December 20, 2019

Email: [redacted]

Dear [redacted]

Re: Request for Access to Information under Part II of the Access to Information and Protection Privacy Act (the ATIPP Act, 2015)

On November 26, 2019, the City of St. John's received your request for access to the following information:

> *A copy of the Fort Amherst Sewage Treatment Feasibility Study (Oct 2017).*

Enclosed is the information you requested. Please be advised that you may ask the Information and Privacy Commissioner to review the processing of your access request, as set out in Section 42 of the ATIPP Act. A request to the Commissioner must be made in writing within 15 business days of the date of this letter or within a longer period that may be allowed by the Commissioner:

> Office of the Information and Privacy Commissioner
> 2 Canada Drive; P. O. Box 13004, Stn. A, St. John's, NL. A1B 3V8
> Telephone: (709) 729-6309; Facsimile: (709) 729-6500

You may also appeal directly to the Supreme Court Trial Division within 15 business days after you receive the decision of the public body, pursuant to Section 52 of the Act.

If you have any further questions, please feel free to contact me by telephone at 576-8429 or by e-mail at kcutler@stjohns.ca.

Yours truly,

Kenessa Cutler
ATIPP Coordinator

Fort Amherst Sewage Treatment Feasibility Study
Department of Planning, Development and Engineering
St. John's, NL

October 6, 2017

NEWFOUNDLAND
DESIGN
ASSOCIATES
LIMITED
CONSULTING ENGINEERS

Table of Contents

Appendices

1.0 INTRODUCTION

Fort Amherst is a small community located within the City of St. John's adjacent to the entrance to St. John's Harbour. The approximately twenty-five residences in the area discharge untreated sanitary sewage directly into the harbour through three sewage outfalls. It is the City of St. John's (CSJ's) intention to intercept these three outfalls and convey the wastewater to the Riverhead Wastewater Treatment Facility (RHWTF) on Southside Road or an on-site sewage treatment system in order to comply with new Federal discharge regulations slated for 2020.

Ostensibly, the practical way to eliminate the Fort Amherst sewage outfalls is to provide pumping and forcemain infrastructure to convey the sewage to RHWTF for treatment. This involves pumping sewage from a location near the Prosser's Rock Small Craft Harbour (SCH) along Southside Road for approximately 1,455 m to a manhole that gravity feeds the RHWTF. The RHWTF is currently a primary treatment plant, but the CSJ is committed to upgrading the plant to a secondary treatment plant and the CSJ is currently trying to access multi-governmental funding for those upgrades.

There are numerous advantages to pumping the sewage to RHWTF, including:

- The sewage will be conveyed to RHWTF for primary treatment and ultimately secondary treatment as required by Federal legislation;
- The CSJ considers it beneficial from and operation and maintenance perspective to maintain sewage treatment at one location. Construction of a separate treatment plant would require operation and maintenance at a separate location;
- Public concerns about the effectiveness or nuisance of a local treatment plant in a tourist and heritage area would not come into play;
- If the Federal discharge regulations become more onerous, required treatment upgrades will only be required at one location;
- Future potential increases in population in the Fort Amherst area will be easily handled by pumping to RHWTF, rather adding on to a small treatment plant; and
- All treatment plants have to meet both Federal and Provincial discharge regulations. A small treatment plant of the size that would handle sewage emanating from the Fort Amherst area would fall below the threshold for Federal reporting. That being said, small plant would require a Provincial Permit to Operate and regular monitoring of that permit.

However, a number of small secondary on-site sewage treatment systems are currently being marketed in Newfoundland. The CSJ therefore decided to conduct a feasibility study into those options versus the option to pump the sewage to RHWTF. This feasibility study is not meant to be exhaustive, but to investigate the matter in sufficient detail to establish whether or not there would be merit in pursuing the on-site sewage treatment option further.

A vacant site exists near Prosser's Rock which could potentially be used for an on-site treatment system. The property is currently owned by Newfoundland Power. The CSJ has approached Newfoundland Power about purchasing the property. Newfoundland Power has indicated that they may be agreeable to selling the property to the CSJ. They have also noted that past uses of the site may give cause for concern about potential contamination issues.

The CSJ has engaged Newfoundland Design Associates Limited (NDAL) to conduct a feasibility study of treatment options. The untreated wastewater from three existing outfalls would be intercepted and routed via gravity sewers, sewage pumping stations (SPSs), and forcemains to the treatment location as indicated on Drawings CSK 1 and CSK 2 in Appendix A and shown in Photo 1 and CSK 5 and CSK 6 in Appendix E. The treatment system will provide secondary treatment to the wastewater to meet the discharge limits set out in the Newfoundland and Labrador Environmental Control Water and Sewage Regulation (NL ECWSR) as detailed in Table 1. The number of residences to be serviced is 25 with an Average Daily Flow of 0.3 L/s and a Peak Dry Weather Flow of 1.3 L/s. The ultimate population based on a population density of 40ppha and a residential zoning area of 2.3011 ha is estimated to be 92 people.

Photo 1: Proposed On-Site Sewage Treatment System Location

On-site sewage treatment systems offer a variety of approaches to collect, treat, and release wastewater from residential homes and provide an alternative to individual or communal septic systems. A number of on-site sewage treatment systems providing secondary treatment have been installed in Newfoundland and Labrador (NL). This study examines on-site sewage treatment options for Fort Amherst provided by three firms: Abydoz Environmental Inc.; Blivet Marketing Services North America; and, Clarity Aquatech Ltd. The following sections will provide a description of the processes utilized by each system as well as other pertinent factors such as the anticipated effluent quality, annual operating and maintenance costs, and capital costs. It should be noted that the effluent quality and costs are the proponent's claims and have not been verified at this time.

We will compare the estimated cost of the on-site sewage treatment systems to the cost of pumping the untreated wastewater via forcemain to the RHWTF. The works involved with intercepting the 3 existing outfalls and conveying the untreated wastewater to the Prosser Rock area is the same for the on-site sewage treatment systems as for the forcemain to the RHWTF. As a result, we will compare the cost of the on-site sewage treatment system to the cost of the forcemain for all works downstream of the SPS adjacent to the Prosser's Rock SCH (Prosser's Rock SPS). Finally, we will make a recommendation based on the considerations in this report and discussions with the CSJ.

Parameter	**Maximum Allowable Limits**
B.O.D.	20 mg/l
Coliform - faecal	1000 / 100 ml
Coliform - total	5000 / 100 ml
Solids (dissolved)	1000 mg/l
Solids (suspended)	30 mg/l
Oils (Ether extract)	15 mg/l
Floating debris, oils and grease	None to be visible
Arsenic	0.5 mg/l
Barium	5.0 mg/l
Boron	5.0 mg/l
Cadmium	0.05 mg/l
Chlorine	1.0 mg/l
Chromium (hexavalent)	0.05 mg/l
Chromium (trivalent)	1.0 mg/l
Copper	0.3 mg/l
Cyanide	0.025 mg/l
Iron (total)	10 mg/l
Lead	0.2 mg/l
Mercury	0.005 mg/l
Nickel	0.5 mg/l
Nitrates	10 mg/l
Nitrogen (ammoniacal)	2.0 mg/l
Phenol	0.1 mg/l
Phosphates (total as P^2O^5)	1.0 mg/l

Phosphorus (elemental)	0.0005 mg/l
Selenium	0.01 mg/l
Sulfides	0.5 mg/l
Silver	0.05 mg/l
Zinc	0.5 mg/l

Table 1: NL ECWSR Discharge Limits

It should be noted that the on-site treatment facilities discussed in this report do not meet all of the standards shown in Table 1, including the nitrogen and phosphate limits. It is understood, however, that the province may not enforce those limits for discharge into the harbour.

2.0 FORCEMAIN TO RIVERHEAD WASTEWATER TREATMENT FACILITY

Conveying the untreated wastewater from the Prosser's Rock SPS to the RHWTF generally involves installing 1,455 metres of 100 mm diameter PVC DR18 forcemain along Southside Road from the SPS to a manhole at station 0+085 which gravity feeds to the RHWTF. General site plans and profiles for the forcemain can be found on Drawings CSK 5 through 9 in Appendix E. The estimated cost associated with this work including engineering fees is $945,663 plus H.S.T[1]. A breakdown of the quantities and associated unit prices for this preliminary estimate can be found in Appendix F.

The 50 year life cycle costs for the Prosser's Rock SPS are not considered here because they are common to both the forcemain option and the on-site treatment options. Additional operation and maintenance costs per annum are presented in Table 2 below.

O & M Task	**Frequency**	**Annual Cost[2,3]**
Pump Replacement and Misc.	Every 20 Years	$2,000
	Annual Subtotal	**$2,000**
	20% Contingency	**$ 400**
	Annual Total	**$2,400**

Table 2: Forcemain Operations and Maintenance Summary
[1] Cost to CSJ is 30% of total capital cost due to cost shared funding
[2] H.S.T. Not Included
[3] Estimate Based on Value of CAD in March 2017

ABYDOZ ENVIRONMENTAL INC.

Abydoz Environmental Inc. (Abydoz) is a Canadian based wastewater treatment firm that focuses on the engineering, construction, operations and maintenance of Engineered Wetland Systems (Systems). The Abydoz Systems are based on a patented technology by the German researcher Dr. Reinhold Kickuth. Abydoz is the licensed representative of Dr. Kickuth's technology in Canada.

Abydoz has designed and constructed over 35 Systems throughout Atlantic Canada over the past 15 years and these Systems have won a number of awards. The Abydoz Systems can be designed to treat a wide range of effluent demands, from whole towns to LEED certified buildings. The Systems low maintenance requirements and high effluent quality provide a solution for decentralized wastewater systems. Abydoz has designed and constructed 7 domestic Systems with similar flow rates to those found at Fort Amherst. These locations include Corner Brook, Marystown, Deer Lake, Gander, Buchan's Junction, Quispamsis, and Salmonier Nature Park (see Photos 2 and 3 for examples). It should be noted that the preceding and following claims and costs estimates in this section were supplied by Abydoz and have not been verified at this time.

Photo 2: Abydoz System at the Long Term Care Facility in Corner Brook, NL

Photo 3: Abydoz System in Marystown, NL

The proposed Abydoz System at Fort Amherst would consist of 2-3 septic tanks for primary treatment and a bilateral horizontal wetland bed for secondary treatment (refer to Figure 1 for a typical Abydoz System cross section). The overall size of the site (including all roadways, berms, and fencing) is approximately 1500 m^2 and the size of the horizontal wetland bed is approximately 750 m^2 with a thickness of 0.6 - 1.0 m. A site plan overlaying the footprint of the Abydoz System on the proposed site can be found on Drawing P-1 in Appendix B.

Effluent enters the primary treatment and then flows to the secondary Abydoz subsurface wetland treatment that uses reed plants to enhance biological treatment. The roots of the reed plants provide dissolved oxygen to the surrounding soil matrix. This results in varying levels of oxygen in the surrounding soil matrix which can be divided into three zones: aerobic zone (containing oxygen); anaerobic zone (containing no oxygen); and, anoxic zone (containing no oxygen, but containing nitrites and nitrates). These zones host different strains of bacteria that break down the wastewater effluent into more inert forms through oxidation and reduction reactions. The effluent is in contact with PVC piping during primary treatment and an engineered matrix of organics, sand, aggregates, lime, and clay overlaying a PVC or HDPE liner during the secondary treatment. A UV filter can be applied to the outlet pipe.

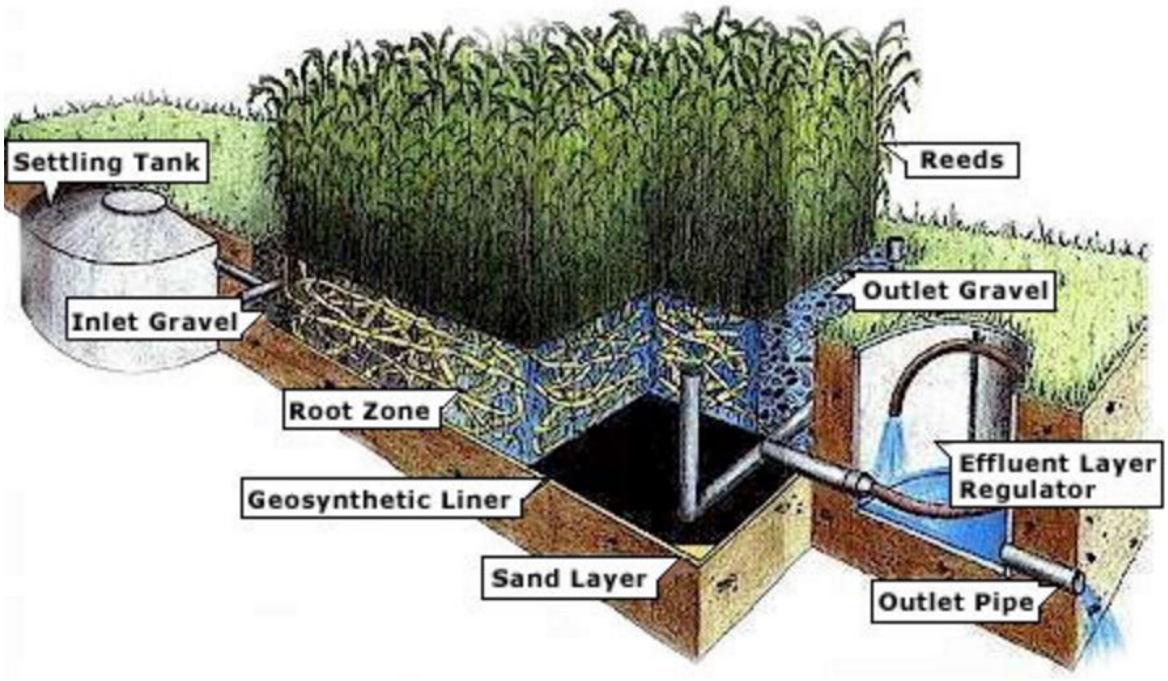


Figure 1: Typical Abydoz System Cross Section

The Abydoz System is energy efficient. It uses reed plants instead of mechanical systems to supply bacteria with the oxygen they need to break down the wastewater effluent. This passive aeration process results in a low maintenance system with no electrical input and no moving parts.

The exposure to salt air and salt water at the proposed site location is not expected to have a detrimental effect on the reed plants and the functioning of the Abydoz System. The reed plants used by Abydoz are a hardy plant and are known to grow in salt concentrations of up to 6 g NaCl/L. For comparison, salt water is 35 g NaCl/L. In addition, the Abydoz facility in Stephenville is much more exposed to saltwater spray than the proposed site location at Fort Amherst. As a result, the Stephenville facility experiences heavy salt accumulation on the building and plants, without any adverse effects on the plants or the System.

The Abydoz System is currently sized for an ADF of 0.3 L/s and a PDF of 1.3 L/s and it is capable of maintaining this footprint even if the ADF increases by more than 3 times. The system can achieve this in two ways. The first way is to construct a containment berm around the secondary treatment so that excess flows (during excess storm runoff events) are stored short term (24 hours) on the surface of the bed, thus reducing peak flows. The diluted storm water will not bypass the system untreated unless it meets the NL ECWSR. Additional primary treatment volume may also be required. These measures are applicable to 2-3x residential flows, and do not apply to industrial operations. The second way to increase the Systems flow capacity beyond the 2-3x outlined previously, would be to install an inlet aeration system to increase biological activity. This would consist of a blower system and aeration piping, but no

change in the wetland footprint. The first method of handling the ultimate population loading would not be acceptable to the CSJ. Consequently, the blower system and aeration piping would have to be incorporated to accommodate the increased loading at an additional cost.

Abydoz provides operator training during commissioning which covers regular maintenance activities that can be easily performed by the CSJ's operators. This includes weekly general system inspection, quarterly flow regulator adjustment, and weed and brush removal twice annually during the growing season. It is also recommended that Abydoz maintenance staff perform an annual in-depth inspection and clean out the System inlet every 15-20 years. The CSJ wishes the inlet cleaning be carried out every 5 years. Annual sludge maintenance of the septic tanks should be performed by a local contractor where the sludge is pumped out of the septic tanks and transported to the RHWTF for processing. Refer to Table 3 for a summary of the operations and maintenance tasks and estimated costs.

O & M Task	**Frequency**	**Man Hours**	**Annual Cost[6,7]**
General Inspection[1]	Weekly	0.5	$1,300
Regulatory Adjustment[1]	Quarterly	1-2	$400
Weed Removal[1]	Twice Annually	2	$200
In-depth Inspection[2]	Annually	N/A	$500
Inlet Cleaning[2]	5 Years	N/A	$2,800
Sludge Pumping[3]	Annually	N/A	$2,700
System Rehabilitation[4]	Every 40 Years	N/A	$1,200
Sampling Program[5]	Continuous	N/A	$25,000
		Annual Subtotal	**$34,100**
		20% Contingency	**$6,820**
		Annual Total	**$40,920**

Table 3: Abydoz System Operations and Maintenance Summary
[1] Assumed CSJ Maintenance Staff Wage of $50/hr
[2] Undertaken by Abydoz Maintenance Staff
[3] Sludge Pumping and Transport and Disposal by Local Contractor
[4] Septic Tank and System Rehabilitation
[5] Influent and Effluent Sampling Program
[6] H.S.T. Not Included
[7] Estimate Based on Value of CAD in March 2017

Estimated capital costs for the works associated with the Fort Amherst Abydoz System are shown in Table 4. This includes all site access, fencing, outlet pipe, and 2 years of plant adaptation in which the horizontal wetland bed is monitored and adjusted by Abydoz staff to ensure the wetland reed plants adapt and grow properly. This estimate does not allow for high water table or unknown soil conditions which could result in increased costs. Please note that the costs are the supplier's claims and have not been verified at this time.

Component	**Cost Estimate[1]**
Primary Treatment	$72,000
Secondary Treatment c/w UV disinfection	$443,000
Forcemain to System	$12,000
20% Contingency	$103,000
Total	**$632,400[2]**

Table 4: Estimated Capital Costs
[1] H.S.T. Not Included
[2] Cost to CSJ is 30% of total capital cost due to cost shared funding

3.0 BLIVET MARKETING SERVICES NORTH AMERICA LTD.

Blivet Marketing Services North America Ltd. (BMSNA) is a Newfoundland firm focused on providing sewage treatment systems and other environmental products. BMSNA is a licensee of the BMS Blivet™ - a compact, modular, all-in-one sewage treatment system that can be installed sub grade or above grade and is ideal for populations ranging from 20 - 2000 PE (Photo 4). The BMS Blivet™ was developed in Ireland and it meets and exceeds their local stringent environmental regulations. The BMS Blivet™ operates in over 38 countries and 5 continents worldwide. It should be noted that the preceding and following claims and costs estimates in this section were supplied by BMSNA and have not been verified at this time.

Photo 4: Modular BMS Blivet™ Units at Vale Long Harbour Processing Facility, NL.

BMSNA has successfully provided 8 BMS Blivet™ Systems (BMSNA Systems) consisting of 11 modular units in NL (4 in Long Harbour, 4 in Marystown, 1 in Bishops Falls, 1 in Placentia, and 1 in Whitbourne) with plans in the works to install 3 more BMSNA Systems in NL in 2017. The BMS Blivet™ Model BL 1500 (BL 1500) is recommended for the Fort Amherst area based on estimated daily flows. The BL 1500 has been used in Marystown to service 56 persons. It has an ADF of 0.28 l/s which closely matches the anticipated ADF of 0.3 l/s at Fort Amherst. Testing results obtained from a manhole immediately downstream of the BL 1500 in Marystown indicate the effluent meets and exceeds the NL ECWSR requirements and the Canadian Wastewater Systems Effluent Regulations (WSER). A summary of the

testing results for the concentrations of BOD_5 and Total TSS for the BL 1500 in Marystown are provided in Table 5.

	Date (M/D/Y)	Air Temp (°C)	BOD_5 Inlet / Outlet (mg/L)	TSS Inlet / Outlet (mg/L)
Sample 1	09/09/09	10.2	450 / 16	3700 / 22
Sample 2	09/17/09	8.6	120 / 9	140 / 8
Sample 3	09/23/09	14.4	160 / 16	200 / 17
Sample 4	09/30/09	12.8	Lost / Lost	1300 / 7
Sample 5	10/20/09	4.3	420 / 17	570 / 7
Sample 6	11/18/09	2.0	56 / 8	74 / 18
Sample 7	12/16/09	0.3	70 / 6	140 / 4
Sample 8	01/20/10	-11	210 /17	200 / 18
Sample 9	02/17/10	-1	150 / 19	160 / 23
Sample 10	03/16/10	-3	160 / 7	240 / 21
Sample 11	04/14/10	1	100 / 6	410 / 9
Sample 12	05/26/10	2	170 / 17	320 / 21

Table 5: Marystown BL 1500 Testing Results

The BL 1500 consists of four main components that work to provide secondary treatment to the wastewater effluent: primary settlement; aerobic treatment; final settlement; and sludge storage. These components are detailed in the BMS Blivet Process Diagram in Figure 2.

The first component is the primary settlement component. As the untreated wastewater enters the BL 1500, it is forced to the bottom of the tank by a vertical baffle opposite the inlet. The wastewater then migrates through a set of lamella plates which serve to settle the heavier particles to the sludge storage component at the bottom of the tank while the supernatant liquid passes over a notched weir into the biozone component. This primary settlement component reduces TSS by 75% and BOD by 25% to 30%. It consists of zero moving or electrical parts and is relatively maintenance free.

The biozone component is where the wastewater is subject to aerobic treatment. This component consists of a rotating fixed film reactor with active aeration known as the BMS Aerotor™. As the wastewater passes through the biozone component, the microorganisms present in the wastewater adhere to the rotating media filter and the biomass gets evenly distributed across its surface. The BMS Aerotor™ rotates at a speed of 6 rpm which allows the microorganisms to accumulate evenly in a given area and keeps the BMS Aerotor™ clean. Since the lower portion of the BMS Aerotor™ is submerged in the passing wastewater, the microorganisms are cyclically exposed to air and liquid which aids in the treatment of the wastewater. The rotating drum also provides hydraulic lift to the wastewater, which allows some of the aerobically treated wastewater to be circulated by gravity back to the beginning of the biozone for another pass at aerobic treatment.

The wastewater that bypasses this recirculation line flows through a pipe to the final settlement component.

The final settlement component is similar to the primary settlement component. A baffle forces the wastewater towards the bottom of the tank and a series of lamella plates at close spacing serve to settle the fine suspended particles. A small, submersible, timer-operated pump is located at the base of the

tank to pump sludge to the main sludge storage area. The supernatant liquid rises through the lamella plates and over a notched weir into a trough and then through the effluent outlet pipe.

The main sludge storage component is located at the base of the tank and provides approximately 6 months of storage before it must be pumped and disposed of.

The interior components of the Blivet modules are made of fibreglass and stainless steel. The only material that is in contact with the effluent is fibreglass.

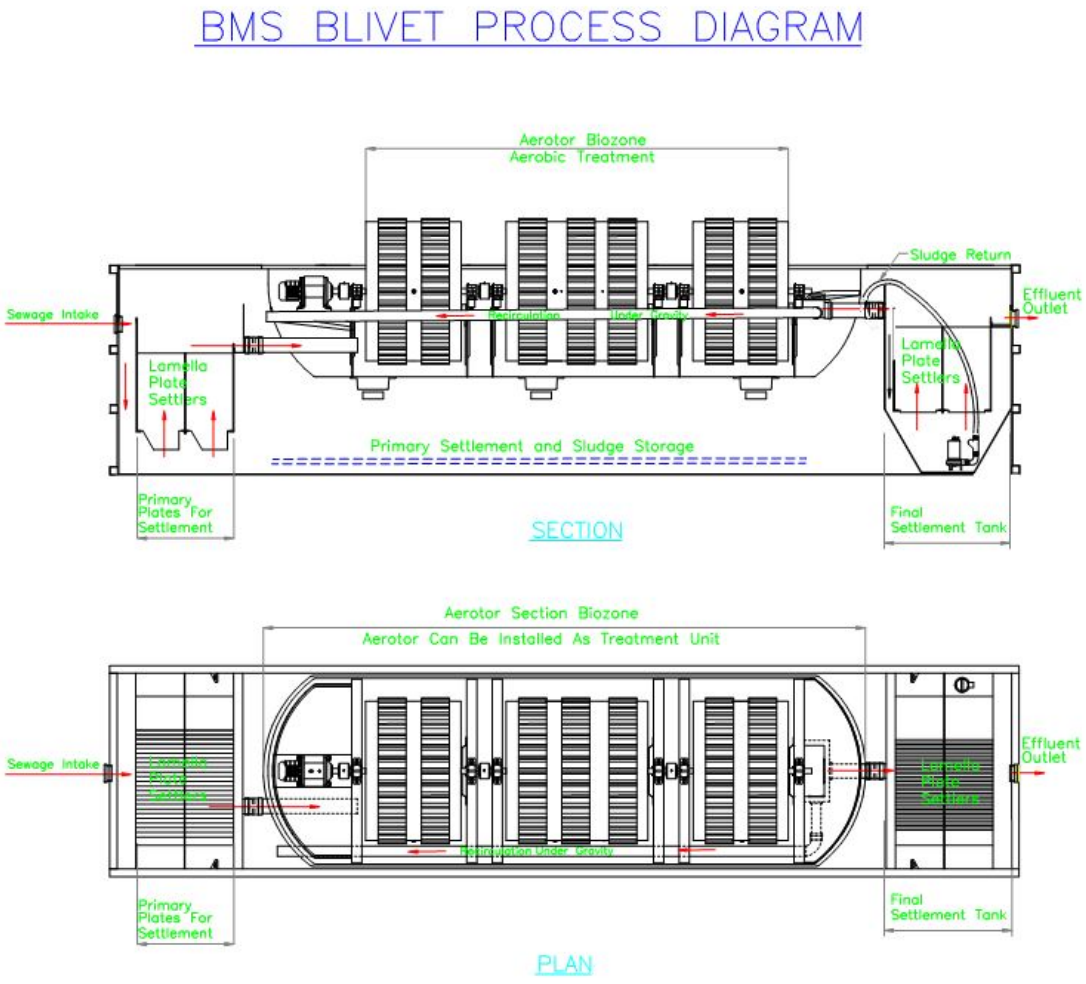


Figure 2: BMS Blivet Process Diagram

The Blivet modules are selected based on the ADF and PDF. The BL 1500 is near full capacity based on the anticipated flows at Fort Amherst. Increasing the capacity is as easy as installing another Blivet module in parallel with the existing unit. Space requirements are minimal and for a BL 1500 one only needs an adjacent plot of land of about 5 m x 10 m. Typically, the same sized units are placed in parallel for consistency. However, if a smaller unit is more economical and future flows are expected to be capped, dissimilar sized modules may be used. Servicing the ultimate population would involve adding an additional unit, which is a future capital cost.

The BL 1500 has two electrical devices - the main shaft drive motor and final sludge return pump - and associated mechanical parts. As such, there are costs associated with the maintenance of the mechanical parts (grease and oil change) and electricity costs associated with the electrical devices. Annual sludge maintenance should be performed by a local contractor where the sludge is pumped out of the sludge storage component and disposed of by a local Contractor. Refer to Table 6 for a summary of the operations and maintenance tasks and estimated costs.

O & M Task	**Frequency**	**Annual Cost[5,6]**
Electricity[1]	Annually	$970
Grease Bearings and Couplers[2]	Thrice Annually	$180
Oil Change	Annually	$120
Sludge Pumping[3]	Twice Annually	$1,163
Sludge Pump	Every 10 Years	$75
Motor Pump	Every 10 Years	$135
Motor Gear Box and Bearings	Every 30 Years	$300
Sampling Program[4]	Continuous	$25,000
	Annual Subtotal	**$27,943**
	20% Contingency	**$ 5,589**
	Annual Total	**$33,532**

Table 6: Blivet 1500 Operations and Maintenance Summary
[1] Assumed Electricity Prices of 20 cents/kwh
[2] $10 for each bearing (4) and coupler (2)
[3] Sludge Pumping and Transport and Disposal by Local Contractor
[4] Influent and Effluent Sampling Program
[5] H.S.T. Not Included
[6] Estimate Based on Value of CAD in March 2017

Estimated capital costs for the Fort Amherst BMSNA System are shown in Table 7. This includes all site access, site works, fencing, and the supply and install of the Blivet 1500 complete with a UV filter and outfall pipe. This estimate does not allow for high water table or unknown soil conditions which could result in increased costs. A site plan illustrating the footprint for the BMNSA System can be found on Drawing CSK 3 in Appendix C.

Component	**Cost[1]**
BMSNA System c/w UV Filter	$189,000
Forcemain to System	$ 12,000
20% Contingency	$ 40,200
Total	**$241,200**

Table 7: Estimated Capital Costs
[1] H.S.T. Not Included
[2] Cost to CSJ is 30% of total capital cost due to cost shared funding

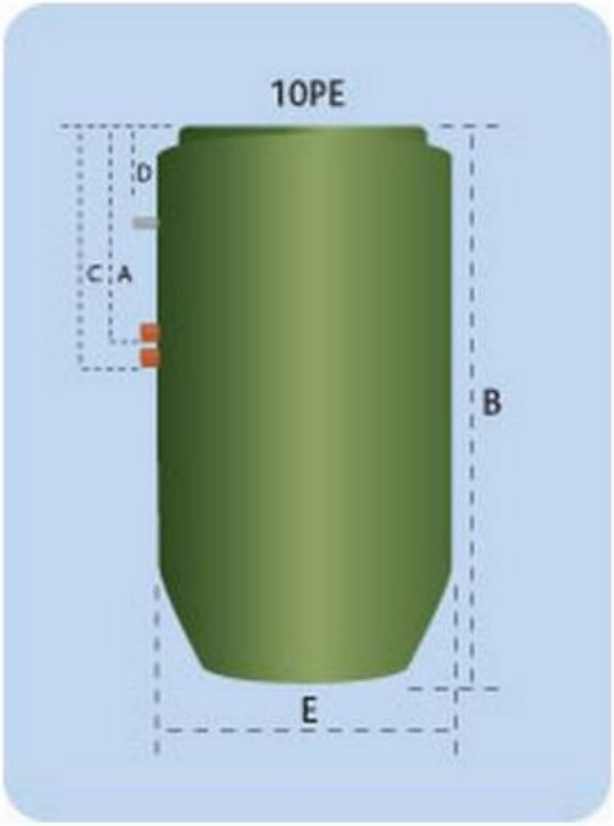
4.0 CLARITY AQUATECH LTD.

Clarity Aquatech Ltd. (Clarity) is a Canadian based on-site wastewater treatment firm that specializes in the design, construction, installation, and operation of Clarity Biofilter Systems (Clarity Systems). The Clarity Systems use the latest biofilter technology coupled with UV treatment to provide secondary treatment to wastewater as an alternative to traditional septic systems and can be installed above or below grade. Clarity has been installing Clarity Systems in Newfoundland since 2008. The photo below shows the top of a below grade Clarity System on a residential property. It should be noted that the preceding and following claims and costs estimates in this section were supplied by Clarity and have not been verified at this time.

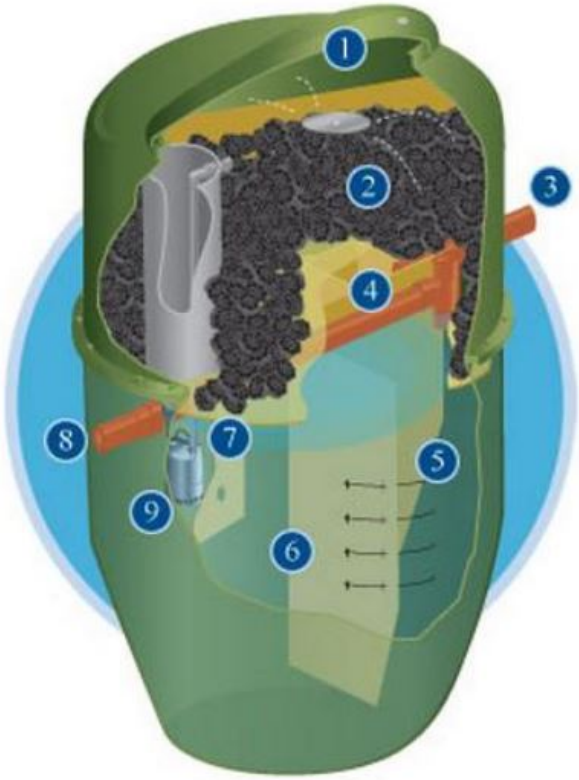
Photo 5: Below Grade Residential Clarity Biofilter System

The Clarity System consists of up to four successive stages within the tank that work to provide secondary treatment to the wastewater effluent: primary processing stage; secondary processing stage; ultra-violet (UV) light emitting unit stage; and, treated effluent diffuser stage. A 3-Dimensional representation of some of these stages is shown in Figure 3.

The primary processing stage accepts the untreated wastewater and applies primary anaerobic treatment by allowing the sludge to settle by gravity. The untreated wastewater enters primary settling zone (5) where the heavier particles settle out and the lighter particles pass through holes in a wall into a secondary settling zone (6) for further settlement and primary treatment. Anaerobic digestion breaks down the sludge in the primary processing stage into low carbon chain organic compounds that are either water soluble or gaseous compounds such as methane.



UNIT	GRAVITY	PUMPED
P/E	10	10
(A) INLET	1275	1275
(B) DEPTH	2900	2900
(C) OUTLET	1325	–
(D) OUTLET	–	400
(E) DIAMETER	1800	1800



1. Distributor
2. Media
3. Outlet
4. Sample Chamber
5. Primary Zone
6. Primary Zone Second Stage
7. Irrigation Zone
8. Inlet
9. Irrigation Pump

Figure 3: 3-D Representation of Clarity Biofilter Tank

In the secondary processing stage, clarified wastewater from the secondary settling zone enters the secondary compartment (7) via gravity. Aerobic digestions takes place in the secondary processing stage in two ways. The first occurs in the secondary compartment through aeration via a pump located near the top of the Clarity Biofilter tank. The second occurs when the clarified wastewater in the secondary compartment is pumped via a sump pump at the bottom of the compartment to a diffuser at the top of the tank which sprays the wastewater over the Biofilter media which is arranged in a honeycomb like structure. The clarified and aerated wastewater then drains back to the secondary compartment. The aerobic digestion occurs when bacteria use oxygen to break down the remaining diluted organic

compounds. The by-products of this process is primarily carbon dioxide and some methane and other volatile organic gases.

In the UV light emitting unit stage, clarified and digested wastewater is exposed to UV light in a compartment after leaving the secondary processing stage. This stage reduces the coliform count to meet and exceed regulatory requirements.

The final treated effluent diffuser stage discharges the fully treated wastewater. In typical residential applications, this consists of a diffuser that disperses the fully treated wastewater to a small leach field via perforated pipes. The leach field is much smaller than a typical septic system as the effluent quality is much higher. For this project, the fully treated wastewater may also be discharged via an outfall into the St. John's Harbour.

Increasing capacity to accommodate the increased future loads involves setting up another unit in parallel. Servicing the ultimate population would incur a future additional cost.

The Clarity Biofilter contains three electrical devices - the two pumps and the UV light emitting unit - and associated mechanical parts. As such, there are costs associated with the maintenance of the mechanical parts and the electricity costs associated with the electrical devices. There is also a cost associated with sludge removal and disposal. Refer to Table 8 for a summary of the operations and maintenance tasks and estimated costs.

O & M Task	**Frequency**	**Annual Cost[3,4]**
Operating Costs[1]	Annually	$8,400
Maintenance Costs[2]	Annually	$6,000
Biofilter Replacement	Every 30 Years	$3,330
Sampling Program[3]	Continuous	$25,000
	Annual Subtotal	**$42,730**
	20% Contingency	**$8,546**
	Annual Total	**$51,276**

Table 8: Clarity System Operations and Maintenance Summary With UV Disinfection
[1] Assumed Electricity Prices of 20 cents/kwh
[2] Includes Cost for Replacing Pumps Approximately Every 5 Years and Cost of Sludge Removal
[3] Influent and Effluent Sampling Program
[4] H.S.T. Not Included
[5] Estimate Based on Value of CAD in March 2017

Estimated capital costs for the Fort Amherst Clarity System are shown in Table 9. This includes all site access, site works, fencing, and the supply and install of the Clarity System and outfall pipe. This estimate does not allow for high water table or unknown soil conditions which could result in increased costs. A site plan illustrating the footprint for the Clarity System can be found on Drawing CSK 4 in Appendix D.

Component	Cost[1]
Clarity System	$275,500
Forcemain to System	$12,000
20% Contingency	$57,500
Total	**$345,000[2]**

Table 9: Estimated Capital Costs
[1] H.S.T. Not Included
[2] Cost to CSJ is 30% total capital cost due to cost shared funding

5.0 CONCLUSIONS

The following table compares the site footprints, capital costs, and operating and maintenance costs of the on-site sewage treatment system options and forcemain option investigated in this study. Given the cost sharing funding structure, the capital costs are 30% of the total capital costs presented earlier.

System	Footprint (m^2)	Capital Costs[1,2]	Annual O&M Costs[2,3]
Forcemain	N/A	$283,699	$2,400
Abydoz Environmental Inc.	1500	$189,720	$40,920
BMSNA	38	$72,360	$33,532
Clarity Aquatech Ltd.	200	$103,500	$51,276

Table 10: On-Site Sewage Treatment Systems Summary
[1] 30% of Total Capital Cost
[2] H.S.T. Not Included
[3] Estimate Based on Value of CAD in March 2017

The annual Operations and Maintenance costs are presented in today's dollars, and include foreseeable expenses over a 50 year time frame. Table 11 below compares the life cycle costs (capital costs plus operations and maintenance costs over 50 years) of the Systems presented in the previous table.

System	50 Year Life Cycle Costs[2,3]
Forcemain[1]	$403,699
Abydoz Environmental Inc.	$2,235,720
BMSNA Ltd.	$1,748,940
Clarity Aquatech Ltd.	$2,667,300

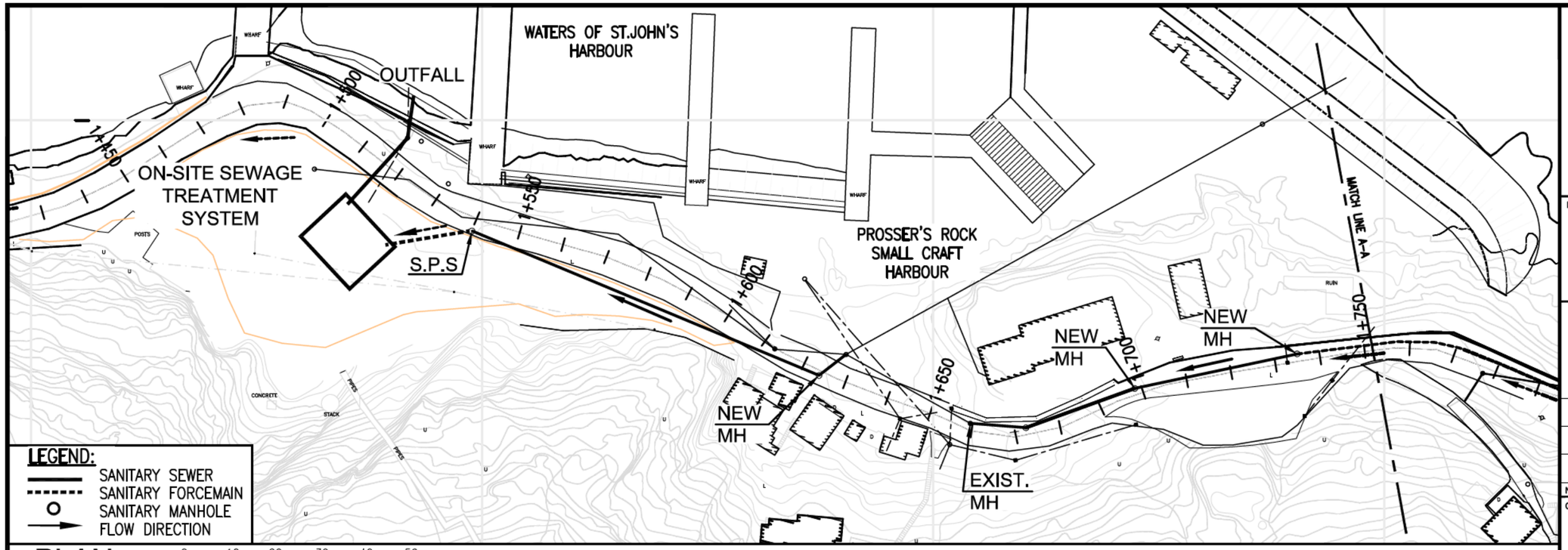
Table 11: 50 Year Life Cycle Costs
[1] Extra run of SPS and Forcemain to RHWTF Compared to SPS and Forcemain to On-Site Treatment
[2] H.S.T. Not Included
[3] Estimate Based on Value of CAD in March 2017

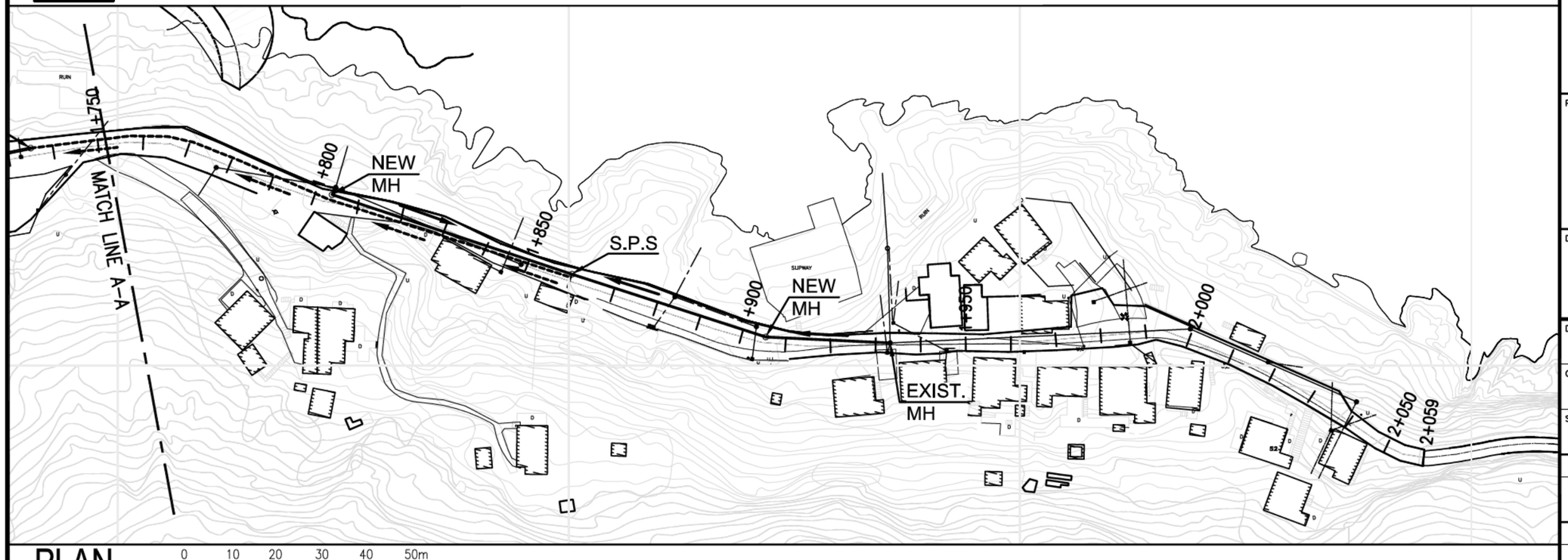
There are a few costs that have not been accounted for. The cost of the land required for the on-site treatment system options and the potential remediation measures required at that site have not been accounted for. On the other side, the cost for the SPS that pumps sewage to the on-site systems is ~$7,000 cheaper than the cost of the SPS that pumps sewage to the RHWTF.

The cost estimates are preliminary and do not include the cost of the work associated with intercepting the existing outfalls and conveying the untreated wastewater from Fort Amherst to the Prosser's Rock SPS. A breakdown of the quantities and associated unit prices for the preliminary estimate of works associated with conveying the wastewater from Fort Amherst to the Prosser's Rock SPS can be found in Appendix G.

Based on cost alone, the Forcemain is the preferred option at less than 1/4 cost the nearest competitor. A list of pros and cons for each option is presented in a table in Appendix H to help further evaluate the options. It is our opinion that Forcemain option is would be the most effective at meeting the CSJ's sanitary sewage treatment needs in the Fort Amherst area.

Appendix A
CSK 1 - On-Site Wastewater Treatment General Site Plan
CSK 2 - On-Site Wastewater Treatment Profile





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PROJECT TITLE

FORT AMHERST
ON-SITE SEWAGE
TREATMENT STUDY

DRAWING TITLE

ON-SITE WASTEWATER TREATMENT
GENERAL SITE PLAN

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S.R. BUTT	J.A. AYLWARD
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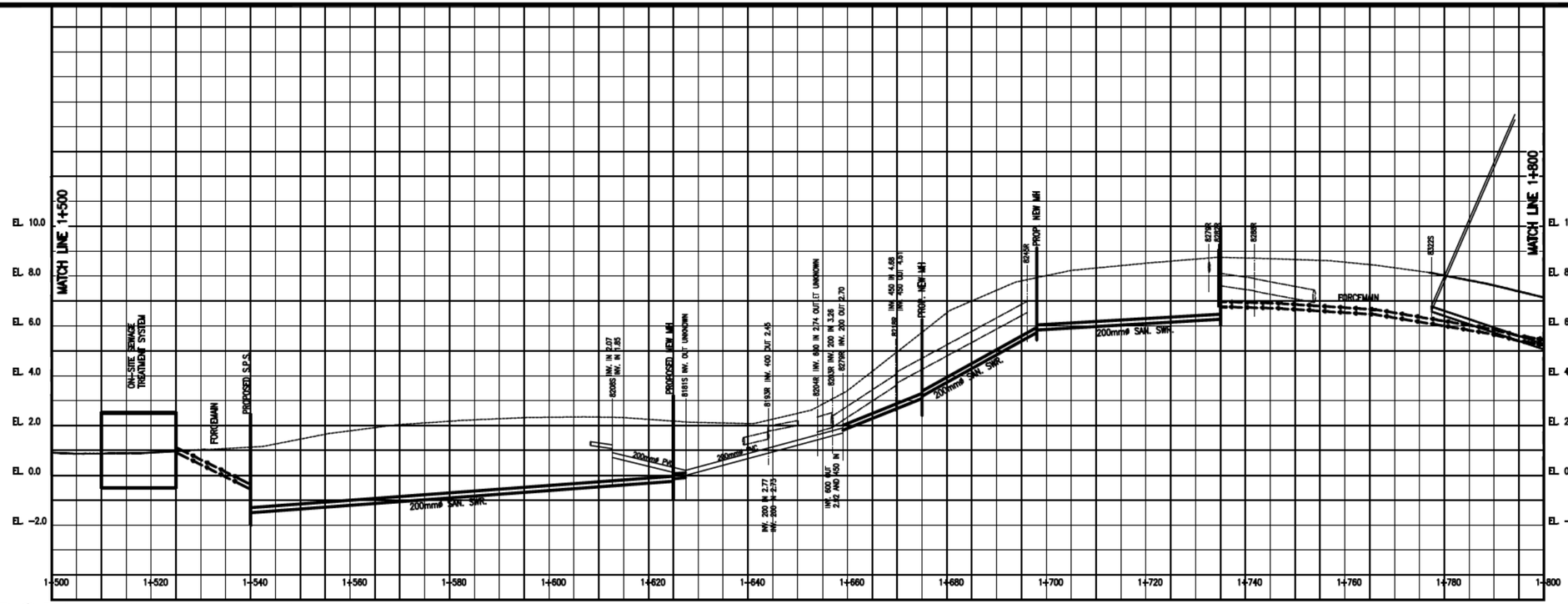
CONTRACT NO	REVISION



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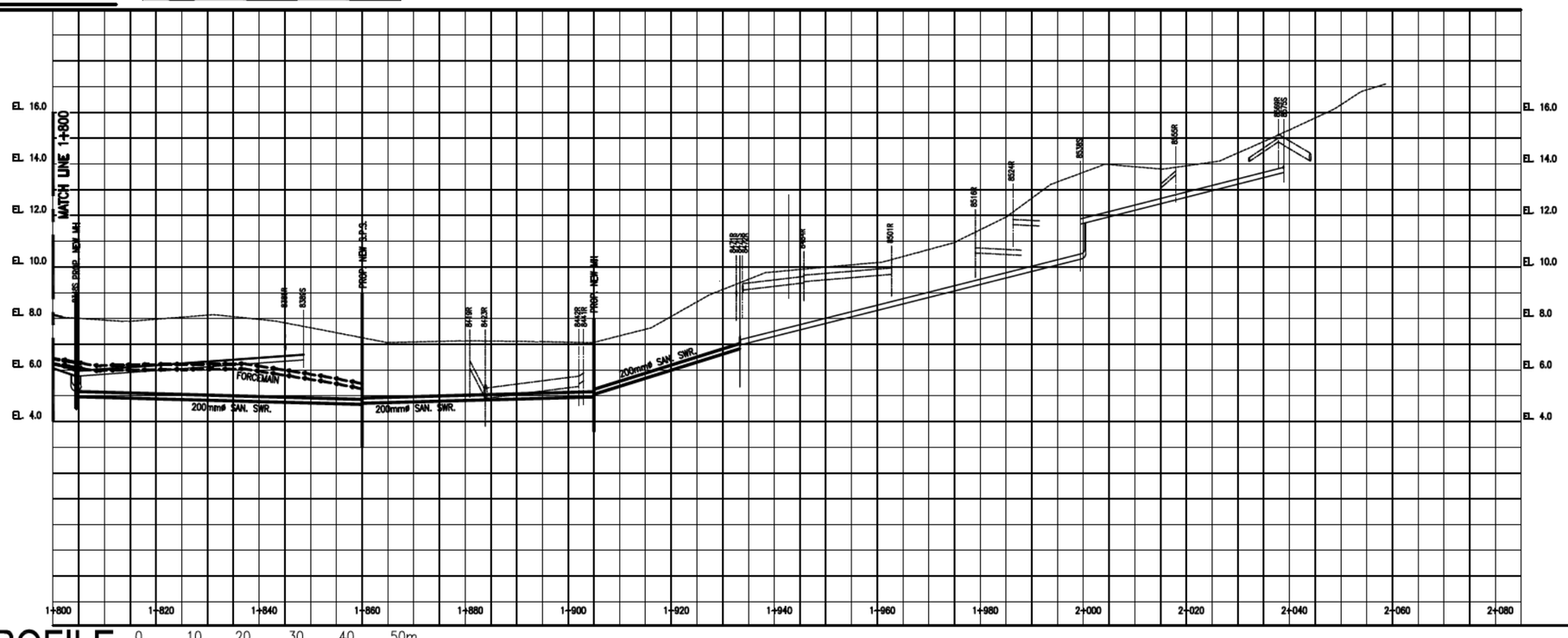

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DRAWING TITLE

ON-SITE WASTEWATER TREATMENT PROFILE

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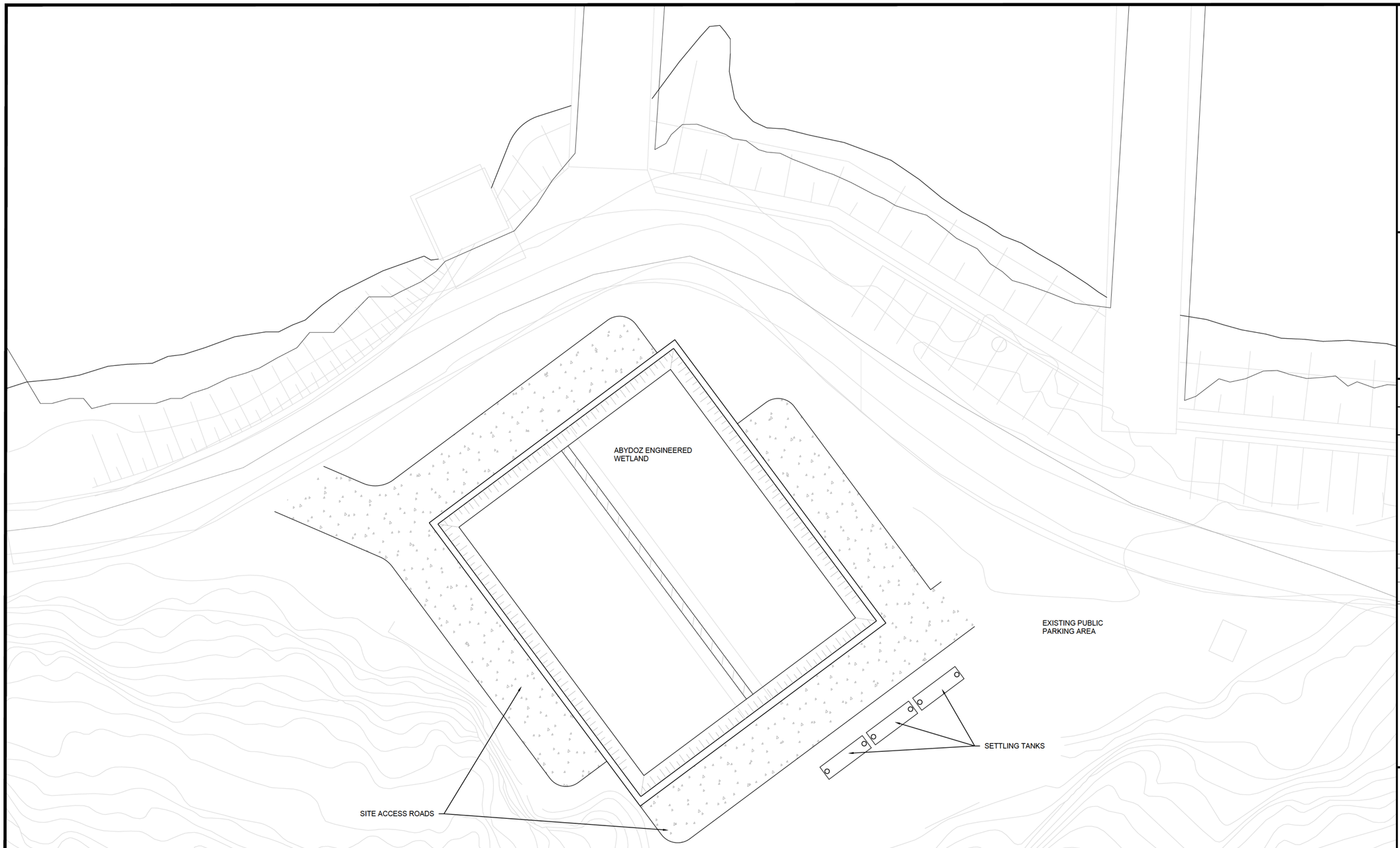
SCALE: AS SHOWN	DATE: MARCH 2017
PROJECT NO: 2016033	DRAWING NO: CSK 2
CONTRACT NO	REVISION

Appendix B
P-1 - Abydoz Environmental Site Plan



SITE PLAN - PRELIMINARY
SCALE: 1:200

1
P-1

NOTES:

1. ALL INTERNAL PIPE WORK, MATRIX MATERIAL & PLANTS WITHIN BED LINERS ARE SUPPLIED AND INSTALLED BY WETLAND SPECIALIST.

2. SITE PLAN IS PRELIMINARY

ABYDOZ

ENVIRONMENTAL INC.

Treating Wastewater...Naturally.™

369 Old Broad Cove Road
Portugal Cove – St. Philips, Newfoundland
A1M 3N2

Tel: 709-895-2120
Fax: 709-895-2911
email: info@abydoz.com
website : www.abydoz.com

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DRAWN BY: SC	DATE: DEC. 2016
CHECKED BY:	APPROVED BY:

CONFIDENTIAL
PROPRIETARY DESIGN. FOR TENDERING PURPOSES ONLY.

NO.	DESCRIPTION	MM/DD/YY
	REVISIONS	

NOTES:

1) This drawing is for tendering purposes only.

2) Only figured dimensions are to be used. Any discrepancies are to be reported to the Engineer before proceeding.

3) All materials and workmanship to comply with the National Building Code of Canada.

4) This system is patented and confidential. Duplication or reproduction of the drawing without express written permission from "ABYDOZ ENVIRONMENTAL INC." is strictly prohibited.

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FORT AMHERST WASTEWATER TREATMENT FACILITY

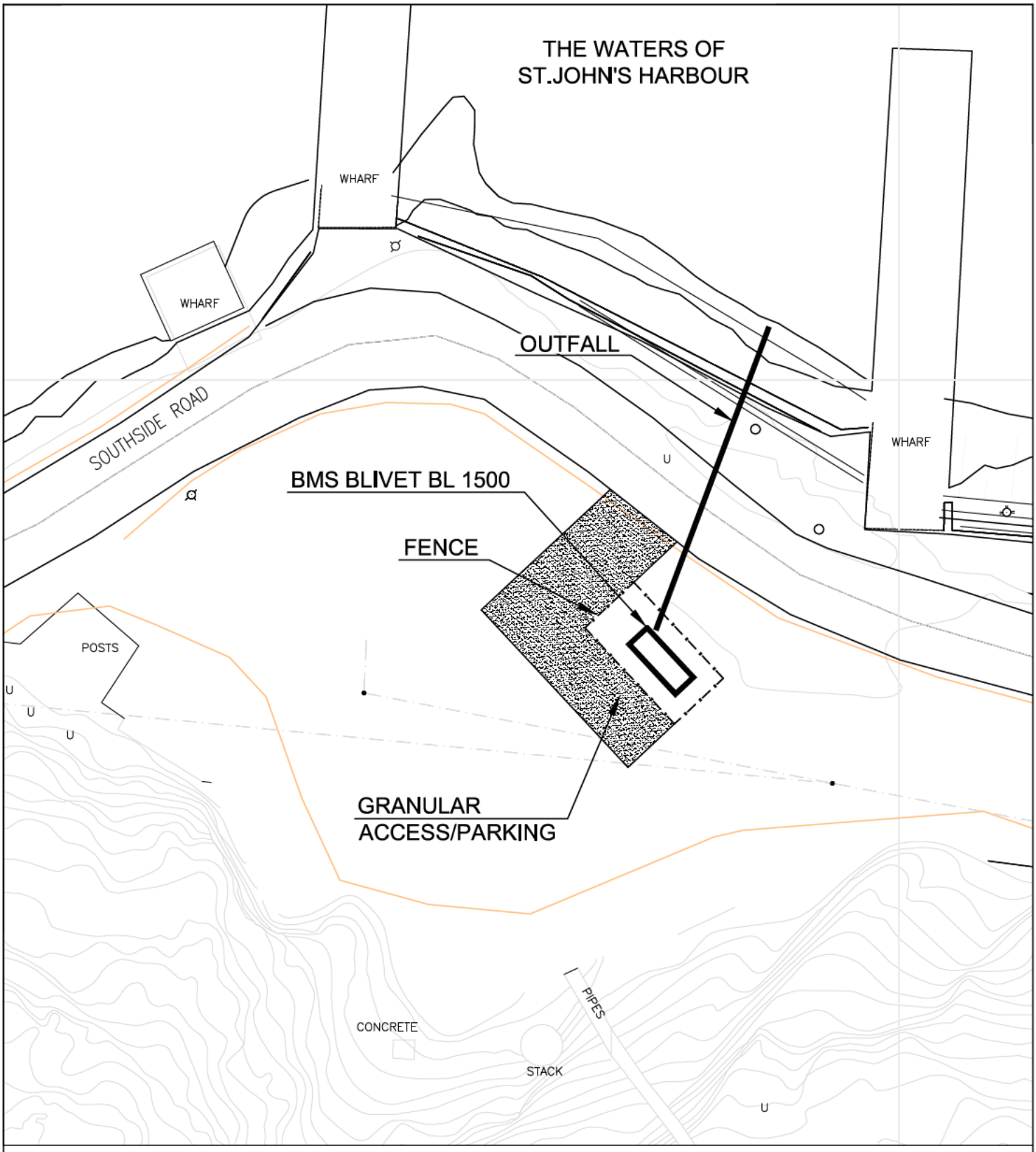
DRAWING TITLE:

SITE PLAN – OVERALL

DRAFT – NOT FOR CONSTRUCTION

SCALE: AS SHOWN	DRAWING NO.: P–1
PROJECT:	
REVISION NO.: 1	

Appendix C
CSK 3 - BMNSA Site Plan



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Project Title

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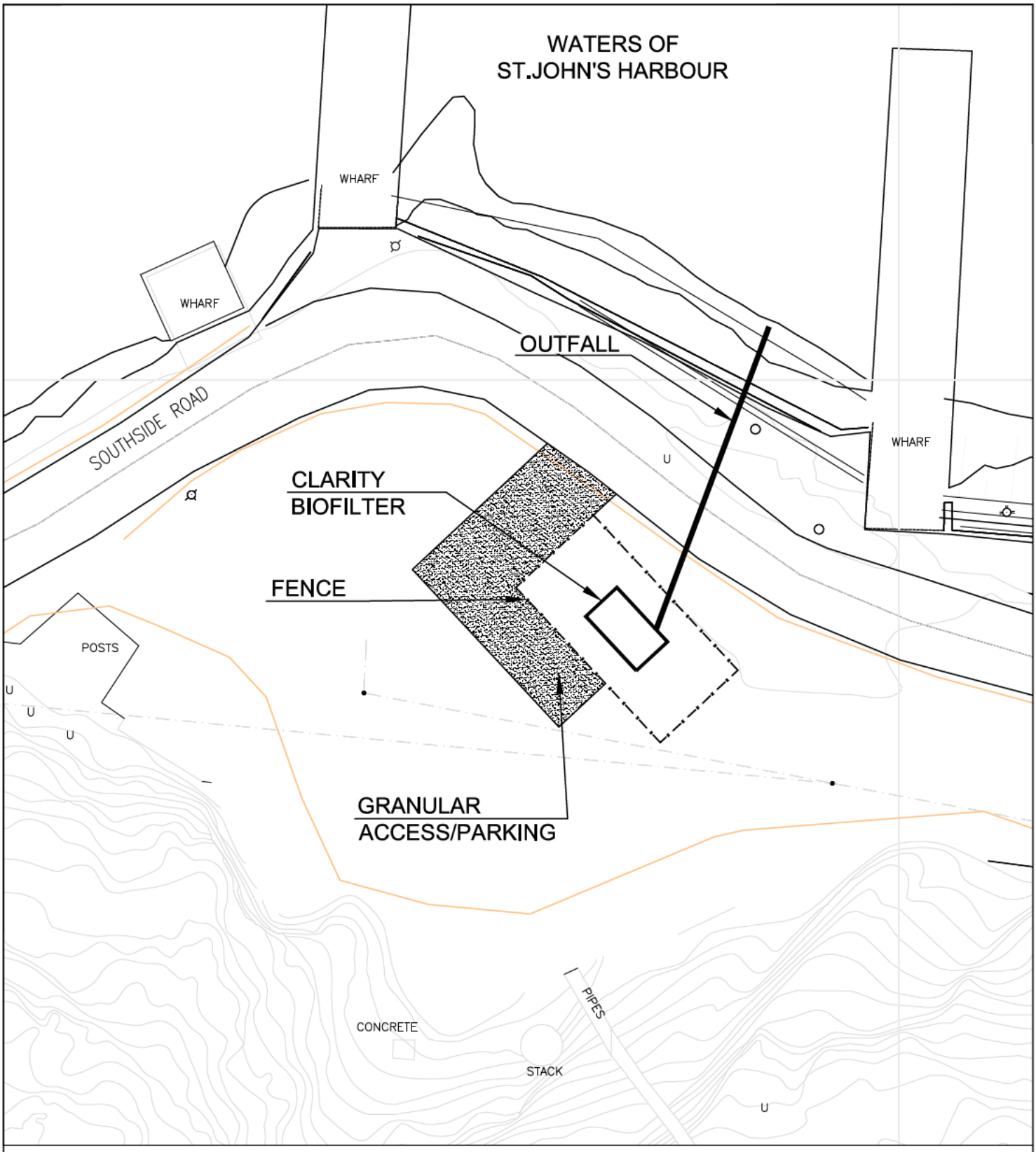
SEWAGE TREATMENT STUDY

Drawing Title

BMSNA SITE PLAN

Date	Scale	Sht. No.	Dwg. No.	Revision
MAR 2017	AS SHOWN		CSK 3	

Appendix D
CSK 4 - Clarity Aquatech Site Plan



PLAN

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Drawing Title

CLARITY AQUATECH
SITE PLAN

Date	Scale	Sht. No.	Dwg. No.	Revision
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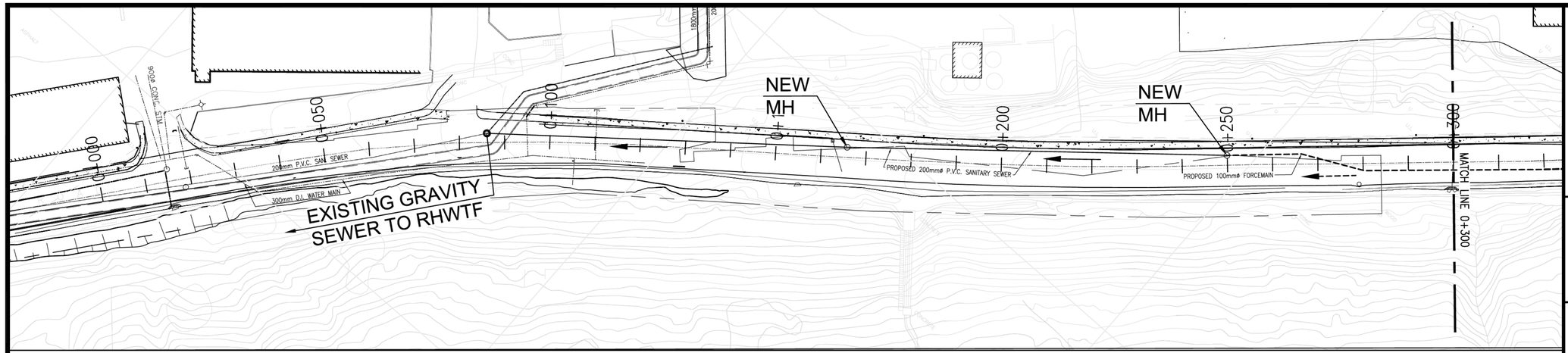
Appendix E
CSK 5 and CSK 6 - Forcemain to RHWTF General Site Plan
CSK 7, CSK 8 and CSK 9 - Forcemain to RHWTF Profile



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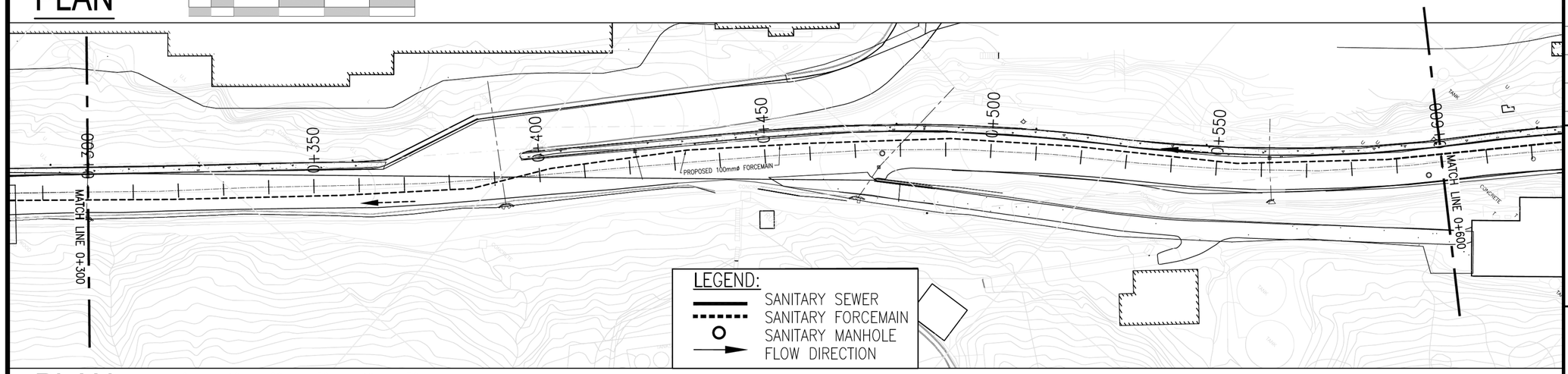

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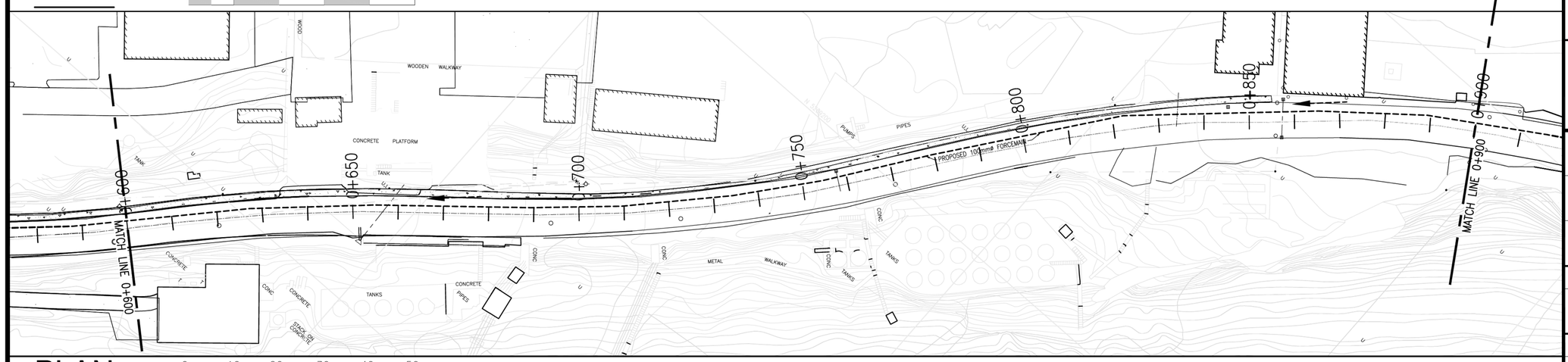

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LEGEND:
- SANITARY SEWER
- SANITARY FORCEMAIN
- SANITARY MANHOLE
- FLOW DIRECTION

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TREATMENT STUDY

DRAWING TITLE

FORCEMAIN TO RHWTF
GENERAL SITE PLAN

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PROJECT NO: 2016033	DRAWING NO: CSK 5
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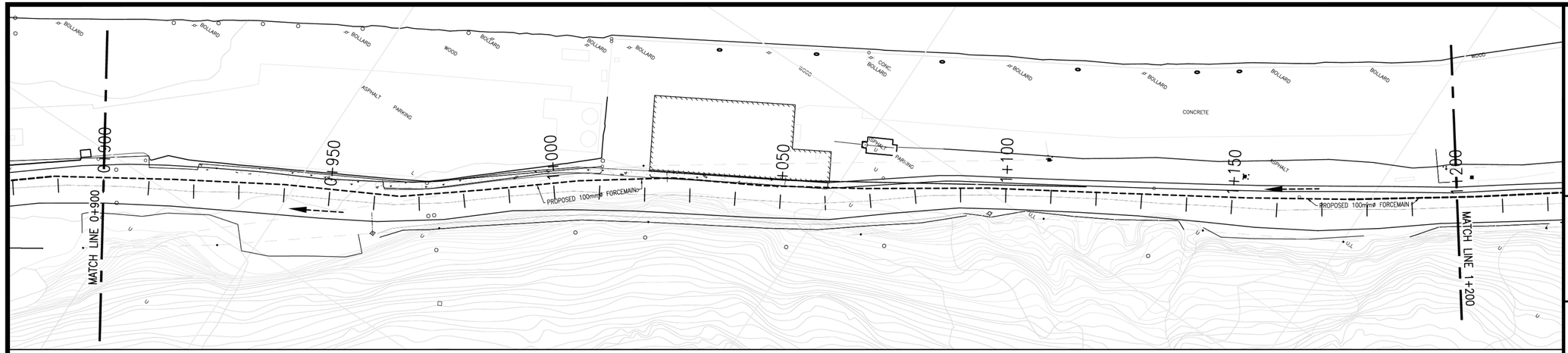

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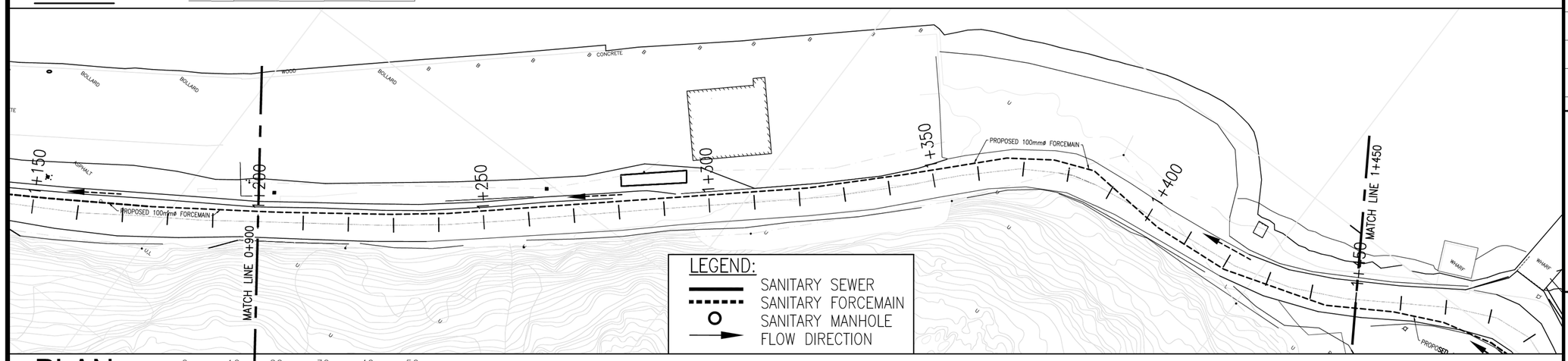

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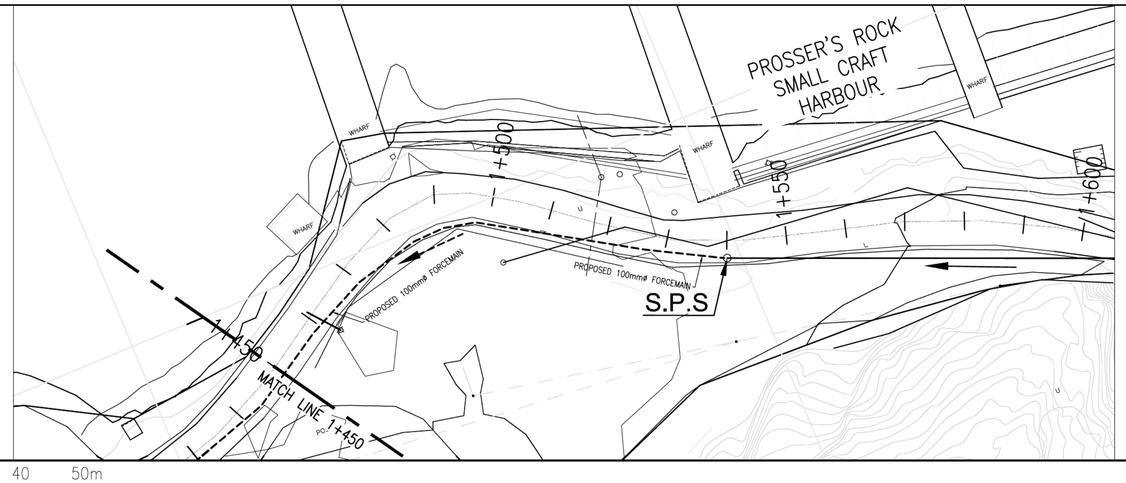

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TREATMENT STUDY

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FORCEMAIN TO RHWTF
GENERAL SITE PLAN

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2016033	CSK 6
CONTRACT NO	
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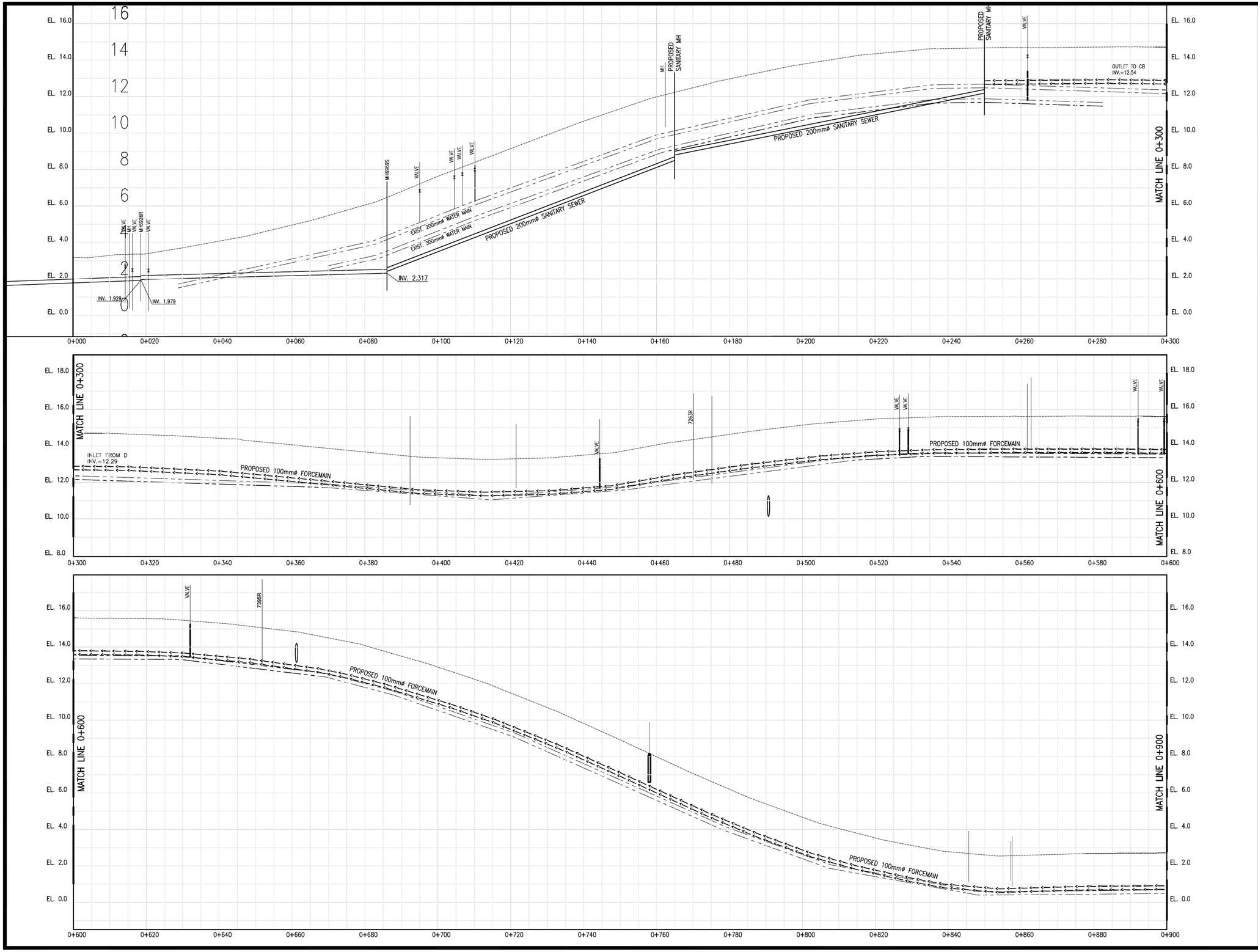

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FORCEMAIN TO RHWTF PROFILE

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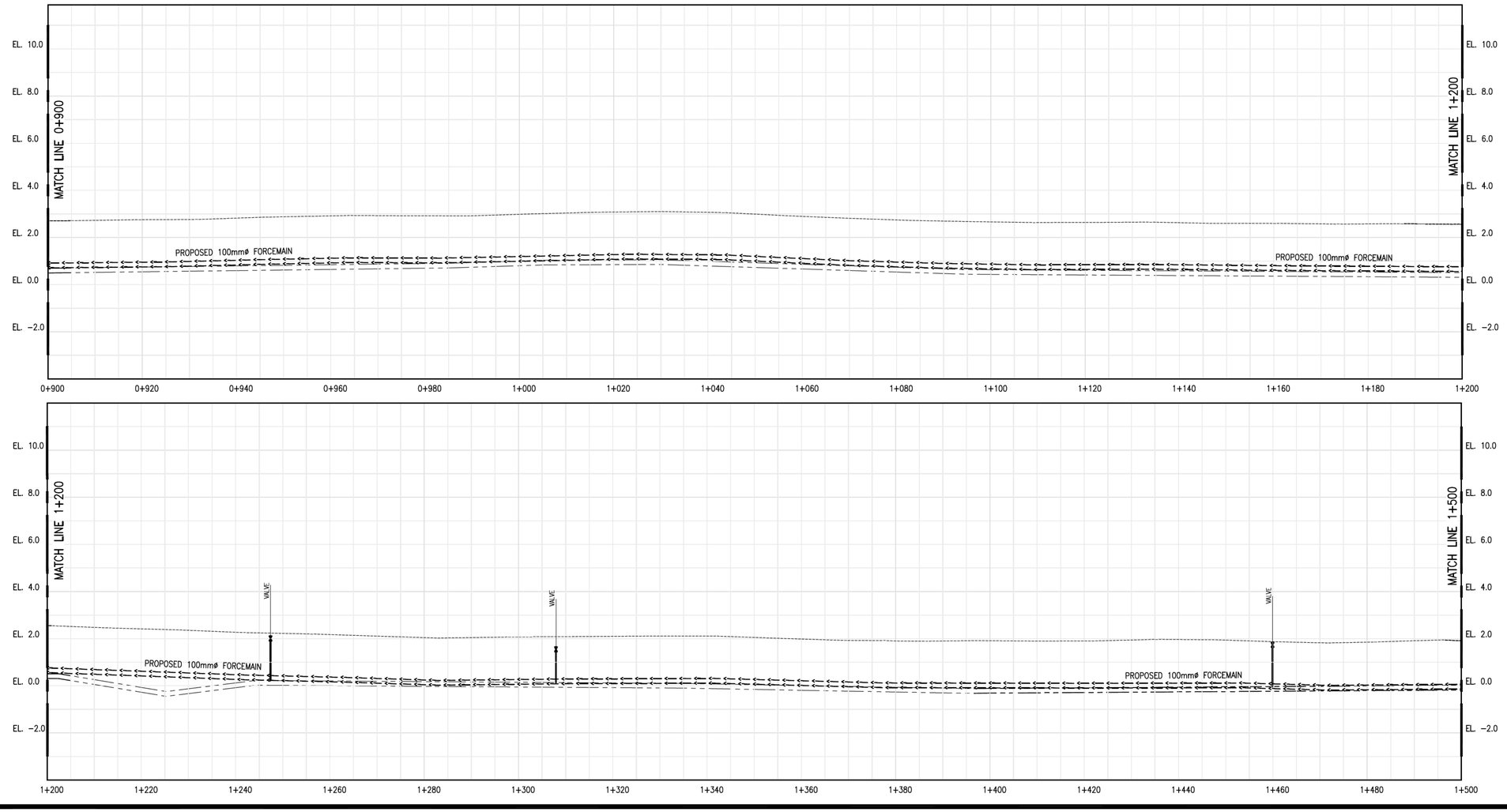

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FORCEMAIN TO RHWTF
PROFILE

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PROJECT NO: 2016033	DRAWING NO: CSK 8
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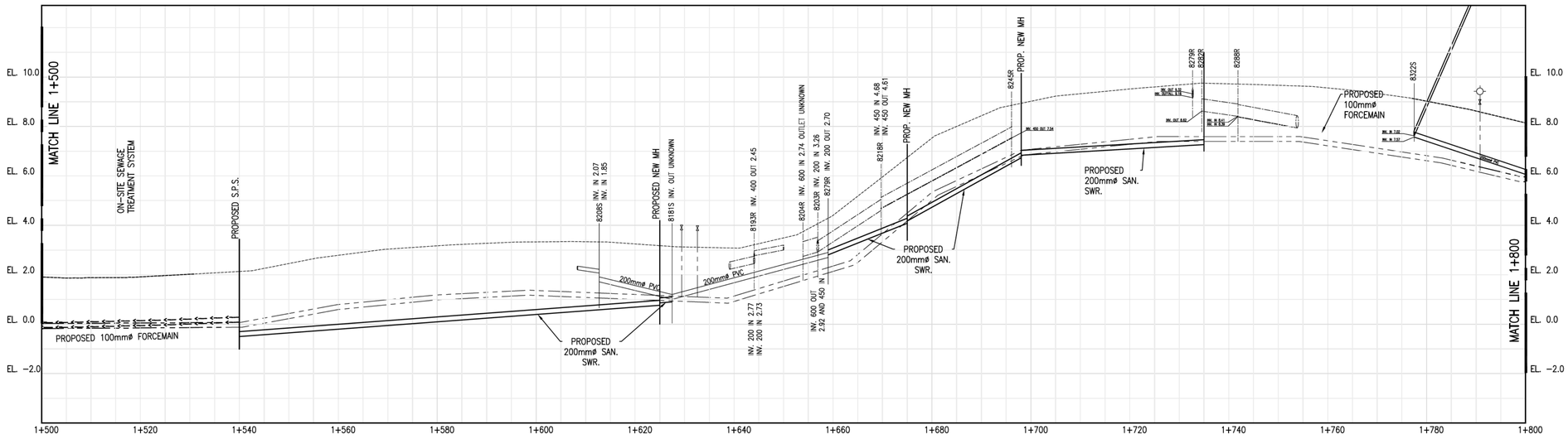

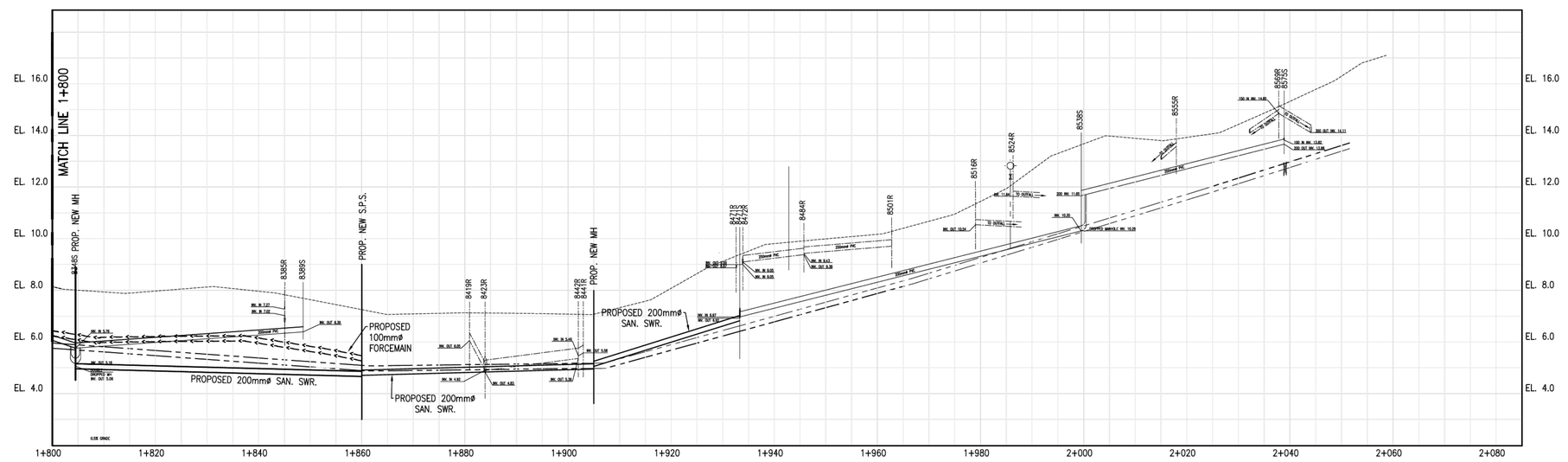

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FORCEMAIN TO RHWTF PROFILE

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CONTRACT NO	REVISION

Appendix F
Preliminary Estimate - Forcemain from Prosser's Rock SPS to RHWTF

CITY OF ST. JOHN'S
FORT AMHERST ON-SITE SEWAGE TREATMENT STUDY
FORCEMAIN FROM PROSSER'S ROCK SPS TO RHWTF
PRELIMINARY ESTIMATE
SEPTEMBER 20, 2017

ITEM	DESCRIPTION	QUANTITIES		UNIT PRICE	TOTALS
110	**ENGINEER'S SITE OFFICE**				
	.1 Engineer's Equipment	1	L.S.	$5,000.00	$5,000
152	**CASH ALLOWANCE**				
	.1 Pole Relocation Shoring and Bracing	1	Allow	$25,000.00	$25,000
153	**MOBILIZATION AND DEMOBILIZATION**	1	L.S.	$30,000.00	$30,000
211	**TRENCH EXCAVATION**				
	.1 SR	1,528	cm	$70.00	$106,960
	.2 OM	1,528	cm	$25.00	$38,200
	.3 USM	220	cm	$25.00	$5,500
	.4 Imported Bedding				
	.1 Class "B" Granular Material	800	cm	$20.00	$16,000
	.5 Borrow Material	300	cm	$15.00	$4,500
	Marker Tape	1,455	m	$1.50	$2,183
224	**SEWER FORCEMAIN**				
	Supply & Installation				
	1. 100mm, PVC DR18 Pipe	1455	m	$110.00	$160,050
	Supply & Installation of Fittings				
	1. Bends				
	150mm x 22.5° DI	28	Each	$200.00	$5,600
	Supply & Install Air Release Chamber	4	LS	$25,000.00	$100,000
	Supply & Placement of Concrete Thrust Blocks	7	cm	$300.00	$2,100
	Break Into and Connect to Existing Manholes	1	Each	$1,725.00	$1,725
	Swabbing of Forcemain	1455	m	$10.00	$14,550
323	**GRAVEL FOR STREETS**				
	.1 Class "A" Granular Materials	785.7	t	$19.00	$14,928
	.2 Class "B" Granular Materials	1571.4	t	$20.00	$31,428
351	**HOT MIX ASPHALTIC CONCRETE**				
	.1 Surface Course (40mm Depth)	419.1	t	$145.00	$60,770
	.2 Base Course (40mm Depth)	419.1	t	$145.00	$60,770
		a. Sub-Total			**$685,263**
		b. Contingency (20%)			**$137,053**
		c. Engineering			**$123,347**
		d. Sub-Total (a + b + c)			**$945,663**
		e. H.S.T. (15% of a + b + c)			**$141,849**
		f. Total			**$1,087,512**

Appendix G
Preliminary Estimate - Sanitary Sewer from Fort Amherst to Prosser's Rock SPS

CITY OF ST. JOHN'S
FORT AMHERST ON-SITE SEWAGE TREATMENT STUDY
SANITARY SEWER FROM FORT AMHERST TO PROSSER'S ROCK SPS
PRELIMINARY ESTIMATE
SEPTEMBER 20, 2017

ITEM	DESCRIPTION	QUANTITIES		UNIT PRICE	TOTALS
110	**ENGINEER'S SITE OFFICE**				
	.1 Engineer's Equipment	1	L.S.	$5,000.00	$5,000
152	**CASH ALLOWANCE**				
	.1 Pole Relocation Shoring and Bracing	1	Allow	$10,000.00	$10,000
153	**MOBILIZATION AND DEMOBILIZATION**	1	L.S.	$25,000.00	$25,000
211	**TRENCH EXCAVATION**				
	.1 SR	200	cm	$70.00	$14,000
	.2 OM	716	cm	$25.00	$17,900
	.3 USM	220	cm	$25.00	$5,500
	.4 Imported Bedding				
	.1 Class "B" Granular Material	262	cm	$20.00	$5,240
	.5 Borrow Material	100	cm	$15.00	$1,500
	Marker Tape	423	m	$1.50	$635
221	**SANITARY SEWER**				
	Supply & Installation				
	1. 200mm, PVC DR35 Pipe	294	m	$110.00	$32,340
	Supply & Installation of Fittings				
	1. End Caps				
	200mm	3	Each	$150.00	$450
	Break Into and Connect to Existing Manholes	4	Each	$1,725.00	$6,900
223	**MANHOLES, CATCHBASINS, DITCH INLETS, HEADWALLS & CHAMBERS**				
	Supply & Placement of 1200mm dia. Pre-Cast Manholes				
	1. 2.5m to 3.0m	6	Each	$4,500.00	$27,000
224	**SEWER FORCEMAIN**				
	Supply & Installation				
	1. 100mm, PVC DR18 Pipe	129	m	$110.00	$14,190
	Supply & Installation of Fittings				
	1. Bends				
	200mm x 22.5° DI	10	Each	$200.00	$2,000
	Supply & Placement of Concrete Thrust Blocks	1	cm	$300.00	$300
	Swabbing of Forcemain	129	m	$10.00	$1,290
227	**SANITARY SEWER LIFT STATION**				
	Supply and Install Sewage Pumping Stations c/w Generator, Enclosure and Electrical Service	2	Each	$440,000.00	$880,000
323	**GRAVEL FOR STREETS**				
	.1 Class "A" Granular Materials	228.6	t	$19.00	$4,343
	.2 Class "B" Granular Materials	457.2	t	$20.00	$9,144

ITEM	DESCRIPTION	QUANTITIES		UNIT PRICE	TOTALS
351	**HOT MIX ASPHALTIC CONCRETE**				
	.1 Surface Course (40mm Depth)	121.8	t	$145.00	$17,661
	.2 Base Course (40mm Depth)	121.8	t	$145.00	$17,661
		a. Sub-Total			**$1,098,054**
		b. Contingency (20%)			**$219,611**
		c. Engineering			**$197,650**
		d. Sub-Total (a + b + c)			**$1,515,314**
		e. H.S.T. (15% of a + b + c)			**$227,297**
		f. Total			**$1,742,612**

Appendix H
List of Pros and Cons

CITY OF ST. JOHN'S
FORT AMHERST ON-SITE SEWAGE TREATMENT STUDY
PROS AND CONS OF EACH OPTION

SEPTEMBER 22, 2017

System	Pros	Cons
Abydoz	- Energy efficient (no fuel or electricity) - Low maintenance (no moving parts) - Can expand capacity without increasing footprint - Minimal traffic disruption	- Large footprint - Recommended yearly inspection by Abydoz personnel - Requires land acquisition - Future availability of parts and general support uncertain - Located in a tourist/heritage area - Potential odour issues
BMNSA	- Low capital costs - Low life cycle costs - Small footprint - Buried under ground - Low life cycle cost - Minimal traffic disruption	- Moving parts - Requires land acquisition - Future availability of parts and general support uncertain - Located in a tourist/heritage area - Can be a source of odour if not properly maintained - Potential odour isssues - Requires generator during power outage
Clarity	- Low capital costs - Buried under ground - Minimal traffic disruption	- High annual costs - Moving Parts - Requires land acquisition - Future availability of parts and general support uncertain - Located in a tourist/heritage area - Requires generator during power outage
Forcemain	- Low life cycle costs - Buried under ground - Does not rely on private entity's solvency for maintenance - Additional capacity at little-to-no extra cost - Ultimately will undergo secondary treatment - Easier from and operations and maintenance perspective - If regulations become more stringent, upgrades need only be made at one Location - Riverhead Secondary Facility excavation along south Side Road may lower Forcemain capital costs	- High capital costs