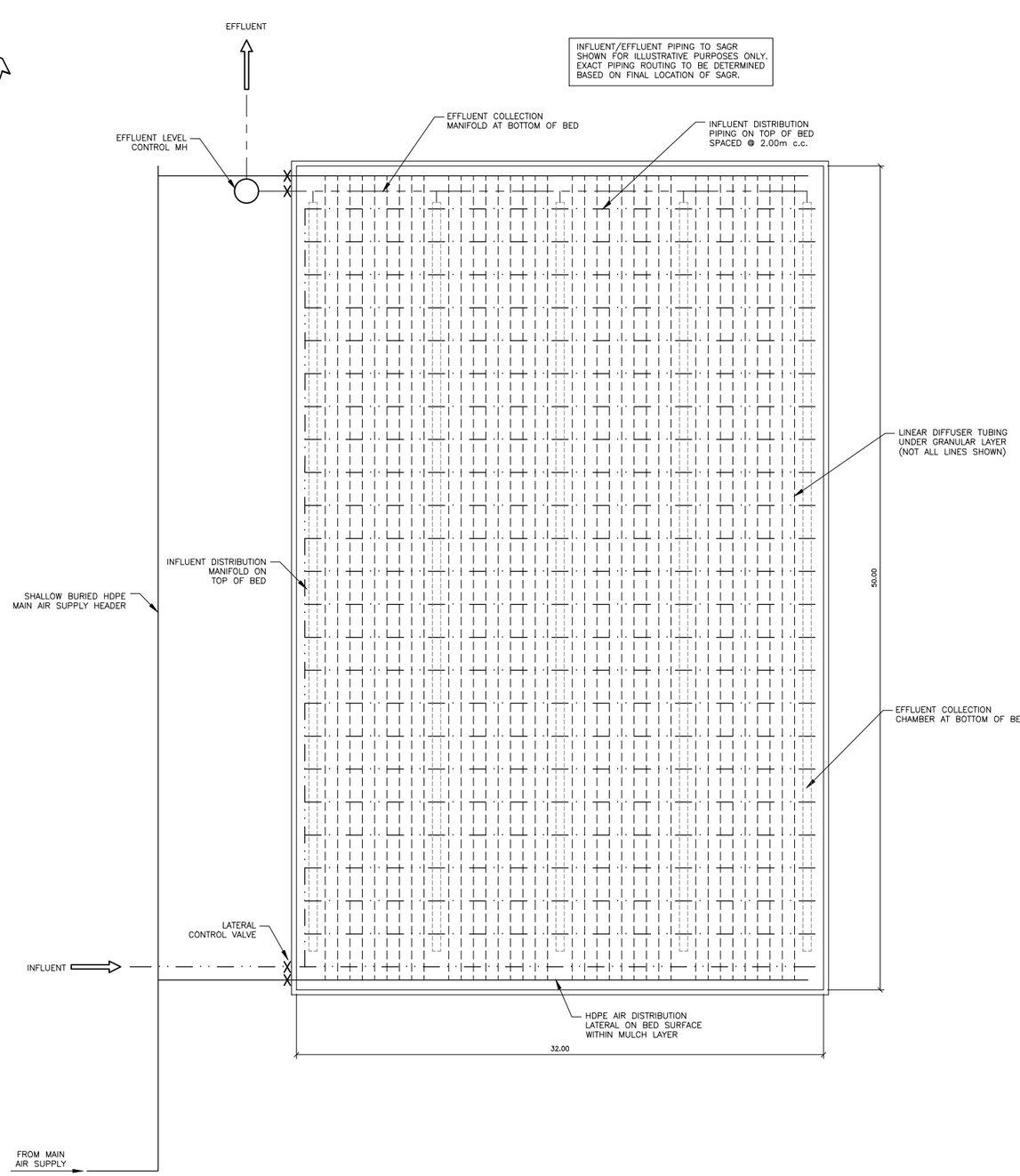
All budgetary prices include shipping to jobsite but do not include taxes.
All budgetary prices are subject to final design review
Budgetary prices are valid for 90 days.

Any questions or comments can be directed to:

Nelson Environmental Inc.
5 Burks Way
Winnipeg, Manitoba, Canada
R2J 3R8
Tel: 204-949-7500
Fax: 204-237-0660

PLOT SIZE: 610mm x 914mm (24" x 36")

REDUCED SIZE PLOT - DO NOT SCALE

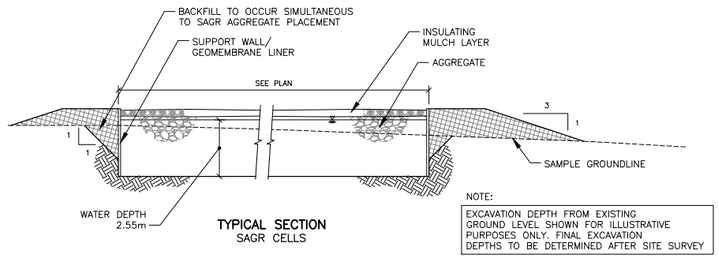


PROPOSED SAGR LAYOUT

SCALE: 1:150

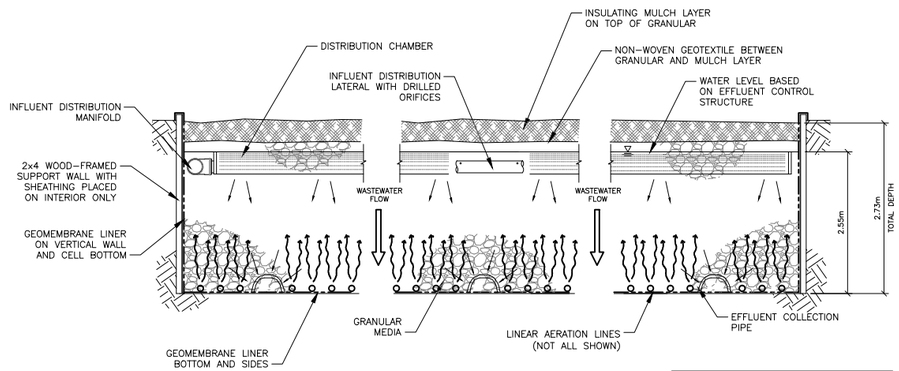
KEY PLAN

SCALE: N.T.S.



TYPICAL SECTION
SAGR CELLS

NOTE:
EXCAVATION DEPTH FROM EXISTING GROUND LEVEL SHOWN FOR ILLUSTRATIVE PURPOSES ONLY. FINAL EXCAVATION DEPTHS TO BE DETERMINED AFTER SITE SURVEY



VERTICAL FLOW SAGR – SECTION

SCALE: N.T.S.

NON-WOVEN GEOTEXTILE BETWEEN GEOMEMBRANE LINER AND GRANULAR LAYER (BOTTOM AND SIDES) AND BETWEEN MULCH LAYER AND GRANULAR LAYER (TOP)

NELSON ENVIRONMENTAL INC.
5 BURKS WAY
WINNIPEG, MANITOBA
CANADA R2J 3R8
Ph: (204) 949-7500
Fax: (204) 237-0660
www.nelsonenvironmental.com

PROJECT: BLACKFALDS, AB
PROPOSED WASTEWATER TREATMENT UPGRADE

TITLE: OPTAER WASTEWATER TREATMENT
PROPOSED SAGR LAYOUT, KEY PLAN, TYPICAL SECTION

DRAWN BY:	APPROVED BY:	SCALE:	DRAWING NO.	SHT.	REV.
JG	LE	AS NOTED	NE01	1 of 1	0
DATE: 2013/04/25	FILE #: CD2158.04				

Appendix G WCS BIO-DOME PROPOSAL

Bio-Dome Preliminary Proposal

To: Johnny Qingsheng Ke, M.SC., P.E.
Project Engineer
Stantec Consulting Ltd.
1100-4900 50th Street Red Deer, AB T4N1X7
P: 403-356-3391
F: 403-342-0969

From: Wade M Stinson
Director of Sales
wade@wcs-utah.com

Kraig Johnson, PhD, P.E.
CTO
kraig@wcs-utah.com

Wastewater Compliance Systems, Inc.
Phone: 801-999-8271

Samantha Thompson
Procesco INC.
#140 5050 106 Ave SE
Calgary AB T2C5E9
403-238-9510

Re: Town of Blackfalds, AB Wastewater Lagoon Upgrade

May 1, 2014

Contents

Executive Summary

Town of Blackfalds, AB is looking for ways to enhance the treatment capacity of their existing wastewater lagoon system. For this reason WCS has created a preliminary design and layout so that Town of Blackfalds can see the potential for further treatment while utilizing the existing infrastructure.

The following proposal provides a description of the proposed system that can provide a long term solution for Town of Blackfalds that allows the city to utilize their existing infrastructure in a cost effective and modular manner.

Key Benefits of the Bio-Domes

1. The Bio-Domes represent the least expensive treatment upgrade available in terms of both Capital expense as well as O&M expense.
2. An upgrade utilizing Bio-Domes will not require new operators with additional training, certification, and or a higher pay grade.
3. The Bio-Dome system is intended to be a modular, expandable, system that is capable of growing with the community over the next 20+ years.
4. The Bio-Domes can be coupled with other, more conventional, technologies to address future phosphorous or Total Nitrogen Limits.
5. Because of the energy efficiency of the Bio-Domes the proposed system can be considered “green” and will possibly qualify the community for Energy Efficiency grants if any are available through their utility provider.

Background

The Town of Blackfalds has reached a consistant level of loading that exceeds the facilities current ability to remove all of the required CBOD in the winter months.

Project Goals

The primary goal of this upgrade is to allow Town of Blackfalds to upgrade their wastewater lagoons in such a fashion as to allow them to meet all state CBOD effluent requirements. The parameters used for the influent and effluent characteristics as described below.

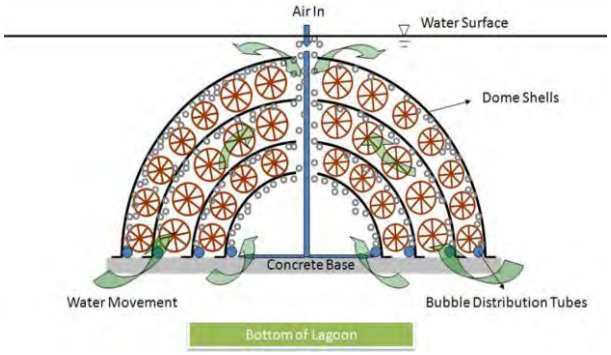
Project Design Parameters

The following proposal does not take into account any facultative performance. The engineering parameters used to develop this proposal for a complete treatment system are as follows:

	Design Criteria	
Daily Flow Rate	2133	m^3/day
Influent		
BOD	62	mg/L
TSS	0	mg/L
Ammonia	0	mg/L
Permitted Limits		
BOD	25	mg/L
TSS	0	mg/L
Ammonia	0	mg/L
Removal		
BOD	37	mg/L
TSS	0	mg/L
Ammonia	0	mg/L
Winter water temperature	0.5	°C
Lagoon Operating Depth	3.5	m

Product Overview

WCS manufactures and sells patented submergible aerated bio-film reactors under the trade names Bio-Dome & Bio-Shell that were developed at the University of Utah to reduce BOD, TSS, and / or NH_4+-N from wastewater streams in a lagoon environment. It is recommended that for this application, Bio-Domes be used to provide the necessary treatment. Each Bio-Dome consists of an assembled 4-dome set that contains 263.84 m^2 of aerated surface designed to remove 2.54kg BOD/Bio-Dome/day and 0.98kg TSS/Bio-Dome/day, or 0.08kg NH_4+-N /Bio-Dome/day.



Bio-Domes and Bio-Shells are positioned on the floor of a lagoon for year round, ice-free operation

Town of Blackfalds System

Because the Bio-Domes rely on fixed film, as opposed to suspended growth, they provide reliable nitrification in water temperatures as low as 2°C. Since the Town of Blackfalds currently uses a lagoon system for their wastewater treatment, utilizing WCS's Bio-Domes will allow the community to cost-effectively utilize their ***existing*** infrastructure while maintaining compliance with the new expected permit levels.

Sizing Calculations

Town of Blackfalds currently utilizes aeration in the wastewater lagoon. It is the intention of this proposal to show an upgrade that can work fluidly along with the existing treatment. These initial designs do not account for facultative performance.

The calculations for these units are provided on the following page. Since the Bio-Dome system can treat BOD and TSS jointly, the larger of the two calculated systems will be utilized and not the two combined. However, the systems are not able to treat BOD, TSS, and Ammonia jointly.

Furthermore it is assumed that because of the robust nature of the fixed film within the Bio-Domes the performance of the Bio-Domes will not decrease appreciably throughout the winter months as long as the water temperatures stay above 0.5°C, therefore no additional Bio-Domes are necessary in order to ensure winter compliance.

Please Note: The proposed system will allow Town of Blackfalds to achieve an effluent quality that meets the expected permit levels based on current information. In the future as the community grows and loading is increased, additional Bio-Domes can be installed incrementally on an as need basis in order to ensure compliance.

In the event that Town of Blackfalds is given a Total Nitrogen limit, air cycling can be introduced into the treatment regime in order to denitrify as well. If Phosphorous limits are added to the permit, an additional process step such as chemical precipitation or filtration can be added to the process in order to meet the new limit. In both cases, the existing Bio-Dome system will reduce the overall size of the future expansion.

A key feature of the Bio-Domes is their modular nature which allows for seamless growth with the community in order to meet increased populations sizes, loading and even more stringent effluent requirements.

CBOD Polishing Calculations

Product Removal Statistics						
BOD (kg/day)		Tss (kg/day)		Ammonia (kg/day)		Flow (m^3/day)
2.54		0.98		0.08		2133
Loading Conversions						
				BOD		
Flow (m^3/day)	*	Δ BOD (mg/l)	/	Conversion Factor	=	Converted Loading (kg/day)
2133	*	37	/	1000	=	78.92
				TSS		
Flow (m^3/day)	*	Δ TSS (mg/l)	/	Conversion Factor	=	Converted Loading (kg/day)
2133		0		1000		0.00
				Ammonia		
Flow (m^3/day)	*	Δ Ammonia (mg/l)	/	Conversion Factor	=	Converted Loading (kg/day)
2133		0		1000		0.00
Sizing Calculations						
BOD						
Converted Loading	/	Bio-Dome Removal	=	# of Units		
78.92	/	2.54	=	31.07		
Bio-Domes Required			=	32		
TSS						
Converted Loading	/	Bio-Dome Removal	=	# of Units		
0.00	/	0.98	=	0.00		
Bio-Domes Required			=	0		
Ammonia						
Converted Loading	/	Bio-Dome Removal	=	# of Units		
0.00	/	0.08	=	0.00		
Bio-Domes Required			=	0		
		Total Required Units	=	**32**		

Aeration / Power Requirements

Item	Bio-Dome System	
Number of Bio-Domes	32	
Aeration Requirements[1]	32	SCFM
Pressure Requirements	6	psi
Estimated Power Requirements	1.6	bhp
Utility Rate	$0.07	/ kWhr
Estimated Annual Power Cost[2]	$732	
Estimated Annual O & M Cost[3]	$800	

1. For blower sizing, WCS strongly recommends 3-phase blowers with a variable speed drive, rated at 2x the estimated power consumption rounded up to the nearest available blower size.
2. Based on $0.07 USD / kWhr.
3. Based on a $25 USD / Bio-Dome for labor and materials to perform a air hose purge every 24 months per the manufacturers recommendations. Blower maintenance not included as that decision is left to the consulting engineers.

Installation

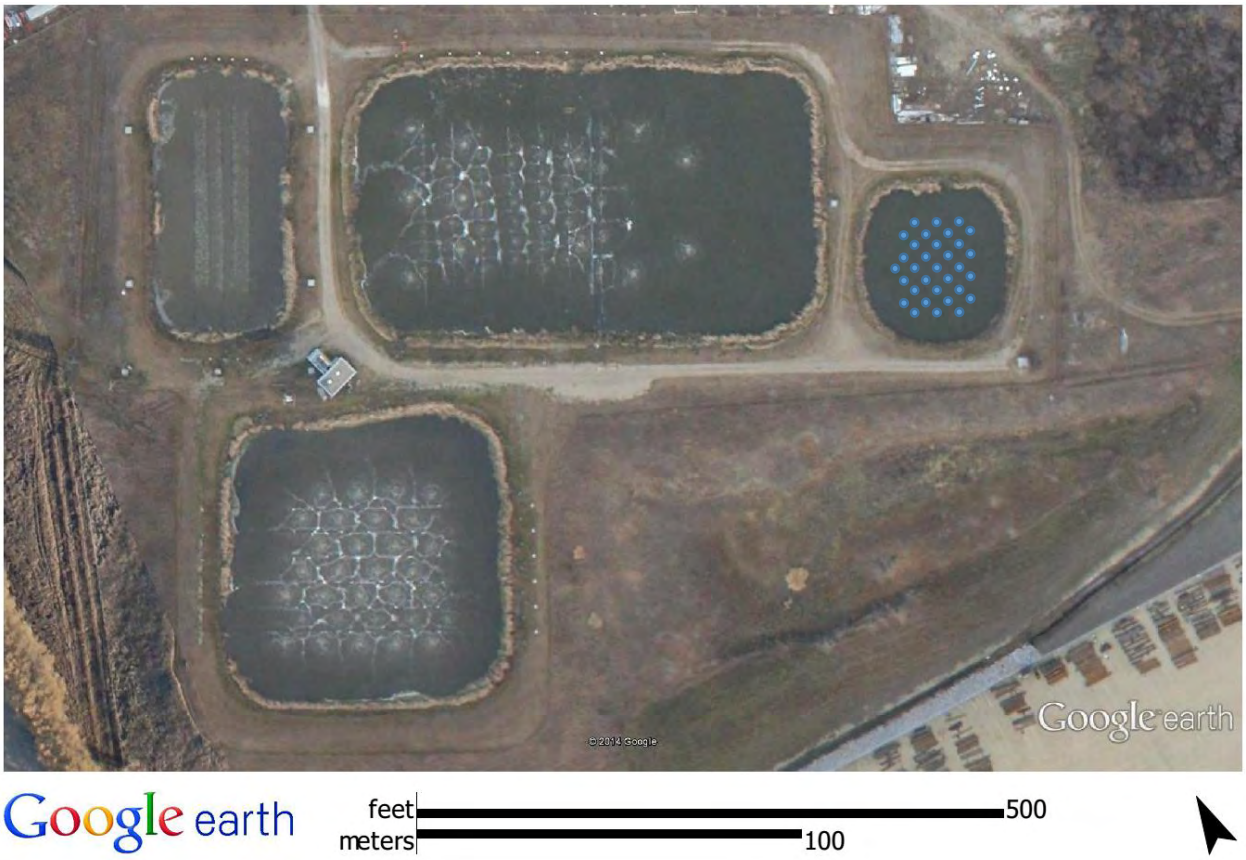
The installation of a Bio-Dome system occurs in two phases. Phase 1 is the construction of the infrastructure needed to deliver the air from the blower(s) to the Bio-Domes. The exact details of the aeration system are left to the discretion of the design engineer as long as the air manifolds are capable of delivering 1CFM to each Bio-Dome. Part 2 of the installation process is the actual placement of the Bio-Domes in the wastewater lagoon. Typically, this is performed utilizing a crane from the bank of the lagoon. It is not necessary that the lagoon be completely drained for the installation although that would speed the installation up considerably.

Based on previous experience, for a project this size, the cost of installation is between 8 – 10% depending on materials and labor costs.

The Bio-Domes should be installed close to the effluent of the lagoons, and arranged in such a fashion as to ensure the water must flow past them. Recommended placement of the Bio-Domes can be seen on the following page.

Preliminary Proposed Layout

WCS recommends the following placement of the 32 Bio-Domes. Placing them in the final polishing cell of the system enables the Bio-Domes to remove the final 25 mg/L of BOD before discharging. This drawing is drawn approximately to scale.



Google earth feet 500 meters 100

Miscellaneous Considerations

Sludge Depth

Because the Bio-Domes are installed on a 12 inch high, concrete base, the maximum sludge depth within the lagoon is 10 inches. A greater sludge depth will require a custom base in order to ensure the Bio-Domes are able to draw water in from the bottom effectively.

Operator Savings

The continued use of the existing lagoons combined with WCS's Bio-Dome system will allow Town of Blackfalds to avoid the necessity of hiring operators that are qualified to operate a mechanical plant, resulting in significant labor cost savings.

Energy Savings / Rebates

Because of the energy efficiency of WCS's products compared to traditional aeration systems, it is typical for communities to lower their monthly utility bill after implementing the Bio-Domes in their lagoons. Additionally many power companies around the country offer rebate incentives for "energy efficiency" upgrades that could potentially help offset the installation cost. WCS recommends you contact your local power company to see if rebates are available.

Maintenance

Maintenance for the Bio-Domes consists of daily visual inspection to ensure the air is on and flowing through each dome. Yearly cleaning of the air diffusers which is achieved by injecting a mild acid into the air hose on the shore and blowing it out through the diffusers. A 10 year visual inspection of the Domes, and a 20 year replacement of the diffusers. Additionally there is maintenance associated with the blowers.

Sizing Accuracy

The removal rates are based on averages from multiple locations, Bio-Dome performance can vary from site to site and WCS recommends performing a pilot study prior to every installation in order to obtain site specific removal rates.

Cost Summary

Item	Bio-Dome System	
Number of Bio-Domes	32	Units
Quantity Discount	5	%
Estimated Capitol Cost[1]	$133,760	
Estimated Shipping Cost[2]	$10,090	
Expected System Life	20	years
System Flow Rate	2133	m^3/day
Estimated Cost/Gallon[3]	$0.26	$/gal/day

1. Quoted price is for Bio-Domes F.O.B Lehi, UT. WCS does not supply hanging curtains or blowers. That equipment must be procured separately. If requested, WCS can provide a quote for the self-sinking rubber air feed hose that runs from shoreline air distribution boxes to each submerged Bio-Dome.
2. This estimate is based on the assumption that 8 units can be included in each load, and each load will cost approximately $2,522.50 to ship from Lehi, UT to Town of Blackfalds, AB.
3. Based on $0.07 USD / kWhr plus annual O&M expenses for 350 gallons / day / household.
4. **All prices reflect current cost estimates as of the date of this proposal. Final pricing will reflect actual costs at time of order issuance.**

Warranty Information

WCS warrants the performance of WCS Bio-Domes & Bio-Shells under the following conditions:

A. **Warranty Guidelines:**
   a. In order to warrant performance, WCS requires:
      i. That a requisite number of *Bio-Domes* or *Bio-Shells* be installed in accordance with the calculated number intended to meet or exceed engineering requirements. This requirement may include contaminant and flow levels that exceed currently expected values. The number of additional *Bio-Domes or Bio-Shells* will be determined exclusively by WCS at the request of the customer.
      ii. That the community and engineering firm allow WCS to review and approve the design and operation of the air delivery system.

The customer must maintain an operating log to confirm proper *Bio-Dome or Bio-Shell* operation and maintenance activities in accordance with WCS provided specifications and operator manuals.

   b. The customer must allow WCS to perform on-site examinations of any under-performing and/or defective *Bio-Domes or Bio-Shells* in order to determine the cause of failure. If any of the exceptions described below are found to be the cause of failure, WCS reserves the right to void the warranty.

B. **Performance Warranty:** WCS offers a 5 year performance warranty. In the event that a warranted system fails to meet the effluent limits established in the final engineering requirements, WCS will provide additional equipment necessary to achieve compliance.
   a. Exceptions:
      i. WCS is not responsible for the lack of performance due to contaminants in the wastewater that impair or kill the microbes growing in the biofilm of the *Bio-Domes or Bio-Shells.*
      ii. WCS will not guarantee performance of blowers and equipment provided by others, or failures due to air delivery system malfunction unless all WCS recommended operating and maintenance procedures are complied with.

C. **Mechanical Warranty:** WCS offers a 5 year, prorated, product warranty on all mechanical components manufactured / assembled by or on behalf of WCS. In the event of a mechanical failure, WCS will repair or replace the defective units / parts.
   a. Exceptions
      i. WCS does not offer any warranty on blowers purchased separately and not provided as part of a WCS contract. Warranty on blowers provided by WCS is limited to the manufacturer's warranty. This exception applies to all blower systems, including off-grid blower units.
      ii. WCS warranty will not cover equipment that is damaged because of improper operation, the lack of proper maintenance, or accidental damage.

D. **Claims:** In the event that *Bio-Domes or Bio-Shells* do not achieve expected performance or experience a mechanical failure, the customer should immediately contact WCS and provide a written report of the problem as well as provide WCS with a copy of all operating and maintenance logs. Provided that customer has met all requirements necessary to qualify for warranty coverage, WCS will provide the customer with repaired or replacement units or additional units in order to achieve performance compliance.

Quality Control/GMPs:

WCS shall ensure that Bio-Dome products meet all Product specifications mutually agreed upon by the parties. Any Products failing to conform to such specifications shall be returned to WCS at WCS's expense. WCS shall be responsible for compliance with present and future applicable statutes, laws, and regulations relating to the design, manufacture and/or quality of the Products (including Good Manufacturing Practices).

Training:

WCS shall provide Town of Blackfalds and its designated project managers with product manuals, training materials, and product literature with respect to the use and installation of the Products

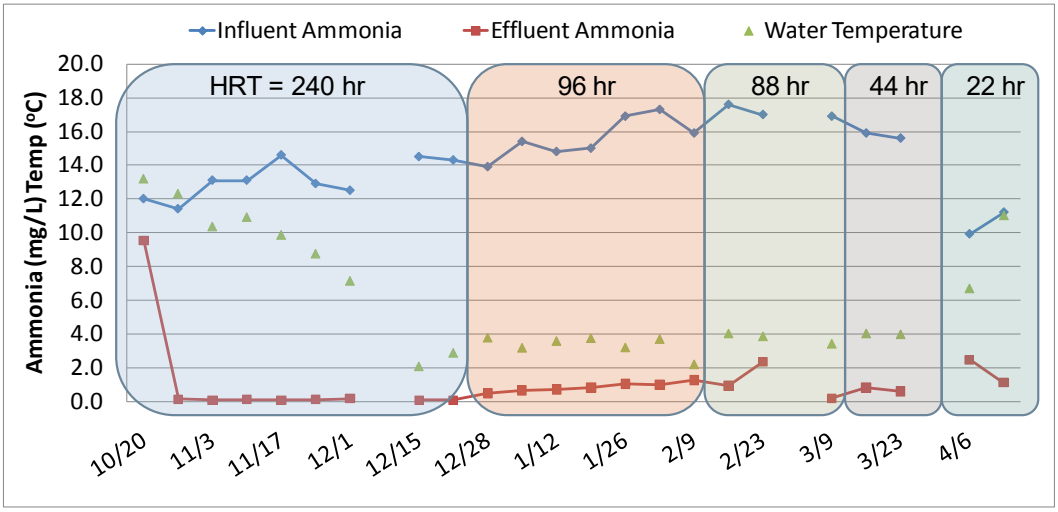
Product Support & Maintenance:

WCS and Town of Blackfalds shall mutually agree upon support and maintenance services in connection with the Project. WCS shall provide mutually agreed upon levels of Product Support and Maintenance.

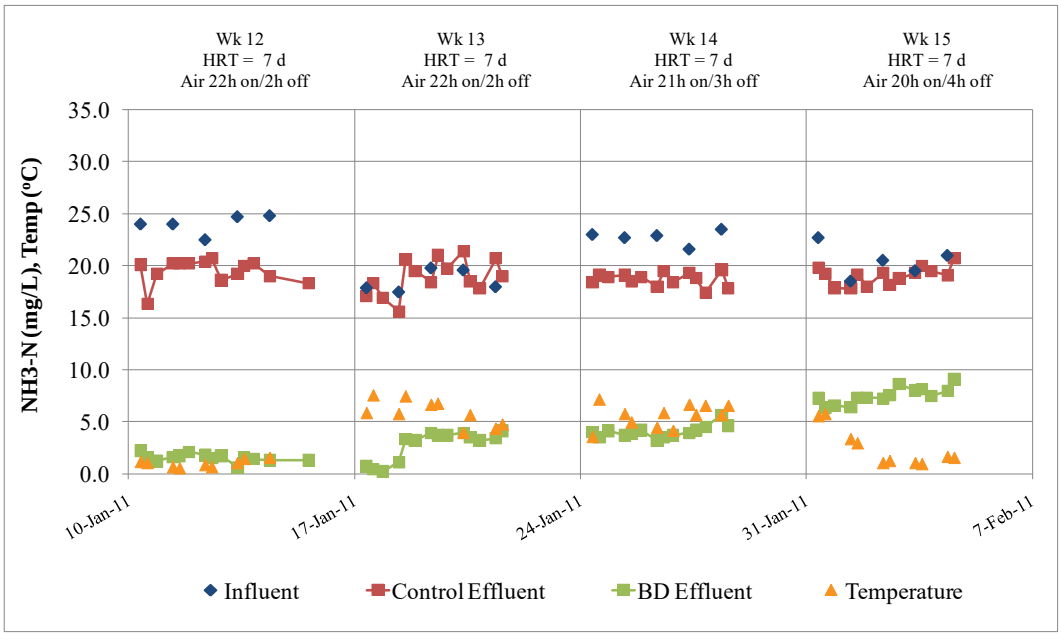
Appendix A

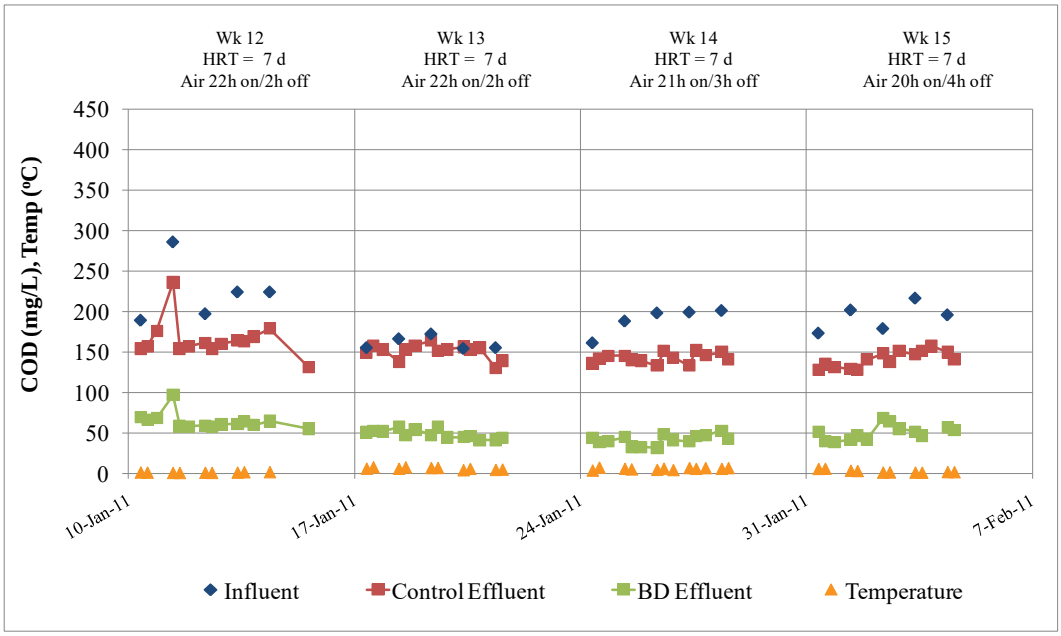
Bio-Dome Performance Examples

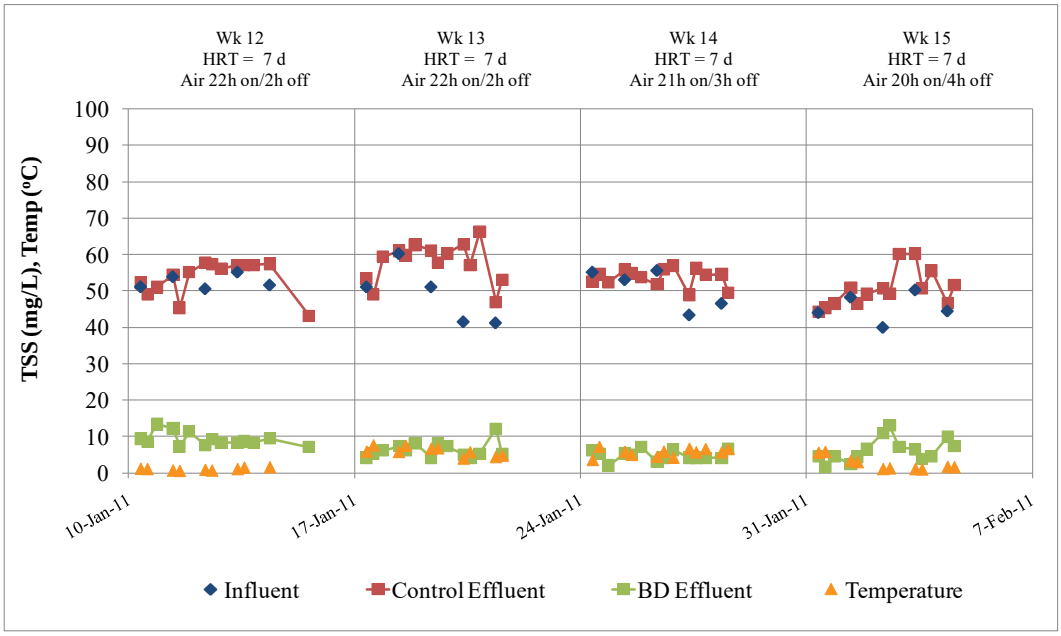
Beginning in October of 2010, WCS provided Gresham WI with a Pilot Unit designed to provide on-site demonstration of the Bio-Dome performance capabilities in cold weather. The pilot unit has been running continuously since then, and the community has taken weekly samples to measure performance. The chart below provides a comparison between the ammonia levels in the influent and effluent of the pilot unit. Also plotted on the graph are the water temperatures measured at the time the samples were collected.



Additionally, beginning in October 2010 and concluding in February 2011, WCS ran a USDA sponsored SBIR Phase I, pilot study in Salt Lake City, UT to evaluate cold weather performance of the Bio-Domes compared to the performance of a typical aeration system. The graphs below shows a sample of the data obtained during the study from January 10, 2011 through February 7, 2011 for Ammonia, COD and TSS. Additional data from the USDA research project, as well as the full USDA report, is available on the WCS website.




Wk 12
HRT = 7 d
Air 22h on/2h off
Wk 13
HRT = 7 d
Air 22h on/2h off
Wk 14
HRT = 7 d
Air 21h on/3h off
Wk 15
HRT = 7 d
Air 20h on/4h off
COD (mg/L), Temp (ºC)
450
400
350
300
250
200
150
100
50
0
10-Jan-11
17-Jan-11
24-Jan-11
31-Jan-11
7-Feb-11
Influent
Control Effluent
BD Effluent
Temperature


Wk 12
HRT = 7 d
Air 22h on/2h off
Wk 13
HRT = 7 d
Air 22h on/2h off
Wk 14
HRT = 7 d
Air 21h on/3h off
Wk 15
HRT = 7 d
Air 20h on/4h off
TSS (mg/L), Temp (ºC)
100
90
80
70
60
50
40
30
20
10
0
10-Jan-11
17-Jan-11
24-Jan-11
31-Jan-11
7-Feb-11
Influent
Control Effluent
BD Effluent
Temperature

Appendix B

Bio-Dome Maintenance Equipment

Given the size of the lagoons and the number of domes associated with this project, WCS recommends the use of a service barge and service cages to facilitate installation and on-going maintenance. They can either be rented from WCS for the duration of the installation or purchased directly for long term use. Both are shown below:

The images above show the service barge being used to pull out (left) a Bio-Dome and deliver it to the shore (right) from the Wellsville UT installation as part of an upgrade to the latest and most efficient air distribution hose.

The images below show the use of the service cage. The image on the left shows the service cage being installed on the dome, tipped on its side (center) and inspected and upgraded with the new softened PVC hose (right)

Appendix C

The Product:

Current *bio-dome* variations consist of 4-dome (*bio-dome* 2800) and 7-dome units (*bio-dome* 400) (Figure 1 & 2) for use in secondary and primary ponds, respectively. Both models consist of concentrically stacked domes secured to a custom concrete base with gas / air delivery under each shell (Figure 3).

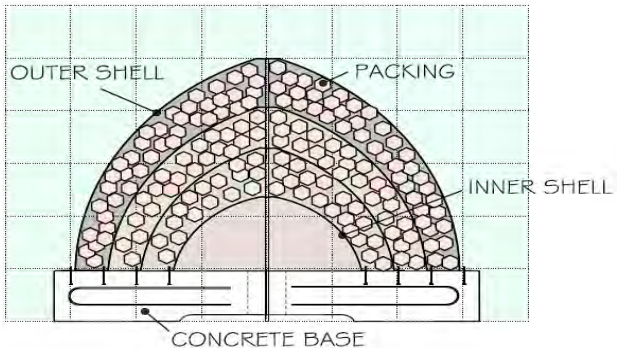


Figure 1 - Cross Section of 4 Dome Bio-Dome

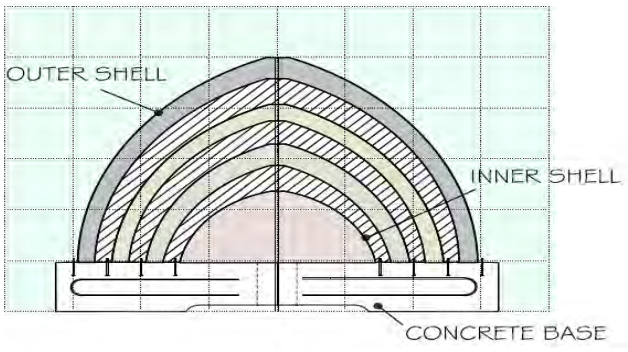


Figure 2 - Cross Section of 7 Dome Bio-Dome

Dimensions:	6 ft OD x 5 ft H
Total Surface Area:	2800 ft^2
Weight:	820 lbs

Dimensions:	6 ft OD x 5 ft H
Total Surface Area:	400 ft^2
Weight:	800 lbs

Materials

Bio-domes are designed and constructed for year round submersion. Each *bio-dome* is constructed of recycled ABS plastic, concrete, stainless steel, pvc pipe and rubber hose, and softened PVC diffuser hose.

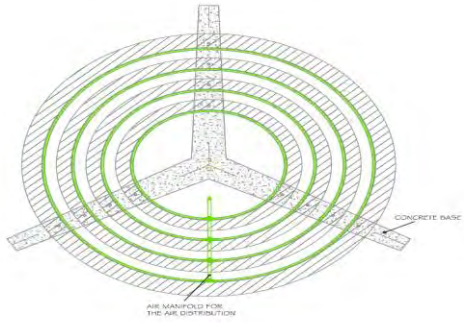


Figure 3 - Plan view of 4 Dome Bio-Dome

Operation Requirements

Airflow:	1 CFM @ 5 psig / *bio-dome*
Power:	~ 75 W / *bio-dome*
Off-Grid Compatible:	Yes (solar or wind)