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1.0 Introduction

1.1 Authorization

In July 2007 ISL Engineering and Land Services (ISL) was commissioned by Aquatera Utilities Inc. to undertake a feasibility study and identify a future strategy to discharge the Clairmont wastewater lagoon to the Aquatera sewerage network within City of Grande Prairie. The project was authorized by Mr. Evan Albinati, C.E.T., of Aquatera Utilities.

1.2 Study Context / Purpose

The recently completed 2005 Wastewater System Master Plan – Grande Prairie-Clairmont Corridor Servicing Strategy (WWMP) assessed the existing wastewater system and determined short and long term improvement requirements. A major finding was the immediate need to address treatment capacity at the wastewater lagoon facility as the existing facility was at or nearing capacity.

The objective of this report is to undertake a feasibility study to investigate future servicing strategies for discharging the Clairmont lagoon into the 116 Street Sanitary Trunk Sewer within the City of Grande Prairie and directly to the Aquatera Wastewater Treatment Plant (WWTP). The overall study area is shown at Figure 1.1.

The study includes considering the feasibility of the options identified in the WWMP and the potential for integrating the Clairmont discharge with planned development in the northwest corner of the City of Grande Prairie (Bear Creek Highlands and adjacent lands).

2.0 Background

2.1 Existing Infrastructure

The existing Clairmont Lagoon is a conventional facultative lagoon. The capacity of the lagoon cells are as follows:

- Anaerobic Cell: 8,000 cubic metres
- Facultative Cell: 48,000 cubic metres
- Storage Cell: 322,500 cubic metres

The treatment capacity of the lagoon is approximately 800 cubic metres per day (refer to Table 2.1).

Table 2.1: Clairmont Lagoon Capacities

Cell	Volume (m^3)	Retention Time	Capacity (m^3/d)
Anaerobic Cell	8,000	2	4,000
Facultative Cell	48,000	60	800
Storage Cell	322,500	365	880

The effluent from the lagoon is released into the outfall of Ferguson Lake which drains into the Grande Prairie Creek.

2.2 Previous Studies

In January 2007 ISL completed the 2005 Wastewater System Master Plan - Grande Prairie-Clairmont Corridor Servicing Strategy (WWMP). The purpose of the WWMP was to develop efficient and cost effective servicing strategies as a planning tool to accommodate the tremendous growth in the Grande Prairie-Clairmont Corridor in an orderly manner. The WWMP assessed the existing wastewater system and determined short and long term improvement requirements. A major finding was the immediate need to address treatment capacity at the wastewater lagoon facility as the existing facility was at or nearing capacity.

2.3 Treatment Improvement Options and Implementation Strategy

The WWMP considered various options to improve capacity of the existing treatment facility, including:

- Expansion of the existing lagoons
- Convert the facility to an aerated lagoon that will permit a bi-annual discharge, effectively doubling the capacity to around 1,600 cubic metres per day
- Construction of a conventional wastewater treatment plant (WWTP)
- Discharging the lagoon to the Aquatera sewerage network within the City of Grande Prairie, and convert the existing lagoon to a wet weather storage facility

Expansion of the existing lagoon was deemed to be unfeasible as adequate space is not available. The construction of a conventional WWTP was discounted on the basis of cost. The option to convert to an aerated facility will approximately double the treatment capacity but will not provide an ultimate solution. The WWMP recommended that the aerated lagoon option be implemented as an interim measure while the option of converting the lagoon to a wet weather storage facility was investigated.

In addition to the above, a further option has also been identified. This option considers the potential to generate further capacity at the site by utilising the adjacent Ferguson Lake as a specialised wetland treatment facility. This option is being considered by ISL on behalf of Aquatera as a separate study.

The lagoon upgrading to an aerated system is currently being implemented as an interim solution while two long term solutions (discharge to City of Grande Prairie and Ferguson Lake) are investigated.

3.0 Flow Projections

3.1 Design Criteria

An assessment of future wastewater flows was carried out for the WWMP. This assessment was undertaken using the best information available and applying the accepted design criteria of the day.

The study found that the projected wastewater flows, when applying Full Design Standards, appeared to be unrealistic. It was reported that the criteria used for commercial and industrial wastewater flows were excessive and that a more realistic estimate, while remaining conservative, was achievable by factoring the flow from the five year growth contour by one sixth, and the remaining growth contours by one third (the Master Plan Reduction).

Further assessment of future flow was carried out for a project to upgrade the Clairmont Regional Lift Station. This project benefited from the availability of flow monitoring data and suggested two additional scenarios for considering these flows. These were

- A 1/6 reduction factor for all no-residential growth contours
- An extrapolation of existing flow conditions.

The flow data for the 'Extrapolated' scenario was estimated based on an extrapolation of existing flow conditions. This was done by calculating flow generation rates from flow monitoring and pump activity records. Records indicated an average and peak dry weather flow rate of 1.8 L/s and 3.2 L/s, respectively, for the Northgate Industrial Park Lift Station #3. The area of site developed lots serviced by Industrial Park Lift Station is about 375 ha resulting in an average dry weather flow generation rate of 415 L/ha/day. This value was multiplied by the proposed developed area as per the WWMP to determine ADWF rates. A peaking factor of 2.0 was assumed to calculate PDWF and I/I was assumed to be 0.1 L/s/ha for PWWF (Based on a PWWF of about 50L/s over a total service area of 485 ha).

The flow projections made by the scenarios applying the systematic reduction factors both provide relatively similar results when compared with those made by applying the Full Design Standards and the extrapolation scenarios. Therefore, only one of these has been used when comparing the possible range of future flows.

For the purposes of this study the following scenarios have been considered:

- The 'Extrapolated' flow scenario
- The 'Master Plan Reduction' flow scenario
- The 'Full Design Standards' flow scenario.

3.2 Wastewater Flow Projections

The average dry weather flow and the peak wet weather flow for the three scenarios described previously in this section are presented at Table 3.1.

The flow data for the 'Master Plan Reduction' and the 'Full Design Standards' scenarios was extracted directly from the WWMP at the growth horizons of 2010, 2020, 2030 and 2040. The data between these horizons has been interpolated linearly.

Table 3.1: Clairmont Wastewater Flow Projections

Year	Flow Rate (L/s)					
	Average Dry Weather Flow (ADWF)			Peak Wet Weather Flow (PWWF)		
	Extrapolated	Master Plan Reduction	Full Design Standards	Extrapolated	Master Plan Reduction	Full Design Standards
2010	18	45	207	208	280	766
2011	19	52	216	218	307	799
2012	21	59	224	229	334	831
2013	22	65	233	240	361	864
2014	23	72	241	251	388	896
2015	24	79	250	261	415	929
2016	26	86	258	272	442	961
2017	27	92	266	283	468	994
2018	28	99	275	293	495	1,027
2019	30	106	283	304	522	1,059
2020	31	113	292	315	549	1,092
2021	34	117	298	329	567	1,118
2022	36	121	305	343	584	1,144
2023	39	124	311	357	601	1,170
2024	42	128	318	371	619	1,196
2025	45	132	324	385	636	1,222
2026	47	136	331	399	654	1,248
2027	50	140	337	413	671	1,274
2028	53	144	344	427	688	1,301
2029	56	148	350	441	706	1,327
2030	58	152	357	455	723	1,353
2031	68	162	368	496	767	1,404
2032	77	172	380	538	810	1,455
2033	87	183	392	579	854	1,506
2034	97	193	404	621	897	1,557
2035	106	203	415	662	941	1,608
2036	116	213	427	704	984	1,659
2037	126	224	439	746	1,028	1,710
2038	135	234	451	787	1,072	1,760
2039	145	244	462	829	1,115	1,811
2040	154	254	474	870	1,159	1,862

The Extrapolated flow projection represents the most likely future flows if the commercial and industrial areas continue to develop with primarily shop and yard facilities with very low water usage. Given the types of development that has occurred to date, this flow projection is arguably the best representation of the future flows.

The Master Plan Reduction projection represents future flows with a mix of shop and yard facilities with higher water users such as hotels, restaurants, and processing facilities (e.g. industry that uses large volumes of water as part of processing). This flow projection, in allowing for higher water users, provides flexibility in land use planning while recognizing the existing types of commercial/industrial development in the service area. The likelihood of the flows exceeding these flow projections is therefore considered to be low.

The Full Design Standards flow projection allows for very high water usage throughout the service area. It is therefore considered to be a very conservative, with a very low likelihood of these flows ever being materialized.

4.0 Opportunities and Constraints

4.1 Introduction

Prior to developing a series of servicing options for discharging the Clairmont Lagoon to the Aquatera sewerage system within the City of Grande Prairie, ISL considered the opportunities and constraints associated with existing and proposed wastewater infrastructure. Facilities that can be used on either an interim or permanent basis are viewed as opportunities. Where the existing or proposed facilities have specific limitations in their capability to be used, these limitations are considered to be constraints.

4.2 Aquatera Wastewater Treatment Plant

Located approximately 20 km south of the Clairmont lagoon treatment facility is the Aquatera Wastewater Treatment Plant (WWTP). This treatment facility provides the opportunity to discharge the ultimate ADWF (Full Design Standards flow scenario) from Clairmont lagoon. Thus providing servicing to around 2040.

It should be noted that the WWTP would have limited capacity to accept flows from the Clairmont Lagoon during wet weather flow conditions due to the local inflow/infiltration from the collection system within the City of Grande Prairie. Discharges rates from the lagoon to the WWTP should therefore be restricted as much as possible, either by pumping at a constant ADWF or further reduced by the use of Real Time Control.

4.3 116 Street Sanitary Trunk Sewer

In order to accommodate development along the west boundary of the City of Grande Prairie Aquatera retained Focus Corporation (formerly GPEC) for the preliminary design of the 116 Street Sanitary Trunk Sewer. The purpose of this sewer is to provide a wastewater collection system for the 116 Street Trunk Sewer Expanded System (land immediately west of 116 Street from about 68 Avenue to 132 Avenue, including the Bear Creek Highlands Development) including an allowance for the Clairmont lagoon discharge. A capacity allowance of 300 L/s has been provided within the 116 Street Trunk for a discharge from the Clairmont Lagoon.

Some sections of this trunk have been constructed, including:

- A 600 m section immediately west of 108 Street (Wapiti Road) in the O'Brien Lake neighbourhood
- A section of trunk within the Centre West Business Park west of 116 Street and south of 100 Avenue

The section of trunk south of 68 Avenue between 102 and 108 Streets has funding approval and the construction is expected to commence in 2008 following completion of the land acquisition.

The estimated cost to construct the 116 Street Trunk to 116 Avenue is approximately $26.3 M ($2007). The timing of construction will depend on the availability of funding and will be developer driven. Completion of the trunk to 116 Street and 116 Avenue is expected to take between 10 and 20 years at the current growth rates, but could take longer.

4.4 Bear Creek Highlands (BCH) Lift Station and Forcemain

The proposed developments in Bear Creek Highlands (BCH) and surrounding areas require wastewater servicing to convey the flow to the Aquatera WWTP. The offsite servicing of the BCH development will be serviced by the 116 Street Trunk. However, the trunk will only extend as far north as 116 Avenue due to topographic constraints. Therefore a lift station and forcemain is being planned to convey wastewater flows from BCH to the 116 Street Trunk at 116 Street and 116 Avenue.

However, the ultimate construction of the 116 Street Trunk to 116 Avenue is in the City of Grande Prairie's long term plans and will not be constructed in the near future. The proposed BCH development is to begin construction in 2008/2009. As a result an interim servicing scheme is required to connect the BCH lift Station to a trunk sewer with sufficient capacity before the ultimate 116 Street Trunk is built out.

A Value Engineering Workshop took place in April 2007 with the purpose of investigating potential interim servicing options. One of the key recommendations from the workshop was to utilize an interim forcemain discharging to the 116 Street Trunk at its upstream terminus at the time of development. The following connection locations are being considered for this interim servicing:

- 102 Street and 68 Avenue (worst case scenario)
- O'Brien Lake development (600 m west of 108 Street) (most likely scenario)
- Terminate at the 116 Street and 68 Avenue (optimistic)

The alignment of the BCH forcemain within the 116 Street corridor has not been finalized. The developer (Great Northern Ventures) has had discussions with the City of Grande Prairie about alignment options. One option being considered is to locate the forcemain two metres inside the ultimate road right-of-way (generally on the west side, subject to conflicts with existing overhead power). This option has significant disadvantages given that the City has not yet obtained the ultimate 116 Street right-of-way, with the remaining sections awaiting development so that the right-of-way can be dedicated. The City of Grande Prairie has indicated that they are open to other possible alignments including following the ultimate 116 Street roadway centreline. However, this would require extensive trenchless construction given the proximity of the existing roadway surface to the ultimate centreline. It is expected that the alignment will be finalized by the spring of 2008.

Due to limited working space it is anticipated that any alignment along 68 Avenue would be unable to use open cut construction techniques.

The BCH lift station and forcemain is being designed for a capacity of approximately 300 L/s. The ultimate service area has not been finalized, but preliminary hydraulic modeling during a 1:25 year, 24 hour event indicated a PWWF of 284 L/s, refer to Figure 4.1 (note: the hydraulic model was not calibrated to this rainfall intensity and is expected to significantly over-estimate the peak wet weather flow). The preliminary analysis also indicated an ADWF of around 37 L/s.

The difference between the design DWF and PWWF presents an opportunity to utilize the BCH lift station and forcemain to discharge Clairmont to the 116 Street Trunk during dry weather conditions. Note that this would require Real Time Controls to ensure that Clairmont inflow does not cause the total inflows to exceed the station's capacity during wet weather conditions.

It is anticipated that the BCH development will not be completed for approximately 20 years (until around the year 2029 based on development starting in 2008/09). Therefore, it may also be possible to utilize the BCH lift station and forcemain as an interim solution to discharge the Clairmont lagoon, without Real Time Controls, by providing the difference between the BCH PWWF and the station design capacity for discharging flow from Clairmont. For example, by 2021 the PWWF from BCH is anticipated to be around 170 L/s. Therefore, if the station is designed for 300 L/s, this leaves some 130 L/s spare capacity for which to use for discharging the Clairmont lagoon. The anticipated development growth of BCH is presented at Table 4.1.

Table 4.1: Anticipated Growth of BCH Development

BCH Development											
Percentage complete	0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Year	2009	2011	2013	2015	2017	2019	2021	2023	2025	2027	2029
PWWF (L/s)	0.0	28.4	56.8	85.2	113.6	142.0	170.4	198.8	227.2	255.6	284.0

4.5 Clairmont Lagoon

While there is opportunity to discharge ADWF from the Clairmont lagoon to either the Aquatera WWTP, the 116 Street sewer or the 116 Street Sewer via BCH, it is not practicable to attempt to discharge wet weather flow. However, the lagoon itself presents the opportunity to provide storage for these flows.

As previously noted, the capacity of the lagoon is as follows:

- Anaerobic Cell: 8,000 cubic meters
- Facultative Cell: 48,000 cubic meters
- Storage Cell: 322,500 cubic meters

Therefore, if the ADWF from Clairmont is to be discharged, this leaves a total volume of some 378,500 cubic metres available for use as storage during wet weather flow conditions in the Aquatera City of Grande Prairie sewerage system (includes BCH Lift Station, 116 Street Trunk, and/or WWTP).

For the lagoon to be utilized to provide storage for wet weather flow, the maximum theoretical volume of storage required would be the total volume of wet weather flow generated by the 1 in 100 year rainfall event for the ultimate growth contour using the Full Design Standards flow scenario. Note that this assumes the lagoon is unable to discharge during the period of this event. Utilizing the XP-SWMM model from the Master Plan, the total volume of wet weather flow generated by this event is 152,035 cubic metres over 3 days; refer to Figures 4.2 and 4.3. This amounts to just over a third of the total volume available storage capacity at the facility, thus, confirming that the lagoon as more than adequate capacity as a wet weather flow storage facility.

The existing lagoon is constructed partially above ground level. Inlet flows enter via a forcemain and are discharged to the anaerobic cells before entering the facultative and storage cells. An oversized outlet structure was recently added to the storage cell as part of the lagoon upgrading.

5.0 Preliminary Servicing Options

5.1 Introduction

This section presents possible servicing options for discharging the Clairmont lagoon to the Aquatera sewerage network within City of Grande Prairie. The options presented in this section have been developed by considering the alternative flow projections against the opportunities and constraints that have been discussed in the previous sections.

Four main options for discharging the Clairmont lagoon have been developed. These options are:

Option 1
This option is based on the assumption that the system is to be designed to accommodate the Full Design Standards flow projection and utilizes a single forcemain between the Clairmont Lagoon and the Aquatera WWTP in the City of Grande Prairie.

Option 2
Option 2 is based on the assumption that the Full Design Standards flow projections could be reached but provides the flexibility to provide for the Master Plan Reduction flow projections through staging of the forcemain.

Option 3
Option 3 is based on the same flow conditions as Option 2. However, this option offers the possibility to discharge the flows to the 116 Street Trunk by combining with the BCH lift station and forcemain. Note that this option requires over-sizing of BCH to accommodate the Clairmont flow.

Option 4
Option 4 is based on the assumption that the Extrapolated or Master Plan Reduction flow projections will likely be realized and that the BCH Lift Station can be utilized for interim servicing without over-sizing. This option assumes that the 116 Street Trunk will be extended to 116 Avenue by the time that the interim servicing options are exhausted.

5.2 Methodology

For the purpose of these assessments, HDPE pipe has been used when selecting forcemain sizes for the design flows and alignment conditions. Also, for consistency the same dimensional ratio (DR21) has been used for all pipe selections. Friction losses have been calculated using the Hazen Williams formula with a C factor of 140 to be conservative.

While the production of vertical alignment drawings was outside of the scope of this study, it was necessary to generate basic ground profiles, using contour information provided by Aquatera, so that an assessment of pump heads for each option could be made. Note that where a forcemain termination point was found to be located immediately downstream of a high point, the assessments have included an artificial head to prevent the draining of the forcemain from these high points during the pumps off cycle. This would require a pressure sustaining valve at the termination point of the forcemain.

Typically this type of mechanism would not be recommended for sewage purposes because it presents the risk of blockages. It would also require permanent power and monitoring equipment. The preferred solution to this problem would be to terminate the forcemain at the high point and build a gravity sewer to connect to the outfall point.

It is Aquatera's preference that gravity sewers be located within the travelled road surface, within road Right-of-Ways. This is to ensure they are accessible for flushing and it also helps reduce susceptibility to inflow that can arise from placing sewers between the road shoulder and the property line. Locating sewers within the travelled road surface can lead to increased costs.

The preferred alignment for any pipelines arising from this study would be located outside of existing road Right-of-Ways wherever possible, to keep costs at a minimum. Therefore, for the purpose of this study it has been assumed that all of the options require building forcemains to the location of the receiving sewer or facility with the application of artificial heads where required. The hydraulics and associated costs should be reviewed in detail during the design phase of the project to determine the most suitable application.

Note that because the head data used for these assessments has been based on basic contour information, the resulting pump capacities are estimations and should only be considered for illustration purposes at this stage.

This study has identified three potential flow scenarios for projecting the required future discharge rates. These have all been considered either in combination or separately within this report. To enable costs for each option to be compared equally, each option has been broken down into either one or more of the following separate projects as required by the flow scenarios considered:

- Project 1: Initial construction for each option
- Project 2: Upgrade option to 300 L/s (if applicable)
- Project 3: Upgrade option to 550 L/s (if applicable)

When considering pumping station configurations for cost estimating the following criteria has been applied:

- Submersible station configurations for power requirements less than 75 kW
- Traditional wet/dry well configurations for power requirements greater than 75 kW

Also, where an option has demonstrated the ability to be escalated, the cost estimate provided for the initial pumping station includes (unless otherwise noted) over sizing of infrastructure to accommodate the possible future expansion and using the ultimate pump size with variable speed control.

It should be noted that cost estimates provided in this report are 'Order of Magnitude" and should be reviewed, verified and updated if an option is to be progressed. All cost estimates provided are a best estimate of likely project costs based on 2007 dollars.

5.3 Option 1 – Forcemain from Clairmont to the Aquatera WWTP

This option is based on the assumption that the future flows at Clairmont will align with those projected by the Full Design Standards method. It offers the possibility to discharge the ultimate Full Design Standards ADWF plus an allowance for inflow and infiltration from Clairmont to the Aquatera WWTP located in the City and County of Grande Prairie.

The option would include the construction of a new pumping station at the Clairmont lagoon and a minimum of approximately 20 km of 750 mm diameter HDPE forcemain to the Aquatera WWTP. The new pumping station and forcemain would be capable of discharging around 550 L/s to include the ultimate ADWF, plus an allowance for inflow and infiltration. The lagoon would be converted to a surge pond to provide storage for wet weather flows in excess of the discharge capacity.

This option, while providing servicing to around the year 2040 (based on the Full Design Standards flow scenario), would be very expensive. It does not offer any flexibility to reduce costs if the high design flows are not realised.

5.3.1 Option Discussion

This option assumes that the future flow conditions will align with those predicted by the Full Design Standards method which predicts an ultimate ADWF of around 550 L/s. It has been previously identified that the 116 Street Trunk Sewer has an allowance of 300 L/s available to receive flows from the Clairmont lagoon. Therefore, this sewer could potentially only provide a temporary servicing opportunity for this option. In order to provide servicing for the ultimate ADWF, this option considers discharging the Clairmont lagoon direct to the WWTP.

Table 3.1 (Section 3) illustrates that the anticipated wet weather flow rate for this flow scenario would be around 1860 L/s. Therefore, for this alternative to be workable the lagoon must be capable of providing sufficient storage to account for the additional flows generated during wet weather conditions.

To assess the ability of the lagoon to provide storage for wet weather flow for this option the XP SWMM models from the 2005 Clairmont Master Plan were reviewed. This previous study developed XP SWMM models for both the 10, 20 and ultimate year development contours, corresponding to the year 2015, 2025 and 2040 respectively.

The ultimate hydrograph was used to calculate the maximum storage that would be required for the peak wet weather event (I in 100 year). Assuming that there are zero outflows during the event, the total volume was calculated to be approximately 152,035 cubic metres. When compared with the existing lagoon cell capacities (Section 2.1) it can be seen that this volume may be accommodated fully by the storage cell in the existing lagoon. The capacity of this cell is around 322,500 cubic meters.

The total storage volume that could be made available at the lagoon for wet weather flow is around 378,500 cubic metres. Therefore, the storage volume available could provide for almost two and half consecutive peak ultimate wet weather events with no discharge from the lagoon.

An alternative to reduce the total rate of discharge to the 116 Street Trunk Sewer by utilising the lagoon operation in parallel with this discharge was considered, however, initial inspection showed that this would not be a feasible option because the improved lagoon capacity (Section 2.3) will only provide some 1,600 cubic metres per day or 18.5 L/s of treatment, which is only a small fraction of the total discharge required. As such the impact on pumping infrastructure required would be minimal.

Note that maintaining the operation of the lagoon while running a pumped discharge would reduce the amount of volume available for wet weather storage and would create two separate wastewater facilities for which maintenance would be required. This would result in some of the effluent being double treated, firstly at the lagoon and again at the WWTP. This is not considered an efficient use of Aquatera's resources and would not be recommended.

5.3.2 Alignment

The preliminary alignment for this option is illustrated at Figure 5.1. The figure shows a new forcemain from the Clairmont lagoon to the Aquatera WWTP within the City and County of Grande Prairie.

This shows the forcemain exiting the Clairmont Lagoon, following a route south until it reaches TWP 724. From here the forcemain would divert west along TWP 724 until is reaches RRD 63. It is anticipated the forcemain would be located within the County owned lands north of TWP 724.

At RRD 63 the forcemain would divert south, following RRD 63 until it becomes 116 Street in the City of Grande Prairie. It is anticipated that the forcemain would be located in a utility right-of-way adjacent to RRD 63.

In order to minimize the land acquisition required, the forcemain may need to alternate between the east and west sides of RRD 63 due to the presence of existing overhead power lines. The 6 km (4 miles) between TWP 724 and 132 Avenue is essentially agricultural, with very limited development (i.e. yards) abutting RRD 63. There are a few small sloughs south of TWP 722. For the purposes of conceptual cost estimating, it was assumed that two or possibly three trenchless road crossings would be required within the County portion of the forcemain.

The forcemain will encounter a bridge crossing Bear Creek at NE-4-72-6-6, just north of the future City limits. A trenchless crossing has been assumed for cost estimating. Also, there are a number of culverts crossing RRD 63/116 Street between TWP 715A (124 Avenue) and the Bear Creek bridge connecting the oxbow lake west of 116 Street with main channel of Bear Creek. The presence of these culverts, along with the presence of wetlands on each side of the roadway, are expected to result in much of this section of forcemain (140 Avenue to 124 Avenue) being installed by trenchless construction methods.

The alignment of the forcemain within the 116 Street corridor is based on the 116 Street Functional planning Study completed by ISL. In general, it is understood that the forcemain would be located two metres inside the ultimate road right-of-way which is typically 45 m wide and construction of the forcemain would be on the opposite side of the road to the existing overhead power lines. The possibility of placing the forcemain along other alignments may be considered at the design stage. For the purposes of conceptual cost estimating, it is assumed that approximately 50% of the alignment along 116 Street south of 124 Avenue would be installed with trenchless construction methods.

From the junction of 116 Street (RRD 63) and 68 Avenue the forcemain would divert east along 68 Avenue to 102 Street. It is anticipated that the forcemain would remain within the road right-of-way along this stretch and that the entire length would be constructed using trenchless technology.

At 102 Street, the forcemain would divert south east, crossing Bear Creek (near the existing pipe bridge) using trenchless construction.

At 100 Street the forcemain would divert directly south and remain within the road right-of-way until reaching the Aquatera WWTP. Note that a further crossing of Bear Creek would be required along this stretch.

An alternate to the 68 Avenue/100 Street alignment was considered, carrying on south along 116 Street and diverting east cross-country to the WWTP. This alignment has the potential to avoid two Bear Creek crossings but would be required to cross the outlet from Flyingshot Lake to Bear Creek. Much of this alignment is currently treed and adjacent to existing acreages. With the forcemain entering the WWTP from the west, there may be some site constraints in the plant site that would have to be considered. This alternate alignment should be reviewed further if Option 1 is ultimately selected for implementation.

5.3.3 Forcemain and Pump Selection

Project 1

The initial assessments of forcemain and pump requirements for this option are presented at Table A-1 (Appendix A). It is shown that this option would require a 750 mm diameter HDPE forcemain to discharge a flow of 550 L/s from the Clairmont lagoon the Aquatera WWTP.

The total static head is -9 m, based on a geodetic head of -13 and a pressure sustaining head of 4 m. The resulting total pumping head is estimated at around 46 metres. It is estimated that this option would require three 186 kW pumps, two duty and one standby.

5.3.4 Cost Estimates

Cost estimates for Option 1 are presented at Table 5.1. A detailed breakdown of estimate costs is provided at Table B-1.1 (Appendix B).

Table 5.1: Cost Estimate – Option 1

Option	Project Combination	Termination Point where Applicable	Cost ($M)			
			Project 1	Project 2	Project 3	Total
1	n/a	n/a	32.3	0.0	0.0	32.3

5.4 Option 2 – Forcemain from Clairmont to the 116 Street Trunk Sewer at 68 Avenue

Option 2 provides for potential that the future flows at Clairmont are likely to be significantly less than those considered in Option 1. It is based on the assumption that the flows will align with those projected by the Master Plan Reduction projection. It offers the possibility to discharge the ultimate Master Plan Reduction ADWF plus an allowance for inflow and infiltration from Clairmont directly to the 116 Street Trunk at three possible locations around 68 Avenue.

The option would include the construction of a new pumping station at the Clairmont lagoon and approximately 15-18 km of 600 mm diameter HDPE forcemain to the 116

Street Trunk at around 68 Avenue (actual length dependant on 116 Street Trunk connection point). The new pumping station and forcemain would be capable of discharging around 300 L/s. The lagoon would be converted to a surge pond to provide storage for wet weather flows in excess of the discharge capacity.

5.4.1 Option Discussion

The 116 Street Trunk Sewer has an allowance of 300 L/s capacity available to receive a discharge from the Clairmont lagoon. The ultimate ADWF projected by the Master Plan Reduction method, including an allowance for inflow and infiltration is around 300 L/s. Therefore, the Clairmont lagoon could be discharged to this trunk sewer.

As discussed in Section 4.3 the 116 Street Trunk Sewer is proposed to be constructed up to the junction of 116 Street and 116 Avenue. However, this could take as much as 20 years if not longer to complete.

Based on the assumption that initiation of this option would be required immediately, it is anticipated that the available point of discharge at the time of construction would be somewhere around 68 Avenue.

As described in Section 4.4, three possible options for where the forcemain could terminate, depending on the location of the 116 Street Trunk at the time of construction, have been considered. These are:

- Point A: Terminate at the 116 Street and 68 Avenue
- Point B: Terminate at O'Brien Lake Lift Station
- Point C: Terminate at 102 Street and 68 Avenue

The servicing strategy considered for this option, was therefore to discharge the Clairmont lagoon direct to the 116 Street Trunk Sewer at one of the above mentioned discharge points.

As with Option 1, because the system would be designed for ultimate ADWF, accommodation will need to be provided for excess wet weather flow. Option 1 showed that the existing lagoons could be capable of providing storage for almost two and a half consecutive peak wet weather events (Full Design Standards) with no outflow from the lagoon. Therefore, as the flows projected by the Master Plan Reduction method are less than those for Option 1, it is evident that the existing lagoon could be converted to provide sufficient storage for this primary option.

Escalation of Discharge Rate

If the future flow conditions were to begin to align with those projected by the Full Design Standards there would be a need to increase the discharge rate from the Clairmont lagoon. As the 116 Street Trunk Sewer only has an allowance to receive flows of 300 L/s from Clairmont any future increase above this will require an alternative point of discharge.

The concept of utilising the treatment operation of the existing lagoon to reduce the discharge capacity of Option 1 was explored in Section 5.3.1. It was illustrated that the improvements to the treatment operations at the lagoon will only provide a total treatment capacity of some 18.5 L/s. When compared with the projected ADWF for the Full Design Standards (Table 3.1, Section 3.2), clearly this would not provide a future option capable of meeting these projected flows.

Two further alternatives were considered. These are:

Alternative 1 (Project 3a)

- Build a second forcemain from the Clairmont lagoon to the 116 Street Trunk at 116 Avenue, provided this trunk was completed (capacity 250 L/s)
- Extend the initial forcemain termination point to the WWTP (capacity 300 L/s)

Alternative 2 (Project 3b)

- Build a second forcemain from the lagoon to discharge the additional flow direct to the WWTP (capacity 250 L/s)

The first would require approximately 10 km forcemain from the Clairmont lagoon to the 116 Street Trunk Sewer at 116 Avenue (provided this trunk is complete). Extending the initial discharge to the WWTP would involve some additional 2-5 km of forcemain depending upon the point of initial discharge.

The second would require some 20 km of forcemain from the Clairmont lagoon to the WWTP.

The advantages of the Alternative 1 over Alternative 2 are that it requires less additional forcemain construction and it would not require an additional alignment Right-of-Way along 116 Street. The disadvantages are that is will require over sizing of the initial forcemain and pump requirements due to the increased pipe friction losses generated by extending the initial forcemain.

It should be noted that these downstream capacity constraints requiring the initial forcemain to be extended to the WWTP could possibly be overcome with the use of a Real Time Control system in the Clairmont Lagoon Lift Station that is controlled by the water levels in the downstream trunks.

5.4.2 Alignment

The preliminary alignment for this option is illustrated at Figure 5.2. This shows options for a new forcemain from the Clairmont lagoon to the 116 Street Trunk at three possible locations around 68 Avenue. Note that options for escalating the discharge rate are not shown as the alignments for these would be similar to those illustrated for Option 1.

The described alignment for this forcemain is the same as for Option 1 (refer to Section 5.3.1) up to the junction of 116 Street and 68 Avenue. Also, the additional forcemain (if required) would again follow this option up to the junction with 116 Street/Avenue.

At 116 Street and 68 Avenue the forcemain would terminate at one of the three possible discharged locations described at Section 5.4.1.

Due to limited working space it is anticipated that any alignment along 68 Avenue would be unable to use open cut construction techniques.

5.4.3 Forcemain and Pump Selection

The initial assessments of forcemain and pump requirements are shown at Table A-1 Appendix A.

Project 1
The pump and forcemain requirements for discharging 300 L/s from the Clairmont lagoon to the 116 Street Trunk Sewer are estimated to be the same for each of the possible termination points. The initial assessment shows a requirement for between 15 and 18 km of 600 mm diameter forcemain and three 119 kW rated pumps, two duty and one standby.

Project 3a
Increasing the discharge capability to 550 L/s by implementing Alternative 1 would require the following:

- Extend the forcemain by between 2 – 5 km (depending on the initial termination point) and upgrading the pumps to 186 kW
- 10 km of a new 500 mm diameter forcemain from the lagoon to the 116 Street Trunk (at 116 Avenue) and three 138 kW rated pumps, two duty and one standby

Project 3b
Increasing the discharge capability to 550 L/s by implementing Alternative 2 would require approximately 20 km of 550 mm diameter forcemain and three 186 kW rated pumps, two duty and one standby.

5.4.4 Cost Estimates

Cost estimates for Option 2 are presented at Table 5.2. A detailed breakdown of estimate costs is provided at Tables B-2.1 and B-2.2 (Appendix B).

Table 5.2: Cost Estimate – Option 2

Option	Project Combination	Termination Point where Applicable	Cost ($M)			
			Project 1	Project 2	Project 3	Total
2	1 & 3a	(A)	15.9	0.0	13.9	29.8
		(B)	18.6	0.0	11.2	29.8
		(C)	23.0	0.0	6.8	29.8
	1 & 3b	(A)	15.3	0.0	21.0	36.3
		(B)	17.9	0.0	21.0	38.9
		(C)	22.4	0.0	21.0	43.4

5.5 Option 3 – Forcemain from Clairmont to BCH and Over-Size BCH Lift Station and Forcemain

Option 3 is based on the same flow conditions as Option 2. However, this option considers the possibility to discharge these flows to the 116 Street Trunk by combining with the BCH lift station and forcemain. Note that this option requires over-sizing of BCH to accommodate the Clairmont flow.

The option would include the construction of a new pumping station at the Clairmont lagoon and approximately 9 km of 500 mm diameter HDPE forcemain to the BCH lift station. In order to combine both Clairmont and BCH discharges, the BCH lift station and forcemain would be oversized to accommodate a total flow of 600 L/s. The combined pipeline would consist of approximately 6-9 km of 700 mm diameter HDPE forcemain (actual length and size dependant on 116 Street Trunk connection location).

Similar to the previous options the lagoon would be converted to a surge pond to provide storage for wet weather flows in excess of the discharge capacity.

5.5.1 Option Discussion

This option is based on the same conditions as Option 2 with the exception that the Clairmont lagoon would be discharged to the BCH lift station and the BCH lift station and forcemain would be oversized to provided capacity to discharge the combined flow to the 116 Street Trunk.

This option would also require the same wet weather storage as for Option 2.

Escalation of Discharge Rate

Similar to Option 2, the discharge rate provided by this option could be escalated to enable the ADWF projected by the Full Design Standards method to be discharged from the lagoon.

Three possible ways this could be realised are:

Alternative 1 (Project 3a):

i. Extend the initial discharge from the lagoon to the finished 116 Street Trunk (capacity 300 L/s)
ii. Extend the BCH FM to the WWTP (capacity 300 L/s). Note that releases 300 L/s capacity within the 116 Street Trunk
iii. Build a new discharge of 250 L/s from the lagoon the 116 Street Trunk. This creates a total discharge from the lagoon of 550 L/s

Alternative 2 (Project 3b):

i. Extend the combined BCH forcemain to the WWTP (capacity 600 L/s)
ii. Build a new discharge from the lagoon to the 116 Street Trunk (capacity 250 L/s)

Alternative 3 (Project 3c):

i. Build a new discharge from the lagoon direct to the WWTP as described under Option 2 (capacity 250 L/s)

Note that alternatives 1 and 2 could only be realised provided that the 116 Street Trunk was build out to its ultimate location at 116 Avenue.

5.5.2 Alignment

The preliminary alignments for this option are illustrated at Figure 5.3. The figure shows the forcemain from Clairmont to the BCH lift station and a new combined forcemain from BCH to the 116 Street Trunk at three possible locations around 68 Avenue. Note that options for escalating the discharge rate are not shown as the alignments for these would be similar to those illustrated for Option1.

The described alignment for the forcemain from Clairmont to BCH is the same as for Option 1 (Section 5.3.1) up to approximately 600 m south of 132 Avenue. At this point the forcemain would divert west to the BCH lift station.

The alignment for the combined forcemain from BCH is the same as for Option 2 (Section 5.4.1) with the three alternative termination points.

5.5.3 Forcemain and Pump Selection

The initial assessments of forcemain and pump requirements are shown at Table A-1 Appendix A.

Project 1

The pump and forcemain requirements for Project 1 are:

- Approximately 9 km of 500 mm diameter forcemain with 119 kW pumps, two duty pumps and one standby pump for the 300 L/s discharge from the lagoon to BCH
- Between 6 and 9 km of 700 mm diameter forcemain with 250 kW pumps, two duty pumps and one standby pump for the combined discharge of 600 L/s from BCH to either of the possible termination points (A) to (C)

Project 3a

Increasing the discharge capability to 550 L/s by implementing Alternative 1 would require the following:

- Extending the initial Clairmont forcemain by 1 km and increasing the pump rating to be upgraded to 138 kW
- Extending the BCH forcemain (capacity 300 L/s) would require between 2 and 5 km of 550 mm diameter pipeline
- The new forcemain from the lagoon the 116 Street Trunk would require approximately 10 km of 500 mm diameter forcemain with two duty and one standby 138kW pumps.

Project 3b

Increasing the discharge capability to 550 L/s by implementing Alternative 2 would require the following:

- Extending the combined 700mm diameter forcemain by between 2 and 5 km
- Approximately 10 km of new 500 mm diameter forcemain with two duty and one standby 138kW pumps for the new discharge form the lagoon to the 116 Street Trunk.

Project 3c

Increasing the discharge capability to 550 L/s by implementing Alternative 3 would require approximately 20 km of 550 mm diameter forcemain with two duty and one standby 186 kW pumps.

5.5.4 Cost Estimates

Cost estimates for Option 3 are presented at Table 5.3. A detailed breakdown of estimate costs is provided at Tables B-3.1, B-3.2 and B-3.3 (Appendix B). The costs for Project 1 shown in Table 5.3 are net costs. This assumes that Aquatera only contributes to the oversizing costs associated with BCH.

Table 5.3: Cost Estimate – Option 3

Option	Project Combination	Termination Point where Applicable	Cost ($M)			
			Project 1	Project 2	Project 3	Total
3	1 & 3a	(A)	12.0	0.0	13.4	25.4
		(B)	11.7	0.0	12.3	24.0
		(C)	13.1	0.0	7.0	20.1
	1 & 3b	(A)	11.7	0.0	15.7	27.4
		(B)	11.4	0.0	14.2	25.6
		(C)	12.9	0.0	6.8	19.7
	1 & 3c	(A)	11.7	0.0	21.0	32.7
		(B)	11.4	0.0	21.0	32.4
		(C)	12.9	0.0	21.0	33.9

For a detailed breakdown of estimated costs for the BCH lift station and forcemain refer to Tables B-5.1 and B-5.2 (Appendix B).

5.6 Option 4 – Forcemain from Clairmont to BCH (No BCH Over-Sizing)

Option 4 provides for the possibility that the future flows at Clairmont could align with those generated by the Extrapolated flow projection with the flexibility to accommodate those projected by the Master Plan Reduction projections. In particular it investigates alternative scenarios that would enable an interim discharge from the lagoon to the 116 Street Trunk via BCH, without the need to oversize the BCH Lift Station and forcemain.

Generally this option offers a less expensive alternative to the previous ones and also provides for flexibility if the future flows were to increase in line with either the Master Plan Reduction or the Full Design Standards flow scenarios.

Two principal sub-options were investigated to enable this. These are:

Option 4 (i): Discharge from Clairmont to BCH during off-peak periods only. The Clairmont lagoon is to be utilized for storage at all other times.

Option 4 (ii): Discharge the Clairmont lagoon by utilisation of the capacity that is available within the BCH lift station and forcemain at an interim timeframe that is likely to coincide with the completion of the 116 Street Trunk Sewer.

Option 4 (ii) was recommended. This option included the construction of a new pumping station at the Clairmont lagoon and approximately 9 km of 500 mm diameter forcemain to the BCH lift station. Discharges from the Clairmont lagoon would be restricted to a maximum of 125 L/s. The BCH lift station and forcemain would not be oversized and would be designed for a flow rate of some 300 L/s. The forcemain from BCH would consist of approximately 6-9 km of 450 or 550 mm diameter forcemain, as it is currently being planned.

On completion of the 116 Street Trunk Sewer (to 116 Avenue), the forcemain from Clairmont lagoon would be extended to this trunk, enabling the discharge rate to be increased up to 300 L/s if required.

If the future flow rates were found to be aligning with those projected by the Full Design Standards, this option has two potential alternatives to escalate the discharge rate to enable servicing requirements to be realised. These are, construct a second forcemain from the lagoon to discharge the additional flows direct to the WWTP or extend the BCH forcemain to the WWTP and effectively twin the initial forcemain from the lagoon to the 116 Street Trunk Sewer.

Note that as with the previous options, the existing Clairmont lagoon would be used when required for storage.

This option is based primarily on the assumption that the full design standard flows are unlikely to be realized at Clairmont and as such offers a solution that is significantly less expensive than the previous options. It also offers flexibility related to these lesser flows. Significantly, this option provides the ability to offer servicing for all the flow scenarios considered by initially providing for the lowest anticipated flows and providing options for capacity expansion to meet the flows projected by the ultimate Full Design Standards.

5.6.2 Option Discussion

Option 4 (i): Discharge from Clairmont to BCH during off-peak periods only. The Clairmont lagoon is to be utilized for storage at all other times

To ensure flows from Clairmont can be discharged to the 116 Street Trunk via BCH during off-peak periods, the total volume of effluent accumulated over a 24 hour period must be completely discharged during the off-peak window.

The diurnal profile for BCH, refer to Figure 4.1, shows that the off-peak period during which the storage could be discharged is between 1 and 8 am. In order to determine the required rates to dewater the lagoon an initial assessment was made of the volume of effluent accumulated over a 24 hour period. The discharge rate was then calculated by dividing the volume by the period of discharge i.e. seven hours. For example (allowing for 15% inflow and infiltration) the 2010 discharge rate from Clairmont for the Extrapolated flow projection is 18 L/s x 1.15 * (24 hrs/7 hrs) = 71 L/s. The results of this assessment are presented at Table 5.4.

Also shown in Table 5.4 is the anticipated peak flow at BCH. Noting that the capacity of the BCH lift station and forcemain is 300 L/s, the peak flow from BCH was added to the required discharge rate from Clairmont in order to provide an indication of timeframe in which this option would be feasible.

Table 5.4 shows that provided the flow conditions at Clairmont do not exceed those generated by the Extrapolated flow scenario this option has the potential to provide service to around the year 2020. However, it provides little flexibility if flow conditions exceed those of this scenario and therefore it is recommended that this option not considered further.

Table 5.4: Combined Discharge Rates for Clairmont / BCH

Year	BCH Peak Flow (L/s)	Extrapolated		Master Plan Reduction		Full Design Standards	
		Discharge from Clairmont (L/s)	Combined Flow (L/s)	Discharge from Clairmont (L/s)	Combined Flow (L/s)	Discharge from Clairmont (L/s)	Combined Flow (L/s)
2010	14	71	89	177	194	816	834
2011	28	75	108	205	235	852	882
2012	43	83	128	233	277	883	930
2013	57	87	147	256	318	919	977
2014	71	91	166	284	359	950	1025
2015	85	95	185	311	400	986	1073
2016	99	103	204	339	441	1017	1120
2017	114	106	224	363	483	1049	1168
2018	128	110	243	390	524	1084	1216
2019	142	118	262	418	565	1116	1264
2020	156	122	281	446	606	1151	1311
2021	170	134	306	461	635	1175	1351
2022	185	142	331	477	665	1203	1391
2023	199	154	355	489	694	1226	1430
2024	213	166	380	505	723	1254	1470
2025	227	177	405	520	752	1277	1510
2026	241	185	429	536	781	1305	1549
2027	256	197	454	552	811	1329	1589
2028	270	209	479	568	840	1356	1629
2029	284	221	504	584	869	1380	1669

Option 4 (ii): This option investigated the potential to discharge the Clairmont lagoon by utilisation of the capacity that is available within the BCH lift station and forcemain at an interim timeframe that is likely to coincide with the completion of the 116 Street Trunk Sewer.

Two alternatives where considered. These were:

- Use the capacity that is available in BCH during dry weather operation, between the peak dry weather flow and the station capacity. This alternative would require Real Time Controls (RTC) to prevent Clairmont from discharging during wet weather and must utilize the lagoons for storage
- Enable a continuous discharge from Clairmont without using RTC by making the discharge rate from Clairmont to be within the available capacity at BCH lift station between the PWWF and the station capacity at any point in time

From Figure 4.1 (Section 4) it can be seen that there is approximately 200 L/s capacity available between the PDWF at BCH and the proposed station capacity. Therefore, it may be possible to use this as an interim solution to discharge the Clairmont lagoon by using RTC to prevent inflow from Clairmont during wet weather.

This option could be configured to work by preventing inflow from Clairmont when BCH inflow exceeds 90 L/s (PDWF) which would represent wet weather flow conditions at the BCH Lift Station. At this point the reserve wet weather capacity at BCH is then dedicated to BCH Lift Station service area. When BCH inflow reduces below 90 L/s, Clairmont could begin discharging again. This is illustrated at Figure 5.5.

Note that the application of Real Time Controls would require that local discharges to the BCH lift station be continuously monitored. To achieve this is likely to require that construction of a specialized inlet chamber with flow monitoring equipment. The flow at this point would need to be able to be monitored at both BCH and Clairmont lift/pumping stations, and remotely at an operations control centre.

Comparing the available capacity with this option versus the ADWF flow projection (Table 3.1) shows that this option would service the Clairmont discharge to beyond 2040 provided the flows aligned with the Extrapolated flow projection. However, if the flow was to align with the Master Plan Reduction flow projections then Table 3.1 suggests that period of providing servicing to Clairmont would reduce to around the year 2032.

By this time it is expected that the 116 Street Trunk would be built out to its ultimate location at 116 Avenue. As previously described, the available capacity of the 116 Street Trunk for flow from Clairmont is 300 L/s. Therefore, potentially the discharge rate from Clairmont could be increased if the forcemain was disconnected from BCH and extended to the 116 Street Trunk.

In order to enable a continuous discharge from Clairmont through BCH without requiring RTC, the flow rate from Clairmont will need to be such that it is within the available capacity at BCH lift station between the PWWF and the station capacity at any point in time.

It was shown in Section 4.3 that the ultimate PWWF at BCH is anticipated to be around 294 L/s (to be confirmed when the BCH Lift Station is designed). This would not leave any capacity for an additional inflow from Clairmont under ultimate development conditions. Therefore, this option relies on the fact that the BCH inflows will initially be much lower than the design capacity. Table 5.5 shows the development of BCH broken down into bi-yearly stages along with the anticipated flow rates for each. The table also shows a range of possible discharge rates from Clairmont and the impact they would have on the overall flow rate for each of these stages.

To identify a realistic servicing horizon that could be provided by this option, Table 5.5 was compared to the flow projections for both the Extrapolated and Master Plan Reduction methods for the same time periods (Table 5.6), along with possible completion dates for the full construction of the 116 Street Trunk Sewer. Note that the Clairmont flow projections shown in Table 5.6 include a 15% allowance for inflow and infiltration.

Table 5.5: Combined Clairmont/BCH Flow Matrix

Year		2009	2011	2013	2015	2017	2019	2021	2023	2025	2027	2029
BCH percentage complete		0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Flow from BCH (L/s)		0	28	57	85	114	142	170	199	227	256	**284**
`Discharge from Clairmont (L/s)	25	25	53	82	110	139	167	195	224	252	**281**	309
	50	50	78	107	135	164	192	220	249	**277**	306	334
	75	75	103	132	160	189	217	245	274	302	331	359
	100	100	128	157	185	214	242	270	**299**	327	356	384
	125	125	153	182	210	239	267	**295**	324	352	381	409
	150	150	178	207	235	264	**292**	320	349	377	406	434
	175	175	203	232	260	**289**	317	345	374	402	431	459
	200	200	228	257	**285**	314	342	370	399	427	456	484
	225	225	253	**282**	310	339	367	395	424	452	481	509
	250	250	**278**	307	335	364	392	420	449	477	506	534
	275	275	303	332	360	389	417	445	474	502	531	559
	300	**300**	328	357	385	414	442	470	499	527	556	584

Table 5.6: Clairmont Flow Projections

Flow (L/s) / Year	2009	2011	2013	2015	2017	2019	2021	2023	2025	2027	2029
Extrapolated	-	22	25	28	31	34	39	45	51	58	64
MPR	-	60	75	91	106	122	134	143	152	161	170

Inspection of Tables 5.5 and 5.6 identifies that a flow rate of around 50 L/s (based on Extrapolated flow projections) is common to both table at around the year 2025 and a flow rate of 125 L/s (based on Master Plan Reduction flow projections) is common to both tables at around the year 2021.

With completion of the 116 Street Trunk anticipated anywhere between 2017 and 2027 or more, enabling a discharge from Clairmont through BCH of 125 L/s could, if the trunk was completed closer to the 10 year horizon, provide a workable servicing option if flows aligned with the Master Plan Reduction projections. If flows were to be closer to those projected by the Extrapolated scenario then there is a greater chance that the trunk would be completed by the time that the Clairmont flows exceed the available capapcity at the BCH lift station. Note that it would be unlikely that flows lower than around 125 L/s would be achievable with higher rated pumps required for the ultimate Master Plan Reduction ADWF projection.

At such time as the 116 Street Trunk is built out to its ultimate location at 116 Avenue, the forcemain from Clairmont to BCH would be disconnected from BCH and extended approximately 1 km to the trunk.

Should the trunk not be in place by the time it is required it would be possible to introduce RTC to enable the servicing timeframe to be extended to around 2032 (based on Master Plan Reduction flow projections).

As both of these alternatives are intended as interim solutions while the 116 Street Trunk is waiting to be completed and are to have the flexibility to increase discharges to accommodate the ultimate Master Plan Reduction flow projections then the initial forcemain will be the same as required for Option 3 (designed for 300 L/s). The interim reduction in flow rate would be provided by variable speed control pump operations.

Escalation of Discharge Rate
Similar to Options 2 and 3, this option also has the ability for the discharge rate from Clairmont to be increased to enable discharge of the ultimate ADWF as projected by the Full Design Standards method.

The options to do this are the same as described for Option 2 with the exception that the extension of the initial forcemain to the WWTP would refer to the BCH forcemain.

5.6.1 Alignment

The preliminary alignments for this option are illustrated at Figure 5.4. This shows alignments for enabling a discharge of 300 L/s (ultimate ADWF Master Plan Reduction flow projection) from the lagoon. This includes the initial discharge (Project 1) from the Clairmont lagoon to the BCH lift station and the option to extend the forcemain (Project 2) to the 116 Street Trunk at 116 Avenue.

Note that options for escalating the discharge rate further, are not shown as the alignments for these would be similar to those illustrated for Option1.

The described alignment discussion will be the same as for Option 3, described in Section 5.5.1.

5.6.2 Forcemain and Pump Sizes

The initial assessments of forcemain and pump requirements are shown at Table A-1 Appendix A.

Project 1
The forcemain and pump requirements for this option are similar to those of Option 3 (Project 1). However, the reduced pumping rate so that a maximum of 200 L/s could be discharged would require only one duty pump at this stage.

In summary, this option would require approximately a 500 mm diameter forcemain with 119 kW rated pumps, one duty and one standby pump.

Project 2
In order to extend the initial forcemain to the 116 Street Trunk at 116 Avenue would require an additional 1 km of forcemain to be added. The additional pipe friction loses created by this would increase the pump requirements to 138 kW pumps, with two duty pumps and one standby pump.

Project 3a
To further increase the discharge capability to 550 L/s by extending the BCH forcemain to the WWTP and constructing a new discharge from Clairmont to the 116 Street Trunk at 116 Avenue would require:

- The BCH forcemain sized to a 550 mm diameter pipe with 138 kW pumps to enable the extension of the initial forcemain
- Approximately 10 km of 500 mm diameter forcemain with three 138 kW pumps, two duty and one standby, for the new discharge from the lagoon to the 116 Street Trunk

Project 3b
To increase the discharge capability to 550 L/s by constructing an additional discharge from the lagoon direct to the WWTP would require a 600 mm diameter forcemain with three 186 kW pumps, two duty and one standby.

5.6.3 Costs Estimates

Cost estimates for Option 4 are presented at Table 5.7. A detailed breakdown of estimate costs is provided at Tables B-4.1, B-4.2 (Appendix B).

Table 5.7: Cost Estimate – Option 3

Option	Project Combination	Termination Point where Applicable	Cost ($M)			
			Project 1	Project 2	Project 3	Total
4	1, 2 & 3a	(A)	9.5	0.7	12.6	22.8
		(B)	7.8	0.7	11.4	19.9
		(C)	7.8	0.7	6.2	14.7
	1, 2 & 3b	n/a	7.7	0.7	21.0	29.4

If RTC was required for the operation of Option 4 the costs would increase by around $0.2 million. This is based on the following estimates:

- Communications equipment: $50,000
- Flow measuring infrastructure and equipment: $100,000
- Engineering and Contingency: $50,000

6.0 Option Evaluation and Recommendation

6.1 Risk Assessment

This section considers the potential risks associated with each of the four main servicing options described in Section 5. The purpose of this is to provide an evaluation tool to facilitate in the selection of the preferred/recommended option.

6.1.1 Option 1 – Forcemain from Clairmont to the Aquatera WWTP

Option 1 describes a new lift station and forcemain at Clairmont that could discharge the ultimate Clairmont design flow (based on the Full Design Standards method of projecting flows) direct to the Aquatera WWTP.

Preliminary considerations of the main risks identified with the initial works associated with this option are presented at Table C – 1 (Appendix C).

Option 1 is considered to be a high level risk solution. This is because the monitored flows from existing non-residential areas in Clairmont indicated that the actual DWF are much lower than those predicted by the Full Design Standards (refer to Section 3.2).

Therefore, it is considered there is a real potential that the future flows used to outline this option would never be realised. Once constructed, it would not be possible to mitigate this risk and therefore resulting in a significantly over-designed system if the design flows are never realized. There are also operational risks associated with a very long, large diameter forcemain due to the residence time of wastewater in the forcemain.

Other identified risks included the potential to find an alternative forcemain alignment to 116 Street due to either congested services or an unwillingness of the City of Grande Prairie to provide an additional Right of Way.

6.1.2 Option 2 – Forcemain from Clairmont to the 116 St Trunk Sewer at 68 Avenue

Option 2 describes a new lift station and forcemain at Clairmont that could discharge the ultimate Clairmont design flow (based on the Master Plan Reduction method of projecting flows) direct to the 116 Street Sanitary Trunk Sewer at a location around 68 Avenue. This option also has the potential to increase the design flow to that required for the ultimate Full Design Standards method of projecting flow.

Preliminary considerations of the main risks identified with the initial works associated with this option are presented at Table C – 2 (Appendix C).

This option has the potential to offer some flexibility over the uncertainty of required future discharge rates. Initially discharging only about half of the ultimate design flow helps mitigate the risk that the ultimate flow, based on the Full Design Standards method, will never be realized and thus reducing the potential for ‘throw-away’ costs.

If the ultimate future design flow (Full Design Standards) was realized, there is potential that a second phase could be initiated to discharge the additional flow. Two options were considered for this including a new discharge from the lagoon direct to the WWTP and a extension of the initial forcemain to the WWTP including a new discharge from the lagoon to the 116 Street Trunk.

While this option offers some mitigation of the risk of potential ‘throw-away’ costs, the risks associated with the alignment along 116 Street, as outlined in Option 1, remain. There is also a risk if the discharge rate needed to be increased that the 116 Street Trunk may not yet be complete to 116 Avenue. However, this could be addressed by building a new discharge direct to the WWTP.

6.1.3 Option 3 – Forcemain from Clairmont to BCH and Over-Size BCH Lift Station and Forcemain

Option 3 describes a new lift station and forcemain at Clairmont that could discharge the ultimate Clairmont design flow (based on the Master Plan Reduction flow projections) to the BCH lift station. In order to get the design flow to the 116 Street Trunk, this option requires that the BCH lift station and forcemain be oversized to accommodate the full design flows from both Clairmont and BCH developments. This option is similar to Option 2 in that it has the flexibility to accommodate higher flows (e.g. Full Design Standards projections) through the installation of a second forcemain to the 116 Street Trunk at 116 Avenue, along with the extension of the Phase 1 forcemain to 68 Avenue and 102 Street or the WWTP.

Preliminary considerations of the main risks identified with the initial works associated with this option are presented at Table C – 3 (Appendix C).

This option offers similar flexibility over the uncertainty of required future discharges as Option 2. The risks associated with this also remain the same. However, in contrast to Option 2, combining the discharges from Clairmont and BCH into one single forcemain will eliminate the risks associated with alignment along 116 Street and also significantly reduce costs.

This option assumes that the BCH Lift Station will be in operation when the Clairmont Lagoon servicing is required; based on discussions with the developer (Great Northern Ventures), the risk of this not occurring is considered to be very low.

6.1.4 Option 4 – Forcemain from Clairmont to BCH (No BCH Over-Sizing)

Option 4 considered the possibility for discharging the ultimate design flow (based on the Master Plan Reduction flow projections) to the BCH lift station and using the BCH station and forcemain to discharge the Clairmont lagoon.

Option 4 considered the potential to utilize the BCH lift station and forcemain to discharge interim flow conditions from Clairmont, without the need to oversize the BCH infrastructure, until such time as the 116 Street Trunk is completed to 116 Avenue. At this time the Clairmont lagoon would be connected to the completed 116 Street Trunk where flows up to the ultimate projected by the Master Plan Reduction method could be discharged.

Three alternative methods for realizing this were considered. These were: using the lagoon to store flows received from Clairmont during the day and releasing the stored volume through BCH during off-peak periods (this was discounted and is not considered in this section); using RTC to enable discharges from Clairmont to utilize the wet weather capacity within BCH lift station; and enabling a continuous discharge from the lagoon through BCH lift station by utilizing capacity that is intended for the BCH developments but has not been utilized due to staging of development.

Preliminary considerations of the main risks identified with the initial works associated with this option are presented at Table C – 4.1 and C – 4.2 (Appendix C) respectively.

If required, in order to provide serviceability for the ultimate flow projected by the Full Design Standards method, a separate forcemain from the Clairmont Lagoon to the WWTP or extension of the BCH forcemain and a new forcemain from the lagoon to the 116 Street Trunk could be constructed. However, because it considered unlikely that these flows will be realized, the risk associated with only providing service for the lower flow projections is considered to be low.

Option 4 carries the small risk that the BCH Lift Station will not be in operation when needed for the Clairmont Lagoon discharge.

The use of RTC and associated flow monitoring to prevent the Clairmont lagoon discharging to BCH when BCH inflows are high will present a risk of equipment and instrumentation failure. It will also require specific training for operation staff. The risks with this also increase as the Clairmont and BCH discharge rates increase. However, this risk can be managed by extending the forcemain to the 116 Street Trunk as soon as it is extended to 116 Avenue. The other risk factor for this option is the timing of the 116 Street Trunk being extended to 116 Avenue.

The ability to enable a continuous flow to be discharged from Clairmont is restricted by the available capacity at BCH, which is dependent upon the flow rates generated by BCH and the ADWF experienced at the lagoon. Timing of the completion of the 116 Street Trunk is slightly more of a risk compared with using RTC. However, this option does have the potential to revert to RTC to enable more flow to be discharged.

6.2 Risk Evaluation

In order to evaluate the risks identified a matrix was developed to score the options in terms of their risks associated with design flow, alignment, operations and flexibility. For comparison purposes, an evaluation matrix including costs has also been provided.

The risk evaluation matrix considers all the risks identified in Appendix C and their impact on each option. When assessing the impact of risks, each has been assigned a score relating to likelihood of occurrence (Table 6.1). The scoring parameters have been designed so that low risks receive a low score and conversely, high risks receive a high score. Thus, the, options with high overall scores are considered less favourable than those with lower scores. The evaluation matrix is presented at Table 6.2.

Note that because Option 4 has the ability to initially implement a continuous discharge or to utilize RTC to discharge flow through BCH the risks associated with each have been evaluated. To distinguish between each, the following notation has been used in Table 6.2:

- Option 4a – Discharge with RTC
- Option 4b – Discharge without RTC

Table 6.1: Scoring Parameters

Evaluation criteria	Description	Evaluation scores		
Flow risk	Likelihood that the initial design flows will not be realized	Low – 1	Medium – 3	High – 5
Alignment risk	Likelihood that alignment issues could significantly impact implementation of the option	Low – 1	Medium – 3	High – 5
Operational risk	Likelihood that operational issues could significantly impact Aquatera and/or its customers	Low – 1	Medium – 3	High – 5
Flexibility	Ability of the option to be modified to deal with the potential for different flow conditions to arise	Flexible – 1	Potentially – 3	Inflexible – 5
Reliance on BCH LS	Reliance on the developers to have commissioned the BCH Lift Station	None – 1	Low – 3	Medium – 5
Reliance on 116 St Trunk	Reliance on the developers to have commissioned the 116 Street Trunk	Low – 1	Medium 3	High – 5

Table 6.2: Risk Evaluation Matrix

Option	Flow risk	Alignment risk	Operational risk	Flexibility	Reliance on BCH LS	Reliance on 116 St Trunk	Total Risk	Comments
1	5	3	3	5	1	1	18	Considered the least attractive option. The high flow risk requires the ultimate system to be constructed initially which has significant impact on the front end costs.
2	3	3	1	3	1	2	13	Viable option with relatively high front end costs. Getting a second forcemain alignment (in addition to BCH) along 116 Street will be an issue.
3	3	1	1	3	2	2	12	Viable option without need for a second forcemain alignment.
4a	1	1	3	1	2	3	11	A very good option. The principal risk associated with Option 4a is that is would rely upon instrumental controls to prevent discharges from Clairmont when inflows at BCH are above a certain capacity. With this comes the risk of control failure and or operator failures risking flooding at BCH.
4b	1	1	2	1	2	3	10	A very good option. This option is similar to Option 4a in terms of infrastructure requirements. However, it mitigates the control risk associated with Option 4a by reducing the flows to within the capacity of BCH. This option is slightly more reliant on the 116 Street Trunk than Option 4a.

6.3 Cost Comparison

The capital costs associated with the four main options are summarized in Table 6.3. The costs are broken down to show the costs that would be incurred if the ultimate flows were limited to the Master Plan Reduction projections or less versus the costs for the Full Design Standards projection. Because alternative approaches for increasing the discharge rate have been identified for Options 2, 3 and 4, these cost are also provided for comparison.

Table 6.3: Comparison of Estimated Total Project Costs

Option	Termination Point where Applicable	Cost ($M)							
		Ultimate Flows of 200 L/s or Less (Extrapolated)	Ultimate Flows of 200 to 300 L/s (Master Plan Reduction)			Ultimate Flows of 300 to 550 L/s (Full Design Standards)			
			Project 1	Project 2	Total	Project 1	Project 2	Project 3	Total
1	n/a	32.3	32.3	0.0	32.3	32.3	0.0	0.0	32.3
2 (Projects 1 & 3a)	(A)	15.9	15.9	0.0	15.9	15.9	0.0	13.9	29.8
	(B)	18.6	18.6	0.0	18.6	18.6	0.0	11.2	29.8
	(C)	23.0	23.0	0.0	23.0	23.0	0.0	6.8	29.8
2 (Projects 1 & 3b)	(A)	15.3	15.3	0.0	15.3	15.3	0.0	21.0	36.3
	(B)	17.9	17.9	0.0	17.9	17.9	0.0	21.0	38.9
	(C)	22.4	22.4	0.0	22.4	22.4	0.0	21.0	43.4
3 (Projects 1 & 3a)	(A)	12.0	12.0	0.0	12.0	12.0	0.0	13.4	25.4
	(B)	11.7	11.7	0.0	11.7	11.7	0.0	12.3	24.0
	(C)	13.1	13.1	0.0	13.1	13.1	0.0	7.0	20.1
3 (Projects 1 & 3b)	(A)	11.7	11.7	0.0	11.7	11.7	0.0	15.7	27.4
	(B)	11.4	11.4	0.0	11.4	11.4	0.0	14.2	25.6
	(C)	12.9	12.9	0.0	12.9	12.9	0.0	6.8	19.7
3 (Projects 1 & 3c)	(A)	11.7	11.7	0.0	11.7	11.7	0.0	21.0	32.7
	(B)	11.4	11.4	11.4	11.4	13.2	0.0	21.0	32.4
	(C)	12.9	12.9	0.0	12.9	12.9	0.0	21.0	33.9
4 (Projects 1, 2 & 3a)	(A)	9.5	9.5	0.7	10.2	9.5	0.7	12.6	22.8
	(B)	7.8	7.8	0.7	8.5	7.8	0.7	11.4	19.9
	(C)	7.8	7.8	0.7	8.5	7.8	0.7	6.2	14.7
4 (Projects 1, 2 & 3b)	n/a	7.7	7.7	0.7	8.4	7.7	0.7	21.0	29.4

Note that Table 6.3 does not include RTC costs for Option 4. If Option 4 was to be implemented with RTC for the initial stages then the costs for Project 1 would increase by around $ 0.2 million.

6.4 Recommended Option

Option 4 (without RTC) is the preferred option for the following reasons:

- Has significantly less expensive front end costs than Options 1, 2 or 3
- Generally would have the lowest overall costs if the ultimate flows were aligned with the Extrapolated or Master Plan Reduction flow projections
- Generally would have similar overall costs if the ultimate flows were aligned with the Full Design Standards flow projections
- Generally can provide servicing for approximately 125 L/s (ultimate Extrapolated ADWF projection)

- Generally utilizes the BCH lift station and forcemain to discharge flow from Clairmont to the 116 Street Trunk (downstream sections) without the need for over-sizing the BCH Lift Station or forcemain
- Enables a continuous discharge from Clairmont to BCH without the need for Real Time Controls
- Has the flexibility for the discharge rate to be increased to 200 L/s (ultimate Master Plan Reduction ADWF projection) if the completion of the 116 Street Trunk to 116 Avenue is delayed
- Has the flexibility to increase the discharge rate to that required by the Full Design Standards flow projection method

7.0 Conceptual Design of Recommended Option

7.1 Introduction

This section considers the configuration of the pumping station and lagoon storage required for the implementation of the recommended Option 4 (refer to Sections 5 and 6) and also provides conceptual alignments drawings for initial land acquisition assessments. Alternate locations for the pumping station are considered, as well as how the existing lagoon could be modified to provide the required diurnal and wet weather storage.

7.2 Pumping Station Location Options

The option of locating the new pumping station at the outlet from the storage cell was considered. This would presumably use the oversized outlet structure that was recently added to the storage cell as part of the lagoon upgrading. In order to utilize the oversized outlet structure, the lagoon would have to be configured so that the large storage cell acts as a surge pond. Using the storage cell as a surge pond would reduce the available storage and because of the size of this cell, it would also provide some basic treatment to the Clairmont flows before they are discharged, ultimately to the Aquatera WWTP in the City of Grande Prairie. The additional treatment element would be considered undesirable as it would introduce operation requirements and costs for maintaining the lagoon.

The reduction in available storage volume is also considered undesirable for two main reasons. The first is because of the uncertainty regarding future flows it would be prudent to maintain the ability to utilize the storage available here even if it is not at this stage considered necessary. The second is that it has the potential to reduce the costs associated with the pumping station because the vast amount of storage would negate the requirements for backup power at the station.

The second option that was considered for locating the pumping station was adjacent to the existing lagoon forcemain inlet. This option would require one of the relatively small anaerobic cells to be retrofitted to act as the station inlet chamber. The pumping station could be located south of the existing berm or could be constructed partially into the berm. Constructing the main station wet well into the berm of the anaerobic cell would reduce the overall impact footprint at the site and also reduce the additional interconnecting pipework required. The conversion of the anaerobic cell would require reconstruction of the cell base to slope towards the new pumping station inlet pipe. This will ensure that sewage debris will not settle in the cell and will be discharged through the new pumps.

The second option appears to best meet the needs of this project for the following reasons:

- It maintains the large storage cell for future wastewater storage
- It minimizes the depth of excavation for the pumping station and minimizes the inlet piping
- It makes effective use of the existing anaerobic and facultative cells for diurnal and wet weather flow storage

7.3 Storage Assessment

The following analysis examines the wet weather storage requirements at the lagoon site for the recommended option. From Section 6 it is recommended to discharge flows from the lagoon to the Bear Creek Lift Station at a constant rate of 125 L/s (Option 4b). This would provide approximately 15 years of service to the Clairmont Lagoon or to about the year 2020 assuming the Extrapolated dry weather flow generation rates. Wet weather flows in excess of the allowable discharge rate would require storage.

It is proposed to provide storage for excess flows in the existing lagoon. The existing lagoon is a conventional facultative lagoon. As previously mentioned, the capacity of the lagoon is as follows:

- Anaerobic Cell 8,000 cubic meters
- Facultative Cell 48,000 cubic meters
- Storage Cell 322,500 cubic meters

In order to determine the storage requirements for this option the XP SWMM models from the 2005 Clairmont Master Plan were reviewed.

The previous study developed XP SWMM models for both the 10 and 20 year development contours, corresponding to the year 2015 and 2025 respectively. The lagoon inflow hydrographs from the XP SWMM models for the 10 and 20 year development contours are illustrated in Figure 7.1. The lagoon inflow hydrograph was calculated for the 15 year development year, 2020, by interpolating between the 10 and 20 year contour years. This is also illustrated in this figure.

The hydrograph was used to calculate the maximum storage that would be required for the peak 2020 wet weather event (I in 100 year). This assumes that there are zero outflows during the event. The total volume was calculated to be approximately 43,000 m3. When compared with the existing lagoon cell capacities it can be seen that this storage volume may be accommodated fully by the facultative cell in the existing lagoon.

It should be noted that the above wet weather flow analysis assumed inflows based on Full Design Standards. As the design standards are considered to significantly overestimate the flows, the actual storage requirements are expected to be in the range of 5,000 to 20,000 cubic meters. However, as previously mentioned the large volume of available storage could negate the requirement for a backup power supply at the new pumping station. Eliminating backup power from the pump station design would mean it necessary to provide sufficient storage for the total flow generated by the peak wet weather event.

Also, if in the future, the Clairmont flows suggest that the peak wet weather flows are likely to exceed those considered in this analysis, additional storage is available in the existing lagoon storage cell. As shown in Section 4, the combined storage volume available at the lagoon site is sufficient to provide storage for the full inflow generated by the maximum ultimate design wet weather flow.

7.4 Storage Configuration

The assessment of the required storage volume for the recommended option showed that the maximum storage expected could be provided within the existing facultative cell alone. However, it is likely that use of this would only be required during extreme/severe rainfall events. Therefore, configuration of the storage should provide for incremental increases in volume.

Because it is recommended that one of the existing anaerobic cells is converted to act as an inlet chamber for the new station it would be possible to reconfigure the remaining anaerobic cells to provide the incremental storage requirements previously described. Realizing this would require that each cell be modified so that the overflows from the converted station inlet cell could surge into these cells and return to the inlet cell by gravity.

Conversion of the facultative cell to receive and return flows by gravity would significantly reduce the available storage volume in that cell. Therefore, to gain the maximum benefit of the volume available at this cell, consideration should be given to utilize a sump in the southwest corner of the cell, with the facultative cell re-graded to drain to this sump. Stored effluent could then be returned to the inlet cell using a mobile sump pump. This option should be reviewed as part of the preliminary design phase.

The general storage configuration described in this section is illustrated at Figure 7.2.

7.5 Pumping Station Layout

The proposed conceptual pumping station layout is based on a traditional wet /dry well arrangement in order to comply with the Aquatera standards for stations with pumps greater than 75 kW (refer to Section 5).

The layout shown (Figures 7.3a and b) is for the preferred Option 4C with the flexibility to be able to increase discharges in line with the ultimate projections made by the Full Design Standards. Note that because of this flexibility, the general layout shown would be suitable for all options with modifications required to the mechanical and electrical components as applicable.

As described in Section 5, Option 4C would require three 138 kW pumps (two duty and one standby) for the ultimate Master Plan Reduction projected flow of 300 L/s. While the discharge of the initial flow rate of 125 L/s could be achieved using smaller pumps (26 kW) this would not be recommended. This is because increasing the pump rate would not only require replacing the pumps and motors but also involve significant modifications to the electrical components. The ability to initially discharge lower flows would be better achieved by using variable speed pumps.

Option 4 is based on the assumption that the Clairmont Lagoon inflows would not exceed the Master Plan Reduction projections. However, if the Full Design Standard flow projections were realized, it would be possible to retrofit the pumping station to discharge a further 250 L/s (refer to Section 5.6).

Given the very large storage volume available, the requirements for backup power could potentially be negated with this pumping station. However, the need for backup power and standby pumps should be reviewed as part of the preliminary design phase. Note also that due to the location of the station, odor control equipment has also been omitted from the conceptual layout.

7.6 Forcemain Alignment

This section presents a possible alignment for the Option 4, Project 1(Clairmont lagoon to BCH lift station) forcemain. The purpose of this is to provide an indication of potential land acquisition requirements. The alignment is illustrated at Figures 7.4 to 7.14.

The conceptual forcemain alignment has been designed to avoid overlapping with existing power lines and other utility Right-of-Ways and to minimize the requirement for trenchless construction.

For conceptual purposes, a 10 metre wide pipeline Right-of-Way has been shown where the forcemain would be located outside of existing road Right-of-Way. A 10 metre pipeline Right-of-Way has been chosen as this will provide space for a future parallel forcemain (Option 4, Project 3) should the discharge rate need to be increased.

An additional 10 metre temporary working easement is also shown where applicable.

8.0 Implementation Plan

8.1 Timing of 116 St Sewage Discharge

The lagoon upgrade works described in Section 2 will increase the capacity of the treatment facility from around 800 to 1767 cubic meters per day (average of 9 to 19 L/s). Based on the Extrapolated flow projections described in Section 3 it is anticipated that the improvements will provide servicing to between the years 2011 and 2012 (refer to Table 8.1). Note that the 1767 cubic meters per day capacity would be reached sooner than 2010 if the actual flows were higher than the Extrapolated flow projections.

Table 8.1: Projected Average Daily Inflows to Clairmont Lagoon

Year	Average Daily Inflow (m^3/d)		
	Extrapolated	Master Plan Reduction	Full Design Standards
2010	1,556	3,907	17,910
2011	1,667	4,490	18,640
2012	1,777	5,074	19,371
2013	1,888	5,657	20,101
2014	1,998	6,240	20,831
2015	2,109	6,823	21,562
2016	2,219	7,406	22,292
2017	2,330	7,989	23,022
2018	2,440	8,572	23,753
2019	2,551	9,155	24,483
2020	2,661	9,738	25,213
2021	2,898	10,075	25,772
2022	3,136	10,413	26,331
2023	3,373	10,750	26,890
2024	3,610	11,087	27,449
2025	3,847	11,424	28,008
2026	4,085	11,761	28,567
2027	4,322	12,098	29,126
2028	4,559	12,435	29,685
2029	4,796	12,772	30,244
2030	5,034	13,109	30,803
2031	5,864	13,997	31,819
2032	6,694	14,884	32,835
2033	7,525	15,772	33,850
2034	8,355	16,659	34,866
2035	9,186	17,547	35,882
2036	10,016	18,434	36,898
2037	10,846	19,322	37,913
2038	11,677	20,210	38,929
2039	12,507	21,097	39,945
2040	13,338	21,985	40,961

It has been recognized that all the methods used for projecting flows contain a degree of conservatism. As such, the Extrapolated flow projection suggesting that a new discharge would be required by 2011 – 2012 may itself be conservative. Therefore, in order to determine the timing for the discharge, rainfall and flow monitoring data as well as weekly pump run times for the pumping stations feeding the lagoon should be collected and analyzed. To provide as accurate estimate of the inflows as possible, it is recommended that a flume be constructed upstream of the lagoon as part of the Clairmont Regional forcemain installation in 2008.

Monitoring data should be checked monthly during the summer months to ensure that the data being collected is reasonable accurate, comparing flow monitoring to pump run time/volume calculations. Flow monitoring data should be checked bi-annually and compared to the available lagoon capacity. The analysis of this data will enable accurate projections of near future flows to be made which in turn will assist in proving advance notice to the required timing of the new discharge.

8.2 Planning Needs

This section considers the potential issues that would need to be addressed to facilitate the realization of Option 4 for a 116 St discharge from Clairmont lagoon to the 116 Street Sanitary Trunk Sewer. Note that this section also provides for consideration of the planning issues that could impact, if the BCH lift station and forcemain was not in place at the time required for this option.

8.2.1 Flow Monitoring

In order to provide advance notice to the required timing of the new discharge, flow monitoring as described in Section 8.1 must be carried out.

8.2.2 Liaison with the BCH Developer

Utilization of the BCH lift station and forcemain is a critical component of recommended Option 4. It is imperative to the success of this option that Aquatera engages the BCH developer at an early stage so that infrastructure requirements and any cost sharing arrangements can be agreed to.

8.2.3 Funding

Aquatera should investigate sources of external grant funding for this project. Potential sources of grant funding are listed below with details attached in Appendix D.

The two key programs sponsored by the federal government are:

- Green Municipal Fund (GMF) administered by the Federation of Canadian Municipalities, and
- Municipal Rural Infrastructure Fund (MRIF) administered by Alberta Infrastructure and Transportation

The three key provincial programs administered by Alberta Infrastructure and Transportation are:

- Alberta Municipal Infrastructure Program (AMIP),
- New Deal for Cities and Communities (NDCC), and
- Alberta Municipal Water/Wastewater Partnership (AMWWP)

Note that this project would create a regional wastewater system and should therefore be eligible for higher levels of funding then are normally available for these types of systems.

8.2.4 Design and Land Acquisition Timelines

Because the need for a new discharge from the Clairmont Lagoon has been identified for as early as 2011, Aquatera should proceed to the design phase of the project as soon as a decision is made on the preferred option (i.e. Ferguson Lake discharge vs. pumping to City of Grande Prairie system). The preliminary and detailed design phases of the project should take between 9 and 12 months.

Prior to construction Aquatera will need to obtain utility rights-of-way along RRD 63 with the County of Grande Prairie. It has been assumed that the County will not allow the forcemain to be located within the road right-of-way. It is suggested that a minimum of 12 months be allowed in the overall project schedule for land acquisition.

8.2.5 Crossing Agreements

The recommended Option 4 has one roadway crossing at TWP 722 that would require formal provincial approval if the development of Highway 43X is completed by the time the forcemain is constructed. Construction of Highway 43X at RRD 63 is currently scheduled for 2008 but may not proceed until 2009 or later, subject to land acquisition. If Option 2 was required, then the crossing of Highway 43 (100 Avenue) at 116 Street would also require formal provincial approval. These approvals would be obtained from Alberta Infrastructure and Transportation.

The recommended Option 4 also does not have any rail crossings. However, if Option 2 was required an agreement will be required for the CN Rail crossing on 116 Street.

The requirements for the highway and railway approvals are summarized in Appendix E.

8.2.6 Environmental Regulatory Requirements and Permitting Processes

There are no anticipated Federal environmental permits required for the works associated with the construction of Option 4 or Option 2. This assumes that the Bear Creek crossing will be carried out with trenchless construction methods and that any tree removals are completed prior to the spring nesting season.

It is not anticipated that an Environmental Assessment would be required for either Option4 or Option 2.

The conceptual route for both Option 4 and Option 2 would be exempt from approval under the Water Act. However, both would involve the Crossing of Bear Creek watercourse. This activity would be regulated under the Code of Practice for Watercourse Crossing and the Code of Practice for Pipelines and Telecommunications Lines Crossing a Water Body and will require a submission to Alberta Environment.

9.0 Conclusions and Recommendations

9.1 Conclusions

1. Monitored flows from non-residential areas in Clairmont indicate actual DWF are much lower than that specified in the design standards. The Extrapolated flow projections are considered to be a much more realistic estimate of the future wastewater flows.

2. With the upgrading of the Clairmont lagoons to an aeration treatment facility with a design capacity of 1767 cubic meters per day, it is anticipated that an alternative servicing option (i.e. Ferguson Lake or City of Grande Prairie system) will be required by around 2011.

3. Based on the anticipated design flow conditions, Option 4 (without RTC) is considered the most appropriate solution, based on both cost and risk considerations, for discharge from the Clairmont lagoon to the Aquatera City of Grande Prairie sewerage system.

4. If development of the Bear Creek Highlands Lift Station does not take place before the discharge from the Clairmont Lagoon is required, then Option 2 would become the preferred option.

5. The Clairmont lagoon has sufficient storage capacity available to provide for storage of wet weather flows for all of the options described in this report.

9.2 Recommendations

1. Confirm that the proposed connection to the City of Grande Prairie sewerage system is the preferred option (i.e. rule out Ferguson Lake discharge option).

2. Monitor flows to better understand the required timing of the new discharge.

3. Commence discussions with the BCH developer regarding infrastructure requirements and any cost sharing arrangements.

4. Investigate potential grant funding opportunities.

5. Commence with the design of the system in 2008 and identify land acquisition requirements for the forcemain as soon as possible.