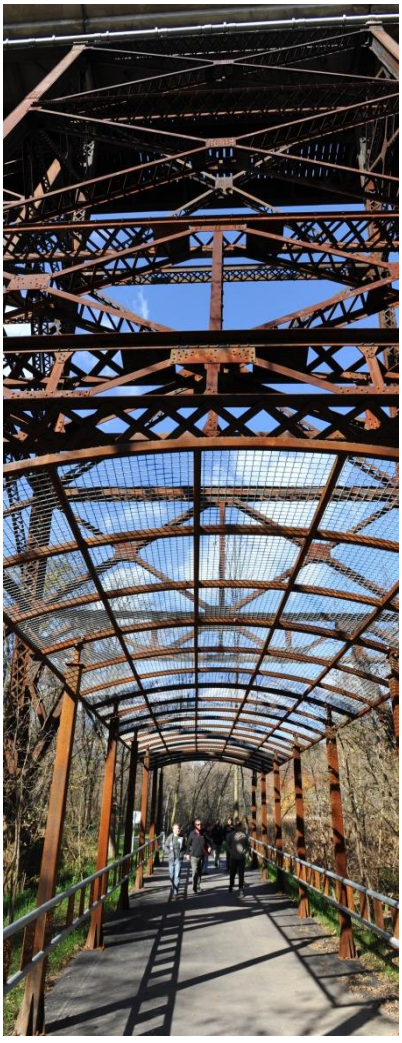

Lynden Garden Block Pumping Station and Forcemain Design Development

Conceptual Design Report

Final

November 8, 2023

Prepared for:
Welton & Innes Limited Partnership

R.V. Anderson Associates Limited
2001 Sheppard Avenue East, Suite 300
Toronto ON M2J 4Z8 Canada
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rvanderson.com

November 8, 2023 RVA R226497

Welton & Innes Limited Partnership
3700 Steeles Avenue West, Suite 800
Vaughan, ON L4L 8M9

Attention: Herthana Siva
hsiva@sorbara.com

Re: Conceptual Design Report
Lynden Garden Block Pumping Station and Forcemain Design Development

Please find enclosed the Conceptual Design Report including a site plan drawing for the referenced project for your review prior to the submission to the City of Brantford.

Please do not hesitate to contact the undersigned if you have any questions.

Yours very truly,

R.V. ANDERSON ASSOCIATES LIMITED

Evan Toews

Digitally signed by Evan Toews
DN: cn=Evan Toews, c=CA, o=R.V. Anderson Associates Limited, ou=Municipal Conveyance, email=etoews@rvanderson.com
Reason: I am the author of this document
Date: 2023.11.08 14:48:12 -05'00'

Evan Toews, P.Eng.
Project Manager

Welton & Innes Limited Partnership

Lynden Garden Block Pumping Station and Forcemain Design Development

Conceptual Design Report

Final

City of Brantford

RVA 226497

November 8, 2023

Lynden Garden Block Pumping Station and Forcemain Design Development
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1.0 INTRODUCTION

The Lynden Garden Block is located at 299 Lynden Road, located on the eastern most edge of the City of Brantford, west of the Canadian National Railway (CNR), north of Lynden Road. The Lynden Garden Block Pumping Station (PS) will service the Lynden Garden Block and the future East Expansion Lands located north of Highway 403 and east of Garden Avenue.

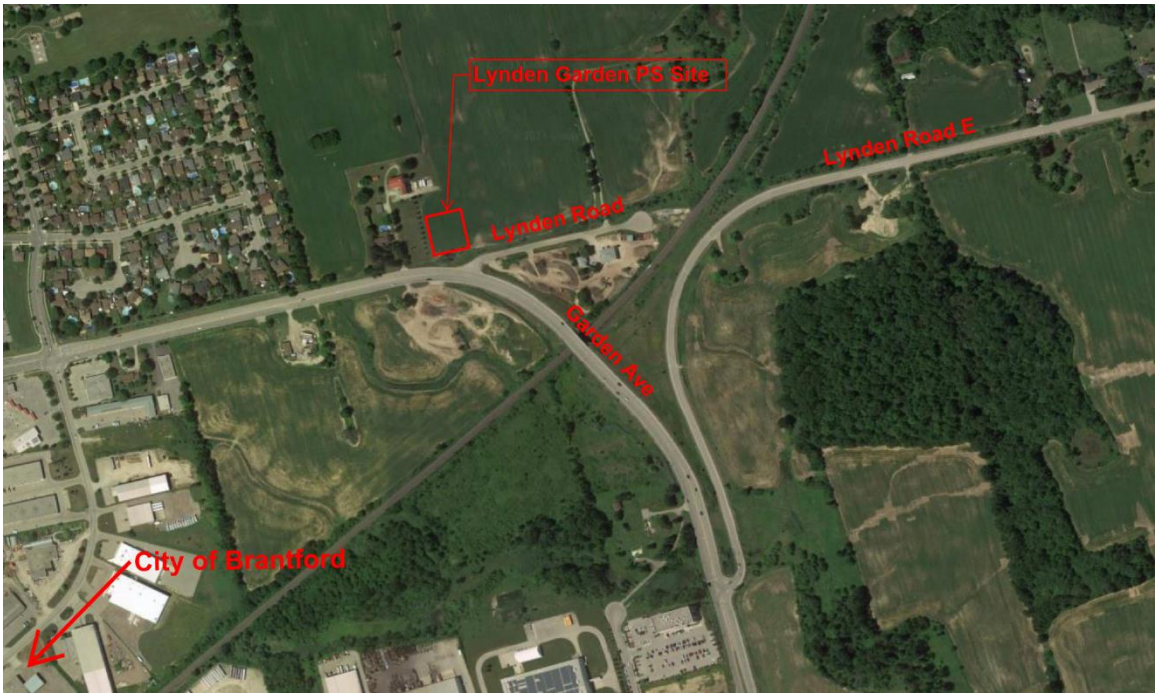

Figure 1.1 Lynden Garden PS - Key Plan

The PS will be located north of the intersection of Lynden Road and Garden Avenue in the proposed subdivision and will serve an approximate population of 18,619 persons.

This report is provided to summarize the conceptual design of the proposed PS.

2.0 DATA SOURCES

2.1 External Drawings and Documentation

The following list of drawings and documentation were referenced by RVA in the development of design parameters for the SPS:

- Lynden Garden Block Subdivision design drawings by Urbantech Consulting, dated October 2022.
- Lynden Garden Block Sanitary Sewer design sheets by Urbantech Consulting, dated 28/09/22.

- Wastewater demand data for the East Expansion Area provided by Urbantech Consulting.

2.2 Codes, Standards, & Guidelines

The following list of documents were referenced and are adhered to by RVA in the development of design parameters for the SPS:

- City of Brantford - Wastewater - Design and Construction Manual, Vertical Municipal Infrastructure Standards – January 2023
- City of Brantford - Sanitary Sewer - Design and Construction Manual, Linear Municipal Infrastructure Standards – February 2023
- Design Guidelines for Sewage Works 2008 (Ministry of Environment, Conservation & Parks)
- Hydraulic Institute Standards

3.0 ENVIRONMENTAL ASSESSMENT REQUIREMENTS

The Environmental Assessment Act (EAA), including the Municipal Engineers' Association (MEA) Municipal Class Environmental Assessment (EA) Process, prescribe that proponents consider potential environmental effects before an infrastructure project begins. We have reviewed the EA considerations for the Lynden Garden PS to determine next steps from an EA perspective. The Municipal Class EA outlines processes that proponents, such as municipalities and in some cases private entities, must follow prior to constructing infrastructure, including sewage collection systems. Under the Municipal Class EA, the Lynden Garden PS would fall under the clause 22a in Appendix 1: Project Tables, Sewage Systems – Maintenance, Operation, Distribution, Storage & Retirement:

"*Establish, extend, or enlarge a sewage collection system and all necessary works to connect the system to an existing sewage outlet, where it is required as a condition of approval on a site plan, consent plan of subdivision or plan of condominium which will come into effect under the Planning Act prior to the construction of the collection system.*"

As such, projects which fall under this description, such as the Lynden Garden PS, are exempt from EAA requirements, and in turn exempt from the Municipal Class EA, provided that Planning Act requirements are fulfilled. In essence, the subdivision cannot be built without the SPS and collector sewers, so they must be built to support the subdivision.

While other clauses regarding SPS's under the Municipal Class EA could be applicable to the Lynden Garden SPS, we recommend following the Planning Act for this specific site. Initiation of the Planning Act process will be included as part of the future planning development.

4.0 PROCESS DESIGN

4.1 Capacity Design Criteria

The station is sized to service a population of 18,619 persons which results in a total peak flow of 203.4 L/s per sewer design calculations and wastewater demand data provided by Urbantech Consulting. The PS services two areas, the Sorbara Land which is located in the Lynden Garden Block and the Employment Land in the East Expansion Lands. The Sorbara Land data was referenced from the flow entering the PS in the sanitary sewer design sheets while the Employment Land data was provided directly in the wastewater demand data (listed in Appendix 1). Table 4-1 below presents the design criteria for the Lynden Garden Block PS.

Table 4-1 PS Sizing Criteria

	Population	Drainage Area (ha)	Infiltration (L/s)	Sanitary Flow (L/s)	Total Flow (L/s)
Sorbara Land	2,612	45.1	13.5	25.9	39.4
Employment Land	16,007	158.3	47.5	116.5	164.00
Total	**18,619**	**203.4**	**61.0**	**142.4**	**203.4**

At a peak flow of 203.4 L/s, the proposed station is classified as a **Type III facility** per the City of Brantford Vertical Municipal Infrastructure Standards. Therefore, the station will consist of a total of three (3) installed pumps (two duty operating in lead-lag sequence, with one on standby) and two (2) discharge forcemains (one duty and one standby).

4.2 Wet Well Sizing

Pump Station Inlet

The pumping station receives sewage from a gravity sewer at invert 203.4 m, approximately 14 m below grade. The conceptual design considers an inlet chamber within the wet well complete with isolation gates to split the flow into two separate wet well cells. As additional measures to mitigate clogging of the pumps, the City/Client may consider removable grinders mounted to the inner wall of the wet well cells.

Pump Station Configuration and Sizing

The pumping station includes a 14 m inner diameter circular shaft which contains a divided wet well and dry well. The wet well is sized to provide volume for pump operation as well as the required 1-hour emergency storage volume; whereas the dry well is allocated for dry-pit submersible pumps, facility equipment, and an access stair well. The wet well is

further split into two cells/chambers, as per MECP guidelines and the City's standard. An isolation gate is included for isolation between the two cells for any maintenance activities.

The pump configuration considers two (2) duty pumps operating in to provide the ultimate pumping capacity of 203.4 L/s and one (1) standby pump of the same model. Pump active volume, emergency storage volume, and pump operating level are shown in table below. Detailed design criteria are shown in Appendix 2.

A below grade chamber is provided to house the flowmeter and bypass connection on each of the twin forcemain.

Table 4-2 Pump Operating Level, Emergency Storage Volume, and Pump Active Volume

Parameter	Units	Value
Overflow level	m ASL	215.05
Inlet sewer invert	m ASL	203.4
High-high water level	m ASL	203.1
High water level (lag pump start)	m ASL	202.8
High water level (lag pump stop, lead pump start)	m ASL	202.2
Low water level (pump stop)	m ASL	201.9
Low-low water level	m ASL	201.7
Wet well bottom	m ASL	200.5
Wet well plan area	m^2	61.6
Lead pump active volume req'd (4 cycles/hr)	m^3	30.6
Lead pump active volume available	m^3	36.9
Lag pump active volume req'd (4 cycles/hr)	m^3	15.3
Lag pump active volume avilable	m^3	18.5
Emergency storage required	m^3	732.2
Emergency storage available	m^3	735.8

4.3 Pump Sizing and Selection

The Lynden SPS is designed to be a split-cell wet well / dry well pumping station with a total of three (3) dry-pit submersible pumps. One pump is connected to both of the wet well cells while the other two pumps are connected to single opposite cells, the pumps were selected to be capable of pumping the peak flow rate of at least 203.4 L/s when two are operating together.

System curves were developed using the Hazen-Williams equation for the following three (3) conditions of suction static head conditions and Hazen-Williams 'C' factors.

- Condition A: Low sewage level in the wet well, C=120
- Condition B: Median sewage level, C=130
- Condition C: High sewage level, C=140

The total dynamic head (TDH) for Condition B was used for pump selection, as per MECP guidelines. In addition, the system curve for the overflow condition was also calculated to review the pump operating condition after an overflow event. The pumps will discharge through one of two 350 mm PVCO forcemains to the downstream MH, approximately 290 m away from the pumping station. The system curves are plotted in Figure 4.1.

The system curves and duty points were used for a preliminary selection of Xylem/Flygt pumps. The Flygt NT3202 with 354 mm impeller was selected for the primary duty point. The flow of lead pump under Condition B is 142 L/s, and the combined flow of both duty pumps is 223 L/s. When operating under the overflow condition, the static head is significantly reduced. The increased pumped flow will cause the forcemain velocity to increase beyond the recommended range. Control measures can be considered at the detailed design stage to mitigate this issue.

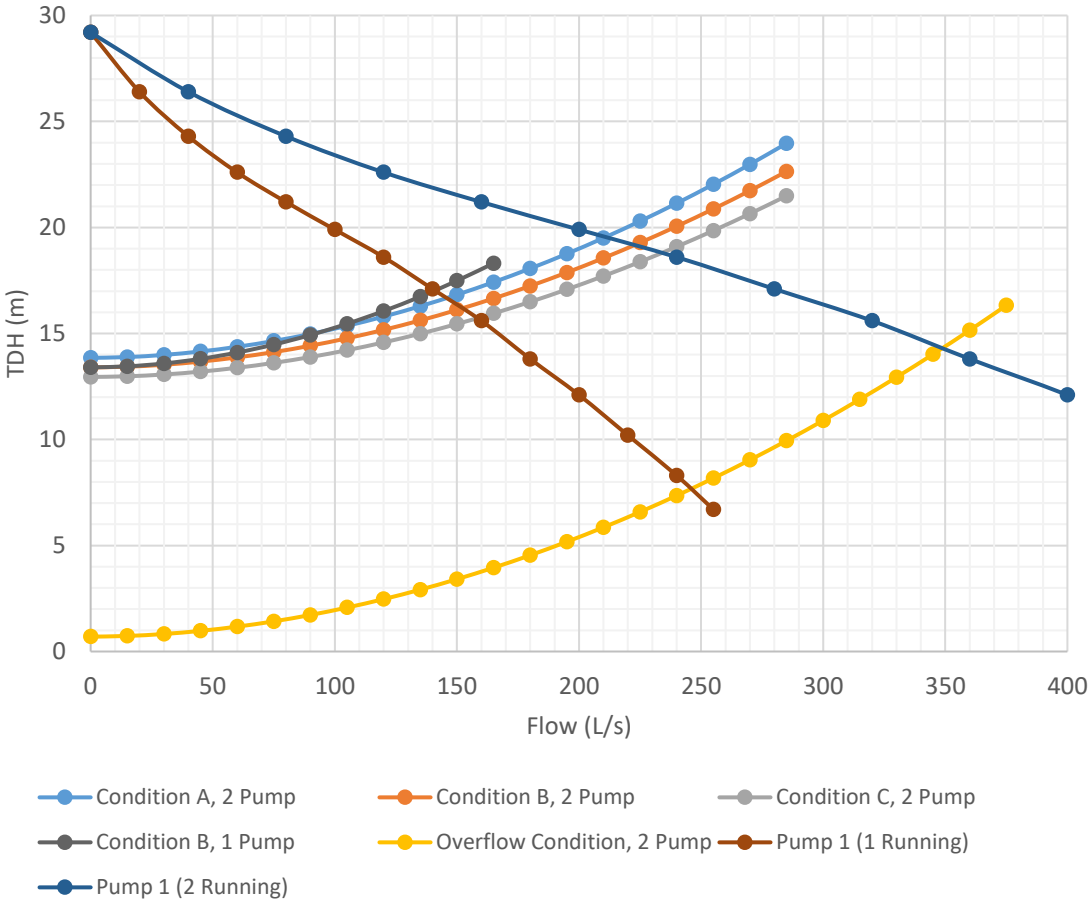

Figure 4.1 System Curves and Selected Pump Curves (Flygt NT 3202 MT 3~ 641 354mm)

The pump configuration and operating conditions are listed in Table 4.3 and detailed hydraulic design calculations are contained in Appendix 3.

Table 4.3 Pump Configuration and Operating Conditions

Parameter	Value
Peak Flow (L/s)	203.4
Pump Configuration	2 duty, 1 standby
Each Pump Capacity Req'd (L/s)	101.7
Total Dynamic Head at duty point, Condition B (m)	18.2
Selected Pump	Flygt NT 3202 MT3-641 354mm
Pump Best Efficiency Point	81.5 % at 147 L/s, 16.6 m
Motor Rated Speed (RPM)	1185
Motor Size	33 kW (44 HP)

4.4 Dry Well

The pumping station includes a 14 m inner diameter circular shaft which contains a divided wet well and dry well. The ventilated below-grade dry well will house valves and a flowmeter for each forcemain. The footprint of the dry well will approximately match that of the wet well at one-half of a 14 m diameter circular shaft. The dry well comprises a Class 1, Division 2 hazardous location per the NFPA 820 guidelines.

Process Piping, Valves, and Appurtenances

The station magnetic flowmeter, pumps, valving and appurtenances will be housed in the below ground dry well.

Forcemain(s)

Two forcemains (duty/standby) are provided, each of 350mm diameter and PVCO material (assumed White Bionax PVCO, PC235). PVC is the preferred forcemain material for the City of Brantford and is generally easier to install and repair in open cut compared to HDPE. The pipe class should be reviewed and finalized upon the completion of a Hydraulic Transient Analysis during detailed design. A motorized isolation valve for each forcemain connected to SCADA will be provided.

The forcemain alignments are from the PS wet well to the discharge maintenance hole located 300 m west of the PS on Lynden Road. The forcemains should be installed at 1.85 m depth of cover to obvert below the future road surface elevation and be continuously rising from the wet well to the discharge point, to ensure that the forcemains will drain back to the PS. If the forcemain cannot be continuously rising, then drain valve chambers should be installed at local low points and air/vacuum release valve chambers should be installed at local high points, with exact locations and valve sizing to be determined through transient analysis.

Under normal operating conditions, the duty forcemain can maintain a velocity between 1.0 m/s to 2.0 m/s, which is within the minimum and maximum acceptable velocity ranges as per the City of Brantford - Sanitary Sewer - Design and Construction Manual. If alternate pumps are selected to provide a lower minimum flow, regular flushing/swabbing is recommended to mitigate solid deposition in the forcemains. This forcemain size selection also has the ability to accommodate future development and increased future flows which could increase the operational velocity up to the maximum limit of 2.5 m/s.

4.5 Overflow

A 450mm overflow pipe is provided with invert elevation at the overflow level set 1.8 m below the Assumed Datum for Ground Elevation for the PS. During design it should be confirmed that this elevation is 0.5 m below the lowest basement flooding elevation in the wet well. The overflow is directed to the adjacent storm water management pond located in the block to the east.

4.6 Pump Station Initial Operation

At the initial stages of pump station operation, it is understood that only a fraction of the full pump station capacity would be utilized due to phased occupancy. Estimates of the initial built-out flows were developed based on design data provided by Urbantech. Assuming 10% of the ultimate population serviced and an infiltration flow equal to 40% of the peak dry weather flow, the average dry weather flow and peak wet weather flow are 5.3 L/s and 26.7 L/s, respectively. The minimum operation volume for one constant speed duty pump at 26.7 L/s incoming flow is approximately 12.9 m^3 (max. 6 starts per hour), which can be met using operational changes (use of a single wet well cell and/or changing pump operating range). However, this volume would result in an exceedance of the recommended fill time as per MECP guidelines at the average flow. The reduced flow may result in excess residence time within the wet well or forcemain that can sulfides generation leading to potential for odours and corrosion. Potential mitigation strategy should be considered once initial flows are confirmed by the client.

5.0 SITE CIVIL DESIGN

The Lynden Garden Block PS (PS) pumping station will include a single-story building constructed over the wet well/dry well shaft. The above ground space of the building contains an electrical room approximately above the wet well and a process room above the dry well. The electrical room will be physically separated from the below ground wet well and dry well, and will therefore comprise an unclassified space per the NFPA 820 guidelines. The electrical room will house the electrical equipment, control panels, and ancillary building mechanical systems and equipment. The process room will contain access to the dry well and allow removal of the process equipment, and have sub-rooms for storage, washroom facilities, and odour control systems as required. The building and site layout are shown on the conceptual site plan drawing in Appendix 4.

The total footprint of the surface building containing the electrical room and process room will be approximately 14.6 x 11.5 metres, or 168.0 m^2 (including walls). The building is sized to provide the assumed necessary clearances for required equipment, as well as walking and standing space through the building as necessary. The process room over the dry well is sized to provide access and removal capability for the pumps, valves, flowmeters, and other process equipment.

The aesthetic quality of the building, including materials and finishes, should be designed to be coherent with existing surrounding structures.

5.1 Site Location

The PS new building is located at 299 Lynden Road, north of the intersection of Lynden Road and Garden Avenue by which there is road access. There is a street-facing main entrance, which includes a double door into the electrical room and a double door leading towards process room. A back double door towards the electrical room is adjacent to the parking area.

This site location was provided by Urbantech in the Lynden Garden Block Subdivision design drawings, see Appendix 5.

5.2 Site Access

The Lynden Garden PS is proposed to have one site access:

1) A single 10.0m wide driveway access to the site with 8.0m radius tie-in apron to Lynden Road.

The pumping station site will be able to accommodate a Transport - Single Unit Tanker Trailer, equivalent to a Vacuum Truck with a length of 12 meters. The site will also contain 4 standard-sized parking spaces.

The driveway access will allow vehicles to access parking, electrical room door and providing maintenance access to inlet bypass chamber, wet well and odour control unit to the side of the pumping station.

5.3 Site Sizing

The required property block for the pumping station site was sized at 45 x 45 meters. This allows sufficient space for the pumping station below ground and above ground structures, inlet chamber, and external generator and transformer, while providing room for a Transport - Single Unit Tanker Trailer to enter the site to service the station, turn-around, and exit the site. This estimate assumes that minimal site grading will be required.

5.4 Yard Piping

With respect to yard piping, we have assumed sanitary, forcemain, water and storm connections as following:

- 450mm dia. sanitary sewer to receive local sewage and convey to the half-14000mm dia. I.D. wet well;
- Twin 350mm dia. Forcemains to receive sewage from the half-14000mm dia. I.D. wet well and covey out of the pumping station site;
- 150mm dia. domestic water connection;
- 450mm dia. overflow pipe connecting to the adjacent stormwater management pond located to the east.

5.5 Provisions

Influent Flow Monitoring

An inlet bypass site MH is provided immediately upstream of the station along the influent sewer, large enough to house the correct size portable bypass pumps for complete station rehabilitation, maintenance purposes, and/or complete station failure. This MH can be also used for flow monitoring purposes. It is located within the limits of the pump station property thereby not requiring traffic control in the public ROW in order to gain access.

6.0 CONCEPTUAL ELECTRICAL DESIGN

6.1 Power Supply and Distribution System

We have estimated the power supply requirements for the station based on the assumed major electrical loads on site including process equipment (pumps and grinder), HVAC equipment (fans and odour control unit), and other small electrical loads (heaters, motorized equipment, and lighting). Assuming these loads we anticipate that the service will be greater than 500kVA, 600A from the transformer based on similarly sized stations, however the exact load requirements must be determined by performing an Electrical Load Analysis during the design phase.

A new Motor Control Center (MCC) is proposed to be installed inside the electrical room in the on-site control building. The Main Circuit Breaker, Hydro Entrance (CT's and PT's), Automatic Transfer Switch (ATS), Digital Power Meter (DPM), Variable Frequency Drive (VFD) and Direct On-Line (DOL) starters for the motors and feeder breakers will be installed in the MCC. A power factor correction system, surge protective device and a lightning arrester system will be provided.

A transformer and lighting panel will be required and could be installed in the electrical room to supply power for the low voltage loads. The panel board will be equipped with transient voltage surge suppression device.

6.2 Generator

A backup power diesel generator is recommended to support the facility upon loss of Hydro supply. The pumping station site will accommodate a permanent on-site diesel standby power generator and a transformer, each mounted on separate concrete pads and protected by bollards. The proposed generator will be an outdoor generator equipped with sub-base fuel tank for aesthetic purposes. The fuel tank will be sized to provide fuel storage duration consistent with the Client/City's needs.

7.0 CONCEPTUAL CAPITAL AND OPERATING COSTS

Conceptual design level capital and operating cost estimates have been developed for the Lynden Garden Block PS based on the assumptions made in this conceptual design report. The conceptual cost estimates are very high level based on preliminary understanding of the pumping station requirements, and therefore are subject to change pending further discussion and design.

Table 7.1 Conceptual Capital Cost Estimate

Item	Cost
General Requirements, Mobilization, Environmental Protection and Controls	$1,000,000.00
Siteworks Including Excavations, Grading, Access Roadway, Fencing, Landscaping, Stormwater Management	$450,000.00
Wet Well/Dry Well Concrete Shaft, Substructure, Including Reinforcing, Formwork, Waterproofing	$2,350,000.00
Electrical Building Superstructure, Including Masonry, Roofing, Doors, Windows, Thermal and Moisture Protection	$740,000.00
Pumps (4), Process Mechanical Equipment, and Appurtenances	$620,000.00
Miscellaneous Metal Fabrications, FRP, Wood, and Plastics	$495,000.00
Electrical, Instrumentation and Control, SCADA	$1,365,000.00
Building Mechanical including Outdoor Generator, Fuel Tank, and Odour Control System	$1,110,000.00
Allowance for Station Overflow	$100,000.00
Yard Piping Including Manholes, Sewers, and Water Servicing	$250,000.00
Sub-total	**$8,480,000.00**
Conceptual Design Contingency (25%)	$2,120,000.00
Total Estimated Capital Cost (Not Including Applicable Taxes)	**$10,600,000.00**

Table 7.2 Conceptual Operating Cost Estimate

Item	Cost
Operating and Maintenance Costs	$52,000/year

The operating and maintenance costs are assuming a 50-year life span for the pumping station.

APPENDIX 1

Urbantech Sanitary Sewer Design Sheets and Wastewater Flow Data

urbantech

SANITARY SEWER DESIGN SHEET

299 Lynden Road

City of Brantford

PROJECT DETAILS

Project No: 19-617
Date: 28-Sep-22
Designed by: Bob Moir
Checked by: Nava Pokharel, P.Eng.

DESIGN CRITERIA

Min Diameter =	250	mm	Avg. Domestic Flow =	245.0	l/c/d
Mannings 'n'=	0.013		Infiltration =	0.300	l/s/ha
Min. Velocity =	1.00	m/s	Max. Peaking Factor =	4.00	
Max. Velocity =	2.50	m/s	Min. Peaking Factor=	2.00	
Factor of Safety =	4	%			

NOMINAL PIPE S

STREET	FROM MH	TO MH	RESIDENTIAL							COMMERCIAL/INDUSTRIAL/INSTITUTIONAL						FLOW CALCULATIONS							PIPE DATA				
			AREA (ha)	ACC. AREA (ha)	UNITS (#)	DENISTY (P/ha)	DENSITY (P/unit)	POP	ACCUM. RES. POP.	AREA (ha)	ACC. AREA (ha)	EQUIV. POP. (p/ha)	FLOW RATE (l/s/ha)	EQUIV. POP.	ACCUM. EQUIV. POP.	INFILTRATION (l/s)	TOTAL ACCUM. POP.	PEAKING FACTOR	RES. FLOW (l/s)	COMM. FLOW (l/s)	ACCUM. COMM. FLOW (l/s)	TOTAL FLOW (l/s)	SLOPE (%)	PIPE DIAMETER (mm)	FULL FLOW CAPACITY (l/s)	FULL FLOW VELOCITY (m/s)	ACTUAL VELOCITY (m/s)
Street H	9A	8A	0.58	0.58	7		3.05	22	22							0.2	22	4.00	0.2			0.4	1.00	250	59.5	1.21	0.31
Street H	8A	7A	1.70	2.28	32		3.05	98	120							0.7	120	4.00	1.4			2.0	1.00	250	59.5	1.21	0.55
Street H	7A	6A	0.91	3.19	18		3.05	55	175							1.0	175	4.00	2.0			2.9	0.50	250	42.0	0.86	0.49
Street H	6A	5A	0.84	4.03	12		3.05	37	212							1.2	212	4.00	2.4			3.6	0.50	250	42.0	0.86	0.53
Street A	5A	4A	1.62	5.65	42		2.71	114	326							1.7	326	4.00	3.7			5.4	0.50	250	42.0	0.86	0.59
Street A	10A	4A	1.42	1.42	22		2.64	59	59							0.4	59	4.00	0.7			1.1	1.00	250	59.5	1.21	0.42
Street C	4A	3A	0.31	7.38	9		2.47	23	408							2.2	408	4.00	4.6			6.8	0.50	250	42.0	0.86	0.63
Street F	14A	13A	1.62	1.62	30		3.05	92	92							0.5	92	4.00	1.0			1.5	1.00	250	59.5	1.21	0.47
street E	7A	13A	0.13	2.41					120							0.7	120	4.00	1.4			2.1					
Street F	13A	12A	0.85	4.88	18		3.05	55	267							1.5	267	4.00	3.0			4.5	0.50	250	42.0	0.86	0.57
Street F	12A	11A	0.85	5.73	18		3.05	55	322							1.7	322	4.00	3.7			5.4	0.50	250	42.0	0.86	0.59
Street B	5A	11A	0.17	4.20					212							1.3	212	4.00	2.4			3.7					
Street F	11A	3A	1.43	11.36	42		2.71	114	648							3.4	648	3.91	7.2			10.6	0.50	250	42.0	0.86	0.69
Street C	3A	2A	0.37	19.11	12		2.47	30	1086							5.7	1086	3.78	11.6			17.4	0.50	250	42.0	0.86	0.80
Street M	21A	20A	0.71	0.71	9		3.05	28	28							0.2	28	4.00	0.3			0.5	1.00	250	59.5	1.21	0.31
Street E	13A	20A	0.13	4.16					212							1.2	212	4.00	2.4			3.7					
Street G	20A	19A	0.30	5.17	5		3.05	16	256							1.6	256	4.00	2.9			4.5	1.00	250	59.5	1.21	0.69
Street G	19A	18A	0.36	5.53	7		3.05	22	278							1.7	278	4.00	3.2			4.8	1.00	250	59.5	1.21	0.71
Street G	18A	17A	0.34	5.87	6		3.05	19	297							1.8	297	4.00	3.4			5.1	0.50	250	42.0	0.86	0.57
Street B	11A	17A	0.17	10.10					534							3.0	534	3.96	6.0			9.0		250			
Street G	17A	16A	0.30	16.27	5		3.05	16	847							4.9	847	3.85	9.2			14.1	0.50	250	42.0	0.86	0.75
Street G	16A	15A	0.36	16.63	7		3.05	22	869							5.0	869	3.84	9.5			14.4	0.50	250	42.0	0.86	0.75
Street G	15A	2A	0.23	16.86	4		3.05	13	882							5.1	882	3.83	9.6			14.6	0.50	250	42.0	0.86	0.77
Street C	2A	1A	1.29	37.26	57		2.47	141	2109							11.2	2109	3.57	21.3			32.5	0.50	250	42.0	0.86	0.93
Street L	30A	28A	0.88	0.88	12		3.05	37	37							0.3	37	4.00	0.4			0.7	1.00	250	59.5	1.21	0.31
Street E	29A	28A	0.37	0.37	7		3.05	22	22							0.1	22	4.00	0.2			0.4	1.00	250	59.5	1.21	0.31
Street E	28A	27A	0.81	2.06	18		3.05	55	114							0.6	114	4.00	1.3			1.9	1.00	250	59.5	1.21	0.51
Street I	31A	27A	0.48	0.48	6		3.05	19	19							0.1	19	4.00	0.2			0.4	1.00	250	59.5	1.21	0.31
Street I	27A	26A	0.13	2.67					133							0.8	133	4.00	1.5			2.3	0.50	250	42.0	0.86	0.45
Street I	26A	25A	0.13	2.80					133							0.8	133	4.00	1.5			2.3	0.50	250	42.0	0.86	0.46
Street I	25A	24A	0.14	2.94					133							0.9	133	4.00	1.5			2.4	0.50	250	42.0	0.86	0.46
Street I	24A	23A	0.17	3.11					133							0.9	133	4.00	1.5			2.4	0.50	250	42.0	0.86	0.46
Street I	23A	22A	0.16	3.27					133							1.0	133	4.00	1.5			2.5	0.50	250	42.0	0.86	0.46
Street I	22A	1A	0.11	3.38					133							1.0	133	4.00	1.5			2.5	0.50	250	42.0	0.86	0.46
Street J	32A	26A	1.45	1.45	34		3.05	104	104							0.4	104	4.00	1.2			1.6	1.00	250	59.5	1.21	0.47
Street K	33A	25A	1.45	1.45	34		3.05	104	104							0.4	104	4.00	1.2			1.6	1.00	250	59.5	1.21	0.47
Street B	34A	24A	1.58	1.58	45		2.71	122	122							0.5	122	4.00	1.4			1.9	1.00	250	59.5	1.21	0.51

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STREET	FROM MH	TO MH	RESIDENTIAL							COMMERCIAL/INDUSTRIAL/INSTITUTIONAL						FLOW CALCULATIONS							PIPE DATA				
			AREA (ha)	ACC. AREA (ha)	UNITS (#)	DENISTY (P/ha)	DENSITY (P/unit)	POP	ACCUM. RES. POP.	AREA (ha)	ACC. AREA (ha)	EQUIV. POP. (p/ha)	FLOW RATE (l/s/ha)	EQUIV. POP.	ACCUM. EQUIV. POP.	INFILTRATION (l/s)	TOTAL ACCUM. POP.	PEAKING FACTOR	RES. FLOW (l/s)	COMM. FLOW (l/s)	ACCUM. COMM. FLOW (l/s)	TOTAL FLOW (l/s)	SLOPE (%)	PIPE DIAMETER (mm)	FULL FLOW CAPACITY (l/s)	FULL FLOW VELOCITY (m/s)	ACTUAL VELOCITY (m/s)
Street N	35A	23A	1.46	1.46	56		2.47	139	139							0.4	139	4.00	1.6			2.0	1.00	250	59.5	1.21	0.55
Street O	36A	22A	1.26	1.26	56		2.47	139	139							0.4	139	4.00	1.6			2.0	1.00	250	59.5	1.21	0.55
Street E	38A	37A	0.67	0.67	7		3.05	22	22							0.2	22	4.00	0.2			0.5	1.00	250	59.5	1.21	0.31
Street E	37A	27A	1.58	2.25	28		3.05	86	108							0.7	108	4.00	1.2			1.9	0.50	250	42.0	0.86	0.42
Street J	38A	26A	1.26	1.26	28		3.05	86	86							0.4	86	4.00	1.0			1.4	1.00	250	59.5	1.21	0.47
Street E	38A	39A	0.32	0.32	5		3.05	16	16							0.1	16	4.00	0.2			0.3	1.00	250	59.5	1.21	0.31
Street K	42A	40A	0.74	0.74	9		3.05	28	28							0.2	28	4.00	0.3			0.5	1.00	250	59.5	1.21	0.31
Street K	40A	39A	1.08	1.82	18		3.05	55	83							0.5	83	4.00	0.9			1.5	1.00	250	59.5	1.21	0.47
Street K	39A	25A	1.25	3.39	28		3.05	86	185							1.0	185	4.00	2.1			3.1	0.50	250	42.0	0.86	0.49
Street B	42A	41A	1.05	1.05	20		3.05	61	61							0.3	61	4.00	0.7			1.0	1.00	250	59.5	1.21	0.38
Street B	41A	24A	1.33	2.38	37		2.70	100	161							0.7	161	4.00	1.8			2.5	1.00	250	59.5	1.21	0.59
Street N	45A	44A	0.52	0.52	7		3.05	22	22							0.2	22	4.00	0.2			0.4	0.50	250	42.0	0.86	0.22
Street N	44A	43A	0.60	1.12	10		3.05	31	53							0.3	53	4.00	0.6			0.9	1.00	250	59.5	1.21	0.38
Street N	43A	23A	1.22	2.34	46		2.47	114	167							0.7	167	4.00	1.9			2.6	0.50	250	42.0	0.86	0.46
Street O	47A	46A	0.49	0.49	8		3.05	25	25							0.1	25	4.00	0.3			0.4	0.50	250	42.0	0.86	0.22
Street O	PARK	46A	2.38	2.38		90		215	215							0.7	215	4.00	2.4			3.2					
Street O	46A	22A	1.20	4.07	46		2.47	114	354							1.2	354	4.00	4.0			5.2	1.00	250	59.5	1.21	0.75
Street D	COMM	1A	3.58	3.58		90		323	323							1.1	323	4.00	3.7			4.7					
Street D	1A	2B	0.88	45.10	19		2.47	47	2612							13.5	2612	3.49	25.9			39.4	0.50	250	42.0	0.86	0.97
	4B	3B																					0.30	250	32.6	0.66	0.17
	3B	2B																					0.30	250	32.6	0.66	0.17
	2B	1B		45.10					2612							13.5	2612	3.49	25.9			39.4	0.30	300	53.0	0.75	0.80
	1B	SPS-2		45.10					2612							13.5	2612	3.49	25.9			39.4	0.30	300	53.0	0.75	0.80
	SPS-1	5B																						250			

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IZE USED	PERCENT FULL (%)
	1%
	3%
	7%
	9%
	13%
	2%
	16%
	3%
	11%
	13%
	25%
	41%
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PERCENT FULL (%)
3%
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Provided by Urbantech Consulting, 2023.02.15

Ultimate SPS (Block 2)

The ultimate SPS will be constructed as part Phase 2 and built for full build out conditions of the East Expansion Area which also includes Block 1. The total catchment area to the ultimate SPS will be 158.3 ha with an equivalent residential population of 3,963 persons and employment population of 12,044 persons for a total population of 16,007 persons. The resultant wastewater demands for the East Expansion Area will be:

Average Daily Dry Weather Flow	= 48.9 L/s
Peaked Dry Weather Flow	= 116.5 L/s
Infiltration Flow	= 47.5 L/s
Total Design Flow	= 164.0 L/s

APPENDIX 2

Design Criteria - Wet Well Sizing Calculations

Lynden Garden Block PS - Residential & Employment Lands
Conceptual Design Criteria

01-Nov-23

	Pumping Station Conceptual Design Concept
▪	The sanitary pumping station will have a total peak flow of 203.4 L/s
▪	Per the City of Brantford Vertical Municipal Infrastructure Standards for Type III facilities the station will comprise:
	• Split wet well/dry well design with dry pit submersible pumps
	• Inlet chamber with isolation gates to divert flows into each cell
	• Inlet bypass chamber large enough to house the correct size portable bypass pumps for complete station rehabilitation, maintenance purposes, and/or complete station failure
	• Wet well interconnection gate to isolate each cell for service
	• Electrical and control panels housed in a dedicated superstructure that is unclassified
	• Ventilated below-grade dry well housing valves and a flowmeter for each forcemain
	• Three pumps (at least one standby)
	• A motorized isolation valve for each forcemain connected to SCADA will be provided.
	• Ventilation duct with a permanent explosion-proof and corrosion resistant ventilation fan
▪	Per the City of Brantford Vertical Municipal Infrastructure Standards, a minimum of 1 hour emergency storage is required for the wet well. The required emergency storage capacity of the wet well will therefore need to be in the order of 732.2 m^3.
▪	The total volume of the wet well, including the normal operating volume and emergency storage, will be approximately 754 m^3. The operating volume will be approximately 49 m^3.
▪	To meet this requirement, based on the conceptual design criteria calculations (attached), the wet well is conceptually sized as two cells, each one-quarter of a 14 metre diameter circular shaft, with a depth of approximately 16.9 metres.
▪	This wet well would be significantly larger than required from an operational or hydraulic standpoint. A deviation from design standards would need to be requested from the City to reduce the costs of the facility (the likelihood of achieving a deviation is not known).
▪	The wet well will be constructed of cast-in-place concrete. The wet well will comprise a Class 1, Division 1 hazardous location per the NFPA 820 guidelines.
▪	The station magnetic flowmeter, pumps, valving and appurtenances will be housed in the below ground dry well. The footprint of the dry well will approximately match that of the wet well at one-half of a 14 metre diameter circular shaft. The dry well comprise a Class 1, Division 2 hazardous location per the NFPA 820 guidelines.
▪	The pumping station will include a single-story building containing an electrical room constructed over the wet/dry well shaft. The above ground spaces of the electrical room will be physically separated from the below ground wet well and dry well, and will therefore comprise an unclassified space per the NFPA 820 guidelines.
▪	The total footprint of the surface building containing the electrical room and access room to the dry well will be approximately 14.6 x 11.5 metres, or 168 m^2 (including walls).
▪	The electrical room will house the electrical equipment, control panels, and ancillary building mechanical systems and equipment.
▪	The pumping station will be equipped with full SCADA integrated with the City of Brantford SCADA system in accordance with City of Brantford Design Standards.
▪	The required property block for the pumping station site is 45 x 45 meters.
▪	The pumping station site will accommodate a permanent on-site diesel standby power generator and a transformer, each mounted on separate concrete pads and protected by bollards.
▪	The pumping station site will be able to accommodate a Transport - Single Unit Tanker Trailer, equivalent to a Vacuum Truck with a length of 12 meters. The site will also contain 4 standard size parking spaces.

Lynden Garden Block PS - Residential & Employment Lands

Appendix A

Sanitary Pumping Station Conceptual Design Criteria

Design Flows			
Average Dry Weather Flow	56.32	L/s	
Peaking Factor (Harmon)	2.5284		
Peak Residential Flow	142.40	L/s	
Infiltration Flow	61.0		
Total Peak Flow	**203.40**	L/s	

Influent Sewer Invert Elevations			
Assumed Datum for Ground Elevation	217.3	m	
375ø Collector Invert	203.4	m	

Pump Initial Assumptions			
Flow	135.6	L/s	*assumed for single pump operation*
Power Draw	>50	HP	
Suction Bell Mouth Diameter	0.35	m	
Check V	1.41	m/s	*HI 9.8.6: 0.6 < V < 2.7; 1.7 m/s recommended*
Minimum Submergence	0.963	m	*HI 9.8; Eq. 9.8.6.3*

Pumping Station Setpoint Elevations			
Pumping Station Diameter	14	m²	
% PS Area as Wet Well	40%	m	
Wet Well Plan Area	61.6	m²	
Sewer Invert	203.4	m	
How Much Invert Freeboard Over HHWL?	300	mm	
HHWL	203.1	m	
How Much Freeboard Over HWL P2?	300	mm	
HWL P2	202.8	m	
How Much Freeboard Over HWL P1?	300	mm	
HWL P1	202.5	m	
How Much Operating Range?	600	mm	
LWL	201.9	m	
How Much Freeboard Over LLWL?	200	mm	
LLWL	201.7	m	
Allowance for Suction Inlet?	1000	m	
Suction Inlet	200.7	m	
Suction Inlet Clearance	200	mm	
Floor of Station	200.5	m	
Elevation of Top of Wet Well Cover?	217.3	m	
Depth of Wet Well	16.8	m	

Pump Cycle Time For Ultimate Build-out Development			
Safety Factor for Capacity vs. Peak Flow	0	%	
Target Starts per Hour	4		*if <50HP, max 6 starts, if >50 HP, max 4 starts*
Cycle Time	900	s	
Pump Capacity (1 Pump Operation)	**135.60**	L/s	
Operating Volume 1	36.95	m³	
Incoming Flow (Qin,1)	67.8	L/s	*min cycle time when Qin = 0.5 Qp1*
Required Operation Vol1	30510	L	*per HI 9.7 Eq. B.2*
	30.5	m^3	
Operating Vol 1 > Req'd?	TRUE		
Operating Volume 2	18.47	m³	
Pump Capacity (2 Pump Operation)	**203.40**	L/s	
Incoming Flow (Qin,2)	169.5	L/s	*min cycle time when Qin = 0.5 (Qp1+Qp2)*
Required Operation Vol2	15255.0	L	
	15.3	m^3	
Operating Vol 2 > Req'd?	TRUE		
Fill Time @ Average Flow	10.93	min	

Lynden Garden Block PS - Residential & Employment Lands

Appendix A

Sanitary Pumping Station Conceptual Design Criteria

Emergency Wet Well Storage Volume		
Overflow Pipe Size	450	mm
Overflow Elevation (estimated)	215.05	m
Alarm Level (HHWL)	203.1	m
Wet Well Emergency Storage Capacity (Ref: HHWL)	735.82	m^3
Pump Start Level (HWL)	202.80	m
Total Capacity for Wet Well Emergency Storage (Ref: HWL)	**754.30**	m^3

Emergency Storage for Ultimate Development		
Emergency Storage Volume Wet Well	735.82	m^3
Minutes of Emergency Storage in System	60.29	minutes
Hours of Emergency Storage in System	**1.00**	hours

Forcemain to Discharge			
Length	288.6	m	
Elevation Leaving Wet Well	201.7	m	
Discharge Elevation	215.75	m	
Q pump	**135.60**	L/s	
Nominal ID of Forcemain	364	mm	White Bionax PVCO, PC235, Nom. 350mm pipe
Velocity at Pump Capacity	1.3031	m/s	
Pipe Area	0.104	m^2	
Pipe Volume	30.03	m^3	
Ratio of Useable Storable to Pipe Volume	81.29%		
Forcemain Residence Time	12.19	min	

APPENDIX 3

Hydraulic Design Calculations

Lynden Garden Block PS

Total Capacity of the System would be determined by:
Two duty one standby pump. Lead-lag operation

Pump Station Flow Requirements				
Flows				
Design Rate	203.4 L/s	17574	m3/day	203.4 L/s
Firm Capacity	203.4 L/s	17574	m3/day	203.4 L/s
No. Duty Pumps		2	No.	
Flow per Pump		8787	m3/day	101.7 L/s
No. Standby pumps		1	No.	
Total Pumps		3		

Lynden Garden Block PS

Design Philosophy							
-Flow from WW to discharge MH							
Hydraulic Profile Summary							
Common discharge line ID						0.3640	m
Discharge line length						289	m
Max Discharge Pipe Velocity						1.95	m/s
Sump Low Water Level Elevation						201.90	Elv. (m)
Sump High Water Level Elevation						202.80	Elv. (m)
Elevation of Pump Impeller Centre Line						201.60	Elv. (m)
Pump Station Ground Level (m)						200.80	Elv. (m)
Max Discharge Elevation HWL (m)						215.75	Elv. (m)
Max Discharge Elevation HWL (m)						215.75	Elv. (m)
Vapour Pressure at t=25°C						0.32	m
Atmospheric Pressure						10.09	m
Partial pressure of dissolved gasses (Volatile organic matter in waste water =0.6m)						0.60	m
NPSH Available						9.47	m

Air pressure above sea level can be calculated as

$$p = 101325\ (1 - 2.25577\ 10^{-5}\ h)^{5.25588} \qquad (1)$$

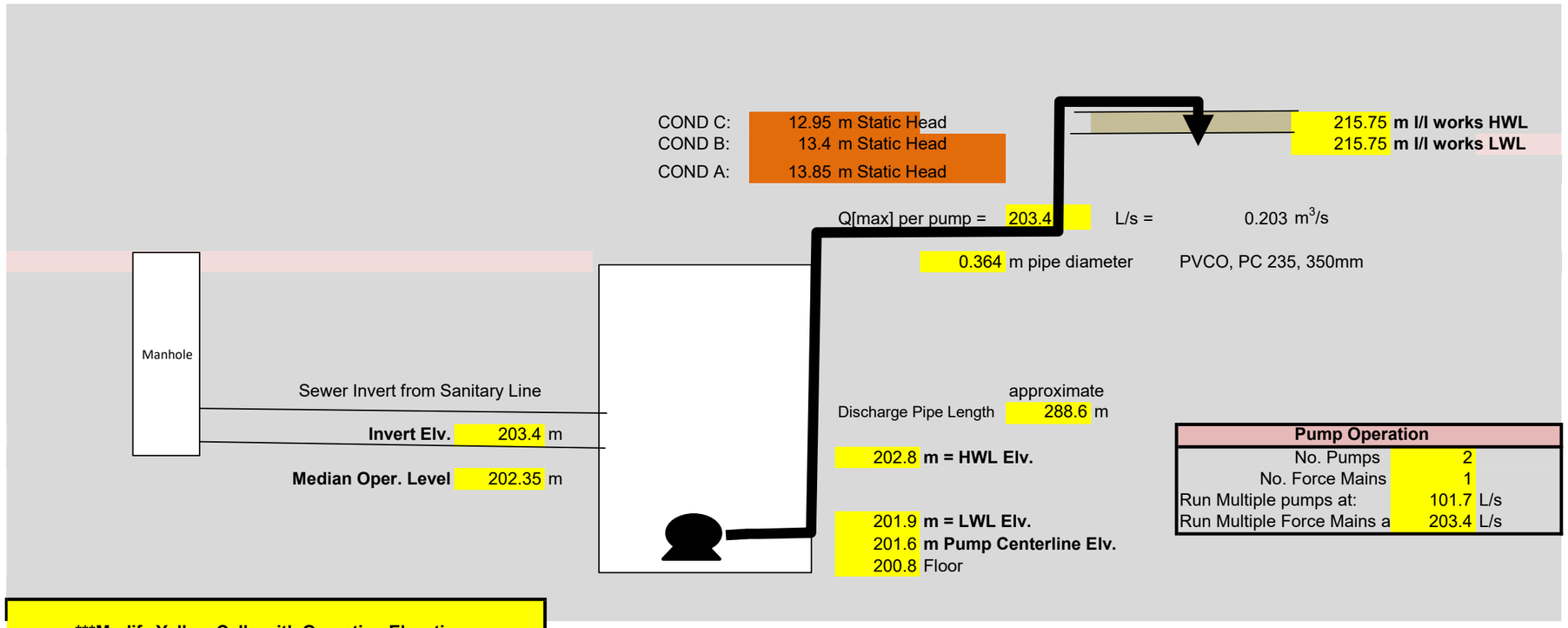
where

101325 = normal temperature and pressure at sea level (Pa)

p = air pressure (Pa)

h = altitude above sea level (m)

Hydraulic Profile



Pump Operation		
No. Pumps	2	
No. Force Mains	1	
Run Multiple pumps at:	101.7	L/s
Run Multiple Force Mains a	203.4	L/s

***Modify Yellow Cells with Operating Elevations

SUMMARY **Condition A: C = 120**

Common discharge line ID (m)	0.364
Common discharge line Length (m)	288.6
Max Velocity (m/s)	1.95
Conditiona A/B/C Operation Level	201.90
Elevation of Pump Impeller Centre Line	201.60
Pumping Station Ground Level (m)	200.80
Discharge Elevation (m) (Tank Level)	215.75
Vapour Pressure at t=25°C (m)	0.32
Atmospheric Pressure (m)	10.09
Partial pressure of dissolved gasses (Volatile organic matter in waste water =0.6m)	0.600
Factor of Safety	1.000
NPSH Available (m)	8.20
Pump Flow at Best Efficiency Point (BEP) (m^3/s)	0.083
Preferred Operating Region-Low Limit (70% of BEP) of (ANSI/HI 9.6.3-1997) (m^3/s)	0.058
Preferred Operating Region-High Limit (120% of BEP) of (ANSI/HI 9.6.3-1997) (m^3/s)	0.100

Operating Conditions Summary

Design Flow: **0.2034** **m^3/s**

Standard Flow Conditions

Conditions: Condition A: C = 120 **Project** Lynden Garden Block PS

TOTAL DYNAMIC HEAD CALCULATIONS **CONDITION:** **A** **C=** **120** **FLOW :** **start -** **0.000** **(m^3/s)** **increase increment -** **0.015** **(m^3/s)**

Roughness Coeff (SS)		120	120	120	120	120	120	120	120	120	**120**	**120**	**120**	**120**	120	120	120	120	120	120	120	120
Pump Flow (L/s)		0	15	30	45	60	75	90	105	120	135	150	165	180	195	210	225	240	255	270	285
Pump Flow (m^3/s)		**0.000**	**0.015**	**0.030**	**0.045**	**0.060**	**0.075**	**0.090**	**0.105**	**0.120**	**0.135**	**0.150**	**0.165**	**0.180**	**0.195**	**0.210**	**0.225**	**0.240**	**0.255**	**0.270**	**0.285**
Total Pumping Station Piping Friction Losses (m)		0.00	0.03	0.10	0.21	0.35	0.54	0.75	1.00	1.28	1.59	1.93	2.31	2.71	3.15	3.61	4.10	4.62	5.17	5.75	6.35
Total Pumping Station Fitting Losses (m)		0.00	0.01	0.04	0.09	0.17	0.26	0.38	0.51	0.67	0.85	1.04	1.26	1.50	1.76	2.05	2.35	2.67	3.02	3.38	3.77
Static Head (m)		13.85	13.85	13.85	13.85	13.85	13.85	13.85	13.85	13.85	13.85	13.85	13.85	13.85	13.85	13.85	13.85	13.85	13.85	13.85	13.85
Total Dynamic Head Including PS Losses (m)		**13.85**	**13.89**	**13.99**	**14.15**	**14.37**	**14.65**	**14.98**	**15.36**	**15.80**	**16.29**	**16.83**	**17.42**	**18.06**	**18.76**	**19.50**	**20.30**	**21.14**	**22.03**	**22.98**	**23.97**
(ft)		45.44	45.56	45.90	46.43	47.15	48.05	49.14	50.40	51.83	53.44	55.21	57.16	59.27	61.54	63.99	66.59	69.36	72.29	75.38	78.64

FLOW THROUGH SECTIONS: (m^3/s)		**Multiple Pumps/Force Mains**	**Flow Through Pipe Sections (L/s)**																			
Sec 1: Suction		2	0.000	0.008	0.015	0.023	0.030	0.038	0.045	0.053	0.060	0.068	0.075	0.083	0.090	0.098	0.105	0.113	0.120	0.128	0.135	0.143
Sec 2: Disharge Piping		2	0.000	0.008	0.015	0.023	0.030	0.038	0.045	0.053	0.060	0.068	0.075	0.083	0.090	0.098	0.105	0.113	0.120	0.128	0.135	0.143
Sec 3: Forcemain		**1**	0.000	0.015	0.030	0.045	0.060	0.075	0.090	0.105	0.120	0.135	0.150	0.165	0.180	0.195	0.210	0.225	0.240	0.255	0.270	0.285

HEAD LOSS THROUGH PIPE [Hazen-Williams formula for Metric Units $h=L*\{V/0.85*C*(D/4)^{0.63}\}^{1/0.54}$]

	Nominal Pipe Size (mm)	Pipe Size-ID (m)	Pipe Material	Pipe Sectional Area (m^2)	V=Q/A (m/s) (Max)		Pipe Length (m)		HEAD LOSS (M) THROUGH PIPE																
Section 1: Pumping Station Suction Line																									
Section 1	300	0.3147	S.S.	0.078	1.31		5.00		0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.05	0.06
Section 2: Pumping Station Discharge Line																									
Section 2	300	0.3147	S.S.	0.078	1.31		40.00		0.00	0.00	0.01	0.01	0.03	0.04	0.05	0.07	0.09	0.11	0.14	0.17	0.19	0.23	0.26	0.29	0.33	0.37	0.41	0.45
Section 3: Common Discharge/Forcemain																									
Section 3	350	0.3640	PVC	0.104	1.96		289.00		0.00	0.03	0.09	0.19	0.33	0.49	0.69	0.92	1.18	1.46	1.78	2.12	2.49	2.89	3.32	3.77	4.25	4.75	5.28	5.84
TOTAL HEADLOSS THROUGH Piping									**0.00**	**0.03**	**0.10**	**0.21**	**0.35**	**0.54**	**0.75**	**1.00**	**1.28**	**1.59**	**1.93**	**2.31**	**2.71**	**3.15**	**3.61**	**4.10**	**4.62**	**5.17**	**5.75**	**6.35**
TOTAL HEADLOSS THROUGH Piping For Sludge (m) with average multiplication factor 1% sludge or below = water									**0.00**	**0.03**	**0.10**	**0.21**	**0.35**	**0.54**	**0.75**	**1.00**	**1.28**	**1.59**	**1.93**	**2.31**	**2.71**	**3.15**	**3.61**	**4.10**	**4.62**	**5.17**	**5.75**	**6.35**

HEAD LOSS FOR PIPE FITTINGS [for Metric Units $h_L=K(v^2/2g)$], based on Table B-6 of "Pumping Station Design", Second Edition, Butterworth Heinemann.

	Nominal Pipe Size (mm)	Pipe Size-ID (m)	Increaser Smaller ID (m)	Pipe Fitting Type	Pipe Fitting No.	K-Factor	K Correction Factor	HEAD LOSS (M) THROUGH FITTINGS																	
Section 1: Pump Suction																									
	350	0.3460		Entry, sq. mouth	1	0.5	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.05	0.06
	300	0.3147		Reducer	1	0.03	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	300	0.3147		KGV	1	0.2	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.03
	300	0.3147		Wye	1	1	1.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.11	0.12	0.14	0.15	0.17
	300	0.3147		45 Bend	1	0.2	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.03
	250	0.2647		Reducer	1	0.03	1.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	250	0.2647		90 Bend	1	0.25	1.10	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.06	0.07	0.08	0.08	0.09
Section 2: Pump Discharge																									
	300	0.3150	0.2647	Increaser	1		1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.03	0.04	0.04
	300	0.3147		Swing Check	1	2.5	1.00	0.00	0.00	0.00	0.01	0.02	0.03	0.04	0.06	0.08	0.10	0.12	0.14	0.17	0.20	0.23	0.27	0.30	0.34	0.38	0.43
	300	0.3147		KGV	1	0.2	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.03
	300	0.3147		90 Bend	1	0.25	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.03	0.04	0.04
	300	0.3147		Tee, branch to line	1	1.5	1.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.03	0.05	0.06	0.07	0.09	0.10	0.12	0.14	0.16	0.18	0.21	0.23	0.26
	350	0.3673	0.3147	Increaser	1		1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02
Section 3: Forcemain																									
	350	0.3460		Tee, run	1	0.6	1.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.04	0.05	0.06	0.08	0.09	0.11	0.13	0.15	0.18	0.20	0.23	0.25	0.28
	350	0.3460		90 Bend	2	0.25	1.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.04	0.05	0.06	0.08	0.09	0.11	0.13	0.15	0.17	0.19	0.21	0.23
	350	0.3460		Tee, turn	1	1	1.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.05	0.06	0.08	0.11	0.13	0.16	0.19	0.22	0.25	0.29	0.33	0.38	0.42	0.47
	350	0.3460		KGV	1	0.2	1.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.06	0.07	0.08	0.08	0.09
	350	0.3460		Magflow	1	1	1.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.05	0.06	0.08	0.11	0.13	0.16	0.19	0.22	0.25	0.29	0.33	0.38	0.42	0.47
	350	0.3460		Tee, run	1	0.6	1.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.04	0.05	0.06	0.08	0.09	0.11	0.13	0.15	0.18	0.20	0.23	0.25	0.28
	350	0.3460		KGV	1	0.2	1.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.06	0.07	0.08	0.08	0.09
	350	0.3640		45 bends	3	0.2	1.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.04	0.05	0.06	0.08	0.09	0.11	0.12	0.14	0.16	0.18	0.21	0.23
	350	0.3640		Exit	1	1	1.00	0.00	0.00	0.00	0.01	0.02	0.03	0.04	0.05	0.07	0.09	0.11	0.13	0.15	0.18	0.21	0.24	0.27	0.31	0.34	0.38
Total Pipe Fitting Head Loss								**0.00**	**0.01**	**0.04**	**0.09**	**0.17**	**0.26**	**0.38**	**0.51**	**0.67**	**0.85**	**1.04**	**1.26**	**1.50**	**1.76**	**2.05**	**2.35**	**2.67**	**3.02**	**3.38**	**3.77**

SUMMARY **Condition B: C = 130**

Common discharge line ID (m)	0.364
Common discharge line Length (m)	288.6
Max Velocity (m/s)	1.95
Conditiona A/B/C Operation Level	202.35
Elevation of Pump Impeller Centre Line	201.60
Pumping Station Ground Level (m)	200.80
Discharge Elevation (m) (Tank Level)	215.75
Vapour Pressure at t=25°C (m)	0.32
Atmospheric Pressure (m)	10.09
Partial pressure of dissolved gasses (Volatile organic matter in waste water =0.6m)	0.600
Factor of Safety	1.000
NPSH Available (m)	8.66
Pump Flow at Best Efficiency Point (BEP) (m^3/s)	0.083
Preferred Operating Region-Low Limit (70% of BEP) of (ANSI/HI 9.6.3-1997) (m^3/s)	0.058
Preferred Operating Region-High Limit (120% of BEP) of (ANSI/HI 9.6.3-1997) (m^3/s)	0.100

Operating Conditions Summary

Design Flow: **0.2034** **m^3/s**

Standard Flow Conditions

Conditions: Condition B: C = 130 **Project** Lynden Garden Block PS

TOTAL DYNAMIC HEAD CALCULATIONS **CONDITION:** **B** **C=** **130** **FLOW :** **start -** **0.000** **(m^3/s)** **increase increment -** **0.015** **(m^3/s)**

Roughness Coeff (SS)	130	130	130	130	130	130	130	130	130	**130**	**130**	**130**	**130**	130	130	130	130	130	130	130	130
Pump Flow (L/s)	0	15	30	45	60	75	90	105	120	135	150	165	180	195	210	225	240	255	270	285	
Pump Flow (m^3/s)	**0.000**	**0.015**	**0.030**	**0.045**	**0.060**	**0.075**	**0.090**	**0.105**	**0.120**	**0.135**	**0.150**	**0.165**	**0.180**	**0.195**	**0.210**	**0.225**	**0.240**	**0.255**	**0.270**	**0.285**	
Total Pumping Station Piping Friction Losses (m)	0.00	0.02	0.08	0.18	0.31	0.46	0.65	0.86	1.10	1.37	1.67	1.99	2.34	2.71	3.11	3.54	3.98	4.46	4.95	5.48	
Total Pumping Station Fitting Losses (m)	0.00	0.01	0.04	0.09	0.17	0.26	0.38	0.51	0.67	0.85	1.04	1.26	1.50	1.76	2.05	2.35	2.67	3.02	3.38	3.77	
Static Head (m)	13.40	13.40	13.40	13.40	13.40	13.40	13.40	13.40	13.40	13.40	13.40	13.40	13.40	13.40	13.40	13.40	13.40	13.40	13.40	13.40	
Total Dynamic Head Including PS Losses (m)	**13.40**	**13.43**	**13.53**	**13.67**	**13.87**	**14.12**	**14.42**	**14.77**	**15.17**	**15.62**	**16.11**	**16.65**	**17.24**	**17.88**	**18.56**	**19.28**	**20.05**	**20.87**	**21.74**	**22.64**	
(ft)	43.96	44.07	44.38	44.86	45.51	46.34	47.32	48.47	49.78	51.24	52.86	54.64	56.56	58.65	60.88	63.26	65.80	68.48	71.31	74.29	

FLOW THROUGH SECTIONS: **(m^3/s)**

	Multiple Pumps/Force Mains	Flow Through Pipe Sections (L/s)																			
Sec 1: Suction	2	0.000	0.008	0.015	0.023	0.030	0.038	0.045	0.053	0.060	0.068	0.075	0.083	0.090	0.098	0.105	0.113	0.120	0.128	0.135	0.143
Sec 2: Disharge Piping	2	0.000	0.008	0.015	0.023	0.030	0.038	0.045	0.053	0.060	0.068	0.075	0.083	0.090	0.098	0.105	0.113	0.120	0.128	0.135	0.143
Sec 3: Forcemain	1	0.000	0.015	0.030	0.045	0.060	0.075	0.090	0.105	0.120	0.135	0.150	0.165	0.180	0.195	0.210	0.225	0.240	0.255	0.270	0.285

HEAD LOSS THROUGH PIPE [Hazen-Williams formula for Metric Units $h=L*\{V/0.85*C*(D/4)^{0.63}\}^{1/0.54}$]

	Nominal Pipe Size (mm)	Pipe Size-ID (m)	Pipe Material	Pipe Sectional Area (m^2)	V=Q/A (m/s) (Max)		Pipe Length (m)		HEAD LOSS (M) THROUGH PIPE														
Section 1: Pumping Station Suction Line																							
Section 1	300	0.3147	S.S.	0.078	1.31		5.00		0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.04	0.04	0.04	0.05
Section 2: Pumping Station Discharge Line																							
Section 2	300	0.3147	S.S.	0.078	1.31		40.00		0.00	0.00	0.01	0.01	0.02	0.03	0.05	0.06	0.08	0.10	0.12	0.14	0.17	0.19	0.22	0.25	0.29	0.32	0.35	0.39
Section 3: Common Discharge/Forcemain																							
Section 3	350	0.3640	PVC	0.104	1.96		289.00		0.00	0.02	0.08	0.17	0.28	0.42	0.60	0.79	1.01	1.26	1.53	1.83	2.15	2.49	2.86	3.25	3.66	4.10	4.56	5.04
TOTAL HEADLOSS THROUGH Piping									**0.00**	**0.02**	**0.08**	**0.18**	**0.31**	**0.46**	**0.65**	**0.86**	**1.10**	**1.37**	**1.67**	**1.99**	**2.34**	**2.71**	**3.11**	**3.54**	**3.98**	**4.46**	**4.95**	**5.48**
TOTAL HEADLOSS THROUGH Piping For Sludge (m) with average multiplication factor 1% sludge or below = water									**0.00**	**0.02**	**0.08**	**0.18**	**0.31**	**0.46**	**0.65**	**0.86**	**1.10**	**1.37**	**1.67**	**1.99**	**2.34**	**2.71**	**3.11**	**3.54**	**3.98**	**4.46**	**4.95**	**5.48**

HEAD LOSS FOR PIPE FITTINGS [for Metric Units $h_L=K(v^2/2g)$], based on Table B-6 of "Pumping Station Design", Second Edition, Butterworth Heinemann.

	Nominal Pipe Size (mm)	Pipe Size-ID (m)	Increaser Smaller ID (m)	Pipe Fitting Type	Pipe Fitting No.	K-Factor	K Correction Factor	HEAD LOSS (M) THROUGH FITTINGS																		
Section 1: Pump Suction																										
	350	0.3460		Entry, sq. mouth	1	0.5	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.05	0.06
	300	0.3147		Reducer	1	0.03	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	300	0.3147		KGV	1	0.2	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.03
	300	0.3147		Wye	1	1	1.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.11	0.12	0.14	0.15	0.17
	300	0.3147		45 Bend	1	0.2	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.03
	250	0.2647		Reducer	1	0.03	1.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	250	0.2647		90 Bend	1	0.25	1.10	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.06	0.07	0.08	0.08	0.09
Section 2: Pump Discharge																										
	300	0.3150	0.2647	Increaser	1		1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.03	0.04	0.04
	300	0.3147		Swing Check	1	2.5	1.00	0.00	0.00	0.00	0.01	0.02	0.03	0.04	0.06	0.08	0.10	0.12	0.14	0.17	0.20	0.23	0.27	0.30	0.34	0.38	0.43
	300	0.3147		KGV	1	0.2	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.03
	300	0.3147		90 Bend	1	0.25	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.03	0.04	0.04
	300	0.3147		Tee, branch to line	1	1.5	1.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.03	0.05	0.06	0.07	0.09	0.10	0.12	0.14	0.16	0.18	0.21	0.23	0.26
	350	0.3673	0.3147	Increaser	1		1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02
Section 3: Forcemain																										
	350	0.3460		Tee, run	1	0.6	1.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.04	0.05	0.06	0.08	0.09	0.11	0.13	0.15	0.18	0.20	0.23	0.25	0.28
	350	0.3460		90 Bend	2	0.25	1.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.04	0.05	0.06	0.08	0.09	0.11	0.13	0.15	0.17	0.19	0.21	0.23
	350	0.3460		Tee, turn	1	1	1.00	0.00	0.00	0.01	0.01	0.02	0.03	0.05	0.06	0.08	0.11	0.13	0.16	0.19	0.22	0.25	0.29	0.33	0.38	0.42	0.47
	350	0.3460		KGV	1	0.2	1.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.06	0.07	0.08	0.08	0.09
	350	0.3460		Magflow	1	1	1.00	0.00	0.00	0.01	0.01	0.02	0.03	0.05	0.06	0.08	0.11	0.13	0.16	0.19	0.22	0.25	0.29	0.33	0.38	0.42	0.47
	350	0.3460		Tee, run	1	0.6	1.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.04	0.05	0.06	0.08	0.09	0.11	0.13	0.15	0.18	0.20	0.23	0.25	0.28
	350	0.3460		KGV	1	0.2	1.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.06	0.07	0.08	0.08	0.09
	350	0.3640		45 bends	3	0.2	1.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.04	0.05	0.06	0.08	0.09	0.11	0.12	0.14	0.16	0.18	0.21	0.23
	350	0.3640		Exit	1	1	1.00	0.00	0.00	0.00	0.01	0.02	0.03	0.04	0.05	0.07	0.09	0.11	0.13	0.15	0.18	0.21	0.24	0.27	0.31	0.34	0.38
Total Pipe Fitting Head Loss								**0.00**	**0.01**	**0.04**	**0.09**	**0.17**	**0.26**	**0.38**	**0.51**	**0.67**	**0.85**	**1.04**	**1.26**	**1.50**	**1.76**	**2.05**	**2.35**	**2.67**	**3.02**	**3.38**	**3.77**

SUMMARY **Condition A: C = 140**

Common discharge line ID (m)	0.364
Common discharge line Length (m)	288.6
Max Velocity (m/s)	1.95
Conditiona A/B/C Operation Level	202.80
Elevation of Pump Impeller Centre Line	201.60
Pumping Station Ground Level (m)	200.80
Discharge Elevation (m) (Tank Level)	215.75
Vapour Pressure at t=25°C (m)	0.32
Atmospheric Pressure (m)	10.09
Partial pressure of dissolved gasses (Volatile organic matter in waste water =0.6m)	0.600
Factor of Safety	1.000
NPSH Available (m)	9.12
Pump Flow at Best Efficiency Point (BEP) (m^3/s)	0.083
Preferred Operating Region-Low Limit (70% of BEP) of (ANSI/HI 9.6.3-1997) (m^3/s)	0.058
Preferred Operating Region-High Limit (120% of BEP) of (ANSI/HI 9.6.3-1997) (m^3/s)	0.100

Operating Conditions Summary

Design Flow: **0.2034** **m^3/s**

Standard Flow Conditions

Conditions: Condition A: C = 140 **Project** Lynden Garden Block PS

TOTAL DYNAMIC HEAD CALCULATIONS **CONDITION:** **A** **C=** **140** **FLOW :** **start -** **0.000** **(m^3/s)** **increase increment -** **0.015** **(m^3/s)**

Roughness Coeff (SS)		140	140	140	140	140	140	140	140	140	**140**	**140**	**140**	**140**	140	140	140	140	140	140	140	140
Pump Flow (L/s)		0	15	30	45	60	75	90	105	120	135	150	165	180	195	210	225	240	255	270	285
Pump Flow (m^3/s)		**0.000**	**0.015**	**0.030**	**0.045**	**0.060**	**0.075**	**0.090**	**0.105**	**0.120**	**0.135**	**0.150**	**0.165**	**0.180**	**0.195**	**0.210**	**0.225**	**0.240**	**0.255**	**0.270**	**0.285**
Total Pumping Station Piping Friction Losses (m)		0.00	0.02	0.07	0.16	0.27	0.40	0.56	0.75	0.96	1.20	1.45	1.74	2.04	2.36	2.71	3.08	3.47	3.89	4.32	4.77
Total Pumping Station Fitting Losses (m)		0.00	0.01	0.04	0.09	0.17	0.26	0.38	0.51	0.67	0.85	1.04	1.26	1.50	1.76	2.05	2.35	2.67	3.02	3.38	3.77
Static Head (m)		12.95	12.95	12.95	12.95	12.95	12.95	12.95	12.95	12.95	12.95	12.95	12.95	12.95	12.95	12.95	12.95	12.95	12.95	12.95	12.95
Total Dynamic Head Including PS Losses (m)		**12.95**	**12.98**	**13.07**	**13.20**	**13.38**	**13.61**	**13.89**	**14.21**	**14.58**	**14.99**	**15.45**	**15.95**	**16.49**	**17.08**	**17.71**	**18.38**	**19.09**	**19.85**	**20.65**	**21.49**
(ft)		42.49	42.59	42.87	43.31	43.91	44.66	45.57	46.63	47.83	49.19	50.68	52.32	54.10	56.03	58.09	60.30	62.64	65.13	67.75	70.51

FLOW THROUGH SECTIONS: **(m^3/s)**

		Multiple Pumps/Force Mains	**Flow Through Pipe Sections (L/s)**																			
Sec 1: Suction		2	0.000	0.008	0.015	0.023	0.030	0.038	0.045	0.053	0.060	0.068	0.075	0.083	0.090	0.098	0.105	0.113	0.120	0.128	0.135	0.143
Sec 2: Disharge Piping		2	0.000	0.008	0.015	0.023	0.030	0.038	0.045	0.053	0.060	0.068	0.075	0.083	0.090	0.098	0.105	0.113	0.120	0.128	0.135	0.143
Sec 3: Forcemain		**1**	0.000	0.015	0.030	0.045	0.060	0.075	0.090	0.105	0.120	0.135	0.150	0.165	0.180	0.195	0.210	0.225	0.240	0.255	0.270	0.285

HEAD LOSS THROUGH PIPE [Hazen-Williams formula for Metric Units $h=L*\{V/0.85*C*(D/4)^{0.63}\}^{1/0.54}$]

	Nominal Pipe Size (mm)	**Pipe Size-ID (m)**	**Pipe Material**	**Pipe Sectional Area (m^2)**	**V=Q/A (m/s) (Max)**		**Pipe Length (m)**		**HEAD LOSS (M) THROUGH PIPE**															
Section 1: Pumping Station Suction Line																								
Section 1	300	0.3147	S.S.	0.078	1.31		5.00		0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.04	0.04
Section 2: Pumping Station Discharge Line																								
Section 2	300	0.3147	S.S.	0.078	1.31		40.00		0.00	0.00	0.01	0.01	0.02	0.03	0.04	0.05	0.07	0.09	0.10	0.12	0.15	0.17	0.19	0.22	0.25	0.28	0.31	0.34
Section 3: Common Discharge/Forcemain																								
Section 3	350	0.3640	PVC	0.104	1.96		289.00		0.00	0.02	0.07	0.14	0.25	0.37	0.52	0.69	0.88	1.10	1.34	1.60	1.87	2.17	2.49	2.83	3.19	3.57	3.97	4.39
TOTAL HEADLOSS THROUGH Piping									**0.00**	**0.02**	**0.07**	**0.16**	**0.27**	**0.40**	**0.56**	**0.75**	**0.96**	**1.20**	**1.45**	**1.74**	**2.04**	**2.36**	**2.71**	**3.08**	**3.47**	**3.89**	**4.32**	**4.77**
TOTAL HEADLOSS THROUGH Piping For Sludge (m) with average multiplication factor 1% sludge or below = water									**0.00**	**0.02**	**0.07**	**0.16**	**0.27**	**0.40**	**0.56**	**0.75**	**0.96**	**1.20**	**1.45**	**1.74**	**2.04**	**2.36**	**2.71**	**3.08**	**3.47**	**3.89**	**4.32**	**4.77**

HEAD LOSS FOR PIPE FITTINGS [for Metric Units $h_L=K(v^2/2g)$], based on Table B-6 of "Pumping Station Design", Second Edition, Butterworth Heinemann.

	Nominal Pipe Size (mm)	**Pipe Size-ID (m)**	**Increaser Smaller ID (m)**	Pipe Fitting Type	Pipe Fitting No.	**K-Factor**	**K Correction Factor**	**HEAD LOSS (M) THROUGH FITTINGS**																		
Section 1: Pump Suction																										
	350	0.3460		Entry, sq. mouth	1	0.5	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.05	0.06
	300	0.3147		Reducer	1	0.03	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	300	0.3147		KGV	1	0.2	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.03
	300	0.3147		Wye	1	1	1.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.11	0.12	0.14	0.15	0.17
	300	0.3147		45 Bend	1	0.2	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.03
	250	0.2647		Reducer	1	0.03	1.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	250	0.2647		90 Bend	1	0.25	1.10	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.06	0.07	0.08	0.08	0.09
Section 2: Pump Discharge																										
	300	0.3150	0.2647	Increaser	1		1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.03	0.04	0.04
	300	0.3147		Swing Check	1	2.5	1.00	0.00	0.00	0.00	0.01	0.02	0.03	0.04	0.06	0.08	0.10	0.12	0.14	0.17	0.20	0.23	0.27	0.30	0.34	0.38	0.43
	300	0.3147		KGV	1	0.2	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.03
	300	0.3147		90 Bend	1	0.25	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.03	0.04	0.04
	300	0.3147		Tee, branch to line	1	1.5	1.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.03	0.05	0.06	0.07	0.09	0.10	0.12	0.14	0.16	0.18	0.21	0.23	0.26
	350	0.3673	0.3147	Increaser	1		1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02
Section 3: Forcemain																										
	350	0.3460		Tee, run	1	0.6	1.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.04	0.05	0.06	0.08	0.09	0.11	0.13	0.15	0.18	0.20	0.23	0.25	0.28
	350	0.3460		90 Bend	2	0.25	1.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.04	0.05	0.06	0.08	0.09	0.11	0.13	0.15	0.17	0.19	0.21	0.23
	350	0.3460		Tee, turn	1	1	1.00	0.00	0.00	0.01	0.01	0.02	0.03	0.05	0.06	0.08	0.11	0.13	0.16	0.19	0.22	0.25	0.29	0.33	0.38	0.42	0.47
	350	0.3460		KGV	1	0.2	1.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.03	0.03	0.03	0.04	0.04	0.05	0.06	0.07	0.08	0.08	0.09
	350	0.3460		Magflow	1	1	1.00	0.00	0.00	0.01	0.01	0.02	0.03	0.05	0.06	0.08	0.11	0.13	0.16	0.19	0.22	0.25	0.29	0.33	0.38	0.42	0.47
	350	0.3460		Tee, run	1	0.6	1.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.04	0.05	0.06	0.08	0.09	0.11	0.13	0.15	0.18	0.20	0.23	0.25	0.28
	350	0.3460		KGV	1	0.2	1.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.06	0.07	0.08	0.08	0.09
	350	0.3640		45 bends	3	0.2	1.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.04	0.05	0.06	0.08	0.09	0.11	0.12	0.14	0.16	0.18	0.21	0.23
	350	0.3640		Exit	1	1	1.00	0.00	0.00	0.00	0.01	0.02	0.03	0.04	0.05	0.07	0.09	0.11	0.13	0.15	0.18	0.21	0.24	0.27	0.31	0.34	0.38
Total Pipe Fitting Head Loss								**0.00**	**0.01**	**0.04**	**0.09**	**0.17**	**0.26**	**0.38**	**0.51**	**0.67**	**0.85**	**1.04**	**1.26**	**1.50**	**1.76**	**2.05**	**2.35**	**2.67**	**3.02**	**3.38**	**3.77**

SUMMARY **Condition B: C = 130**

Common discharge line ID (m)	0.364
Common discharge line Length (m)	288.6
Max Velocity (m/s)	1.95
Conditiona A/B/C Operation Level	202.35
Elevation of Pump Impeller Centre Line	201.60
Pumping Station Ground Level (m)	200.80
Discharge Elevation (m) (Tank Level)	215.75
Vapour Pressure at t=25°C (m)	0.32
Atmospheric Pressure (m)	10.09
Partial pressure of dissolved gasses (Volatile organic matter in waste water =0.6m)	0.600
Factor of Safety	1.000
NPSH Available (m)	7.89
Pump Flow at Best Efficiency Point (BEP) (m^3/s)	0.083
Preferred Operating Region-Low Limit (70% of BEP) of (ANSI/HI 9.6.3-1997) (m^3/s)	0.058
Preferred Operating Region-High Limit (120% of BEP) of (ANSI/HI 9.6.3-1997) (m^3/s)	0.100

Operating Conditions Summary

Design Flow: **0.2034** **m^3/s**

Standard Flow Conditions

Conditions: Condition B: C = 130 **Project** Lynden Garden Block PS

TOTAL DYNAMIC HEAD CALCULATIONS **CONDITION:** **B** **C=** **130** **FLOW :** **start -** **0.000** **(m^3/s)** **increase increment -** **0.015** **(m^3/s)**

Roughness Coeff (SS)	130	130	130	130	130	130	130	130	130	**130**	**130**	**130**	**130**	130	130	130	130	130	130	130	130
Pump Flow (L/s)	0	15	30	45	60	75	90	105	120	135	150	165	180	195	210	225	240	255	270	285	
Pump Flow (m^3/s)	**0.000**	**0.015**	**0.030**	**0.045**	**0.060**	**0.075**	**0.090**	**0.105**	**0.120**	**0.135**	**0.150**	**0.165**	**0.180**	**0.195**	**0.210**	**0.225**	**0.240**	**0.255**	**0.270**	**0.285**	
Total Pumping Station Piping Friction Losses (m)	0.00	0.03	0.10	0.22	0.37	0.56	0.78	1.04	1.34	1.66	2.02	2.41	2.83	3.28	3.77	4.28	4.82	5.39	6.00	6.63	
Total Pumping Station Fitting Losses (m)	0.00	0.02	0.08	0.19	0.33	0.52	0.74	1.01	1.32	1.68	2.07	2.50	2.98	3.50	4.05	4.65	5.30	5.98	6.70	7.47	
Static Head (m)	13.40	13.40	13.40	13.40	13.40	13.40	13.40	13.40	13.40	13.40	13.40	13.40	13.40	13.40	13.40	13.40	13.40	13.40	13.40	13.40	
Total Dynamic Head Including PS Losses (m)	**13.40**	**13.45**	**13.59**	**13.80**	**14.10**	**14.48**	**14.93**	**15.46**	**16.06**	**16.74**	**17.49**	**18.31**	**19.21**	**20.18**	**21.22**	**22.33**	**23.52**	**24.77**	**26.10**	**27.49**	
(ft)	43.96	44.12	44.57	45.29	46.26	47.50	48.98	50.71	52.69	54.91	57.37	60.08	63.02	66.20	69.62	73.27	77.15	81.27	85.62	90.21	

FLOW THROUGH SECTIONS: **(m^3/s)**

	Multiple Pumps/Force Mains	Flow Through Pipe Sections (L/s)																			
Sec 1: Suction	1	0.000	0.015	0.030	0.045	0.060	0.075	0.090	0.105	0.120	0.135	0.150	0.165	0.180	0.195	0.210	0.225	0.240	0.255	0.270	0.285
Sec 2: Disharge Piping	1	0.000	0.015	0.030	0.045	0.060	0.075	0.090	0.105	0.120	0.135	0.150	0.165	0.180	0.195	0.210	0.225	0.240	0.255	0.270	0.285
Sec 3: Forcemain	**1**	0.000	0.015	0.030	0.045	0.060	0.075	0.090	0.105	0.120	0.135	0.150	0.165	0.180	0.195	0.210	0.225	0.240	0.255	0.270	0.285

HEAD LOSS THROUGH PIPE [Hazen-Williams formula for Metric Units $h=L*\{V/0.85*C*(D/4)^{0.63}\}^{1/0.54}$]

	Nominal Pipe Size (mm)	Pipe Size-ID (m)	Pipe Material	Pipe Sectional Area (m^2)	V=Q/A (m/s) (Max)		Pipe Length (m)		HEAD LOSS (M) THROUGH PIPE																
Section 1: Pumping Station Suction Line																									
Section 1	300	0.3147	S.S.	0.078	2.62		5.00		0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.03	0.04	0.04	0.05	0.06	0.08	0.09	0.10	0.11	0.13	0.14	0.16	0.18
Section 2: Pumping Station Discharge Line																									
Section 2	300	0.3147	S.S.	0.078	2.62		40.00		0.00	0.01	0.02	0.05	0.08	0.12	0.17	0.22	0.29	0.35	0.43	0.51	0.60	0.70	0.80	0.91	1.03	1.15	1.28	1.42
Section 3: Common Discharge/Forcemain																									
Section 3	350	0.3640	PVC	0.104	1.96		289.00		0.00	0.02	0.08	0.17	0.28	0.42	0.60	0.79	1.01	1.26	1.53	1.83	2.15	2.49	2.86	3.25	3.66	4.10	4.56	5.04
TOTAL HEADLOSS THROUGH Piping									**0.00**	**0.03**	**0.10**	**0.22**	**0.37**	**0.56**	**0.78**	**1.04**	**1.34**	**1.66**	**2.02**	**2.41**	**2.83**	**3.28**	**3.77**	**4.28**	**4.82**	**5.39**	**6.00**	**6.63**
TOTAL HEADLOSS THROUGH Piping For Sludge (m) with average multiplication factor 1% sludge or below = water									**0.00**	**0.03**	**0.10**	**0.22**	**0.37**	**0.56**	**0.78**	**1.04**	**1.34**	**1.66**	**2.02**	**2.41**	**2.83**	**3.28**	**3.77**	**4.28**	**4.82**	**5.39**	**6.00**	**6.63**

HEAD LOSS FOR PIPE FITTINGS [for Metric Units $h_L=K(v^2/2g)$], based on Table B-6 of "Pumping Station Design", Second Edition, Butterworth Heinemann.

	Nominal Pipe Size (mm)	Pipe Size-ID (m)	Increaser Smaller ID (m)	Pipe Fitting Type	Pipe Fitting No.	K-Factor	K Correction Factor	HEAD LOSS (M) THROUGH FITTINGS																	
Section 1: Pump Suction																									
	350	0.3460		Entry, sq. mouth	1	0.5	1.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.04	0.05	0.06	0.08	0.09	0.11	0.13	0.15	0.17	0.19	0.21	0.23
	300	0.3147		Reducer	1	0.03	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02
	300	0.3147		KGV	1	0.2	1.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.03	0.04	0.05	0.05	0.06	0.07	0.09	0.10	0.11	0.12	0.14
	300	0.3147		Wye	1	1	1.00	0.00	0.00	0.01	0.02	0.03	0.05	0.07	0.09	0.12	0.15	0.19	0.23	0.27	0.32	0.37	0.43	0.49	0.55	0.61	0.68
	300	0.3147		45 Bend	1	0.2	1.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.03	0.04	0.05	0.05	0.06	0.07	0.09	0.10	0.11	0.12	0.14
	250	0.2647		Reducer	1	0.03	1.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.04	0.04	0.05
	250	0.2647		90 Bend	1	0.25	1.10	0.00	0.00	0.00	0.01	0.02	0.03	0.04	0.05	0.07	0.08	0.10	0.13	0.15	0.18	0.20	0.23	0.27	0.30	0.34	0.38
Section 2: Pump Discharge																									
	300	0.3150	0.2647	Increaser	1		1.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.11	0.12	0.14	0.15	0.17
	300	0.3147		Swing Check	1	2.5	1.00	0.00	0.00	0.02	0.04	0.08	0.12	0.17	0.23	0.30	0.38	0.47	0.57	0.68	0.80	0.93	1.07	1.21	1.37	1.54	1.71
	300	0.3147		KGV	1	0.2	1.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.03	0.04	0.05	0.05	0.06	0.07	0.09	0.10	0.11	0.12	0.14
	300	0.3147		90 Bend	1	0.25	1.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.11	0.12	0.14	0.15	0.17
	300	0.3147		Tee, branch to line	1	1.5	1.00	0.00	0.00	0.01	0.03	0.05	0.07	0.10	0.14	0.18	0.23	0.28	0.34	0.41	0.48	0.56	0.64	0.73	0.82	0.92	1.03
	350	0.3673	0.3147	Increaser	1		1.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.06	0.06	0.07	0.08
Section 3: Forcemain																									
	350	0.3460		Tee, run	1	0.6	1.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.04	0.05	0.06	0.08	0.09	0.11	0.13	0.15	0.18	0.20	0.23	0.25	0.28
	350	0.3460		90 Bend	2	0.25	1.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.04	0.05	0.06	0.08	0.09	0.11	0.13	0.15	0.17	0.19	0.21	0.23
	350	0.3460		Tee, turn	1	1	1.00	0.00	0.00	0.01	0.01	0.02	0.03	0.05	0.06	0.08	0.11	0.13	0.16	0.19	0.22	0.25	0.29	0.33	0.38	0.42	0.47
	350	0.3460		KGV	1	0.2	1.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.06	0.07	0.08	0.08	0.09
	350	0.3460		Magflow	1	1	1.00	0.00	0.00	0.01	0.01	0.02	0.03	0.05	0.06	0.08	0.11	0.13	0.16	0.19	0.22	0.25	0.29	0.33	0.38	0.42	0.47
	350	0.3460		Tee, run	1	0.6	1.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.04	0.05	0.06	0.08	0.09	0.11	0.13	0.15	0.18	0.20	0.23	0.25	0.28
	350	0.3460		KGV	1	0.2	1.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.06	0.07	0.08	0.08	0.09
	350	0.3640		45 bends	3	0.2	1.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.04	0.05	0.06	0.08	0.09	0.11	0.12	0.14	0.16	0.18	0.21	0.23
	350	0.3640		Exit	1	1	1.00	0.00	0.00	0.00	0.01	0.02	0.03	0.04	0.05	0.07	0.09	0.11	0.13	0.15	0.18	0.21	0.24	0.27	0.31	0.34	0.38
Total Pipe Fitting Head Loss								**0.00**	**0.02**	**0.08**	**0.19**	**0.33**	**0.52**	**0.74**	**1.01**	**1.32**	**1.68**	**2.07**	**2.50**	**2.98**	**3.50**	**4.05**	**4.65**	**5.30**	**5.98**	**6.70**	**7.47**

SUMMARY **Condition B: C = 130**

Common discharge line ID (m)	0.364
Common discharge line Length (m)	288.6
Max Velocity (m/s)	1.95
Conditiona A/B/C Operation Level	215.05
Elevation of Pump Impeller Centre Line	201.60
Pumping Station Ground Level (m)	200.80
Discharge Elevation (m) (Tank Level)	215.75
Vapour Pressure at t=25°C (m)	0.32
Atmospheric Pressure (m)	10.09
Partial pressure of dissolved gasses (Volatile organic matter in waste water =0.6m)	0.600
Factor of Safety	1.000
NPSH Available (m)	21.36
Pump Flow at Best Efficiency Point (BEP) (m^3/s)	0.083
Preferred Operating Region-Low Limit (70% of BEP) of (ANSI/HI 9.6.3-1997) (m^3/s)	0.058
Preferred Operating Region-High Limit (120% of BEP) of (ANSI/HI 9.6.3-1997) (m^3/s)	0.100

Operating Conditions Summary

Design Flow: **0.2034** **m^3/s**

Standard Flow Conditions

Conditions: Condition B: C = 130 **Project** Lynden Garden Block PS

TOTAL DYNAMIC HEAD CALCULATIONS **CONDITION:** **B** **C=** **130** **FLOW :** **start -** **0.000** **(m^3/s)** **increase increment -** **0.015** **(m^3/s)**

Roughness Coeff (SS)	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130
Pump Flow (L/s)	0	15	30	45	60	75	90	105	120	135	150	165	180	195	210	225	240	255	270	285	
Pump Flow (m^3/s)	**0.000**	**0.015**	**0.030**	**0.045**	**0.060**	**0.075**	**0.090**	**0.105**	**0.120**	**0.135**	**0.150**	**0.165**	**0.180**	**0.195**	**0.210**	**0.225**	**0.240**	**0.255**	**0.270**	**0.285**	
Total Pumping Station Piping Friction Losses (m)	0.00	0.02	0.08	0.18	0.31	0.46	0.65	0.86	1.10	1.37	1.67	1.99	2.34	2.71	3.11	3.54	3.98	4.46	4.95	5.48	
Total Pumping Station Fitting Losses (m)	0.00	0.01	0.04	0.09	0.17	0.26	0.38	0.51	0.67	0.85	1.04	1.26	1.50	1.76	2.05	2.35	2.67	3.02	3.38	3.77	
Static Head (m)	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	
Total Dynamic Head Including PS Losses (m)	**0.70**	**0.73**	**0.83**	**0.97**	**1.17**	**1.42**	**1.72**	**2.07**	**2.47**	**2.92**	**3.41**	**3.95**	**4.54**	**5.18**	**5.86**	**6.58**	**7.35**	**8.17**	**9.04**	**9.94**	
(ft)	2.30	2.41	2.71	3.19	3.85	4.67	5.65	6.80	8.11	9.57	11.19	12.97	14.90	16.98	19.21	21.60	24.13	26.81	29.64	32.62	

FLOW THROUGH SECTIONS: (m^3/s)

	Multiple Pumps/Force Mains	Flow Through Pipe Sections (L/s)																			
Sec 1: Suction	2	0.000	0.008	0.015	0.023	0.030	0.038	0.045	0.053	0.060	0.068	0.075	0.083	0.090	0.098	0.105	0.113	0.120	0.128	0.135	0.143
Sec 2: Disharge Piping	2	0.000	0.008	0.015	0.023	0.030	0.038	0.045	0.053	0.060	0.068	0.075	0.083	0.090	0.098	0.105	0.113	0.120	0.128	0.135	0.143
Sec 3: Forcemain	1	0.000	0.015	0.030	0.045	0.060	0.075	0.090	0.105	0.120	0.135	0.150	0.165	0.180	0.195	0.210	0.225	0.240	0.255	0.270	0.285

HEAD LOSS THROUGH PIPE [Hazen-Williams formula for Metric Units $h=L*\{V/0.85*C*(D/4)^{0.63}\}^{1/0.54}$]

	Nominal Pipe Size (mm)	Pipe Size-ID (m)	Pipe Material	Pipe Sectional Area (m^2)	V=Q/A (m/s) (Max)		Pipe Length (m)		HEAD LOSS (M) THROUGH PIPE															
Section 1: Pumping Station Suction Line																								
Section 1	300	0.3147	S.S.	0.078	1.31		5.00		0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.04	0.04	0.04	0.05
Section 2: Pumping Station Discharge Line																								
Section 2	300	0.3147	S.S.	0.078	1.31		40.00		0.00	0.00	0.01	0.01	0.02	0.03	0.05	0.06	0.08	0.10	0.12	0.14	0.17	0.19	0.22	0.25	0.29	0.32	0.35	0.39
Section 3: Common Discharge/Forcemain																								
Section 3	350	0.3640	PVC	0.104	1.96		289.00		0.00	0.02	0.08	0.17	0.28	0.42	0.60	0.79	1.01	1.26	1.53	1.83	2.15	2.49	2.86	3.25	3.66	4.10	4.56	5.04
TOTAL HEADLOSS THROUGH Piping									**0.00**	**0.02**	**0.08**	**0.18**	**0.31**	**0.46**	**0.65**	**0.86**	**1.10**	**1.37**	**1.67**	**1.99**	**2.34**	**2.71**	**3.11**	**3.54**	**3.98**	**4.46**	**4.95**	**5.48**
TOTAL HEADLOSS THROUGH Piping For Sludge (m) with average multiplication factor 1% sludge or below = water									**0.00**	**0.02**	**0.08**	**0.18**	**0.31**	**0.46**	**0.65**	**0.86**	**1.10**	**1.37**	**1.67**	**1.99**	**2.34**	**2.71**	**3.11**	**3.54**	**3.98**	**4.46**	**4.95**	**5.48**

HEAD LOSS FOR PIPE FITTINGS [for Metric Units $h_L=K(v^2/2g)$], based on Table B-6 of "Pumping Station Design", Second Edition, Butterworth Heinemann.

	Nominal Pipe Size (mm)	Pipe Size-ID (m)	Increaser Smaller ID (m)	Pipe Fitting Type	Pipe Fitting No.	K-Factor	K Correction Factor	HEAD LOSS (M) THROUGH FITTINGS																	
Section 1: Pump Suction																									
	350	0.3460		Entry, sq. mouth	1	0.5	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.05	0.06
	300	0.3147		Reducer	1	0.03	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
	300	0.3147		KGV	1	0.2	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.03
	300	0.3147		Wye	1	1	1.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.11	0.12	0.14	0.15	0.17
	300	0.3147		45 Bend	1	0.2	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.03
	250	0.2647		Reducer	1	0.03	1.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	250	0.2647		90 Bend	1	0.25	1.10	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.06	0.07	0.08	0.08	0.09
Section 2: Pump Discharge																									
	300	0.3150	0.2647	Increaser	1		1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.03	0.04	0.04
	300	0.3147		Swing Check	1	2.5	1.00	0.00	0.00	0.00	0.01	0.02	0.03	0.04	0.06	0.08	0.10	0.12	0.14	0.17	0.20	0.23	0.27	0.30	0.34	0.38	0.43
	300	0.3147		KGV	1	0.2	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.03
	300	0.3147		90 Bend	1	0.25	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.03	0.03	0.04	0.04
	300	0.3147		Tee, branch to line	1	1.5	1.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.03	0.05	0.06	0.07	0.09	0.10	0.12	0.14	0.16	0.18	0.21	0.23	0.26
	350	0.3673	0.3147	Increaser	1		1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02
Section 3: Forcemain																									
	350	0.3460		Tee, run	1	0.6	1.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.04	0.05	0.06	0.08	0.09	0.11	0.13	0.15	0.18	0.20	0.23	0.25	0.28
	350	0.3460		90 Bend	2	0.25	1.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.04	0.05	0.06	0.08	0.09	0.11	0.13	0.15	0.17	0.19	0.21	0.23
	350	0.3460		Tee, turn	1	1	1.00	0.00	0.00	0.01	0.01	0.02	0.03	0.05	0.06	0.08	0.11	0.13	0.16	0.19	0.22	0.25	0.29	0.33	0.38	0.42	0.47
	350	0.3460		KGV	1	0.2	1.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.06	0.07	0.08	0.08	0.09
	350	0.3460		Magflow	1	1	1.00	0.00	0.00	0.01	0.01	0.02	0.03	0.05	0.06	0.08	0.11	0.13	0.16	0.19	0.22	0.25	0.29	0.33	0.38	0.42	0.47
	350	0.3460		Tee, run	1	0.6	1.00	0.00	0.00	0.00	0.01	0.01	0.02	0.03	0.04	0.05	0.06	0.08	0.09	0.11	0.13	0.15	0.18	0.20	0.23	0.25	0.28
	350	0.3460		KGV	1	0.2	1.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.06	0.07	0.08	0.08	0.09
	350	0.3640		45 bends	3	0.2	1.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.04	0.05	0.06	0.08	0.09	0.11	0.12	0.14	0.16	0.18	0.21	0.23
	350	0.3640		Exit	1	1	1.00	0.00	0.00	0.00	0.01	0.02	0.03	0.04	0.05	0.07	0.09	0.11	0.13	0.15	0.18	0.21	0.24	0.27	0.31	0.34	0.38
Total Pipe Fitting Head Loss								**0.00**	**0.01**	**0.04**	**0.09**	**0.17**	**0.26**	**0.38**	**0.51**	**0.67**	**0.85**	**1.04**	**1.26**	**1.50**	**1.76**	**2.05**	**2.35**	**2.67**	**3.02**	**3.38**	**3.77**

System Curve Data

Cumulative data from the TDH Pump curves. This data is used to generate the System Curves for 3 MOE conditions

Pump Flow (L/s)	0	15	30	45	60	75	90	105	120	135	150	165	180	195	210	225	240	255	270	285
Condition A, 2 Pump	13.85	13.89	13.99	14.15	14.37	14.65	14.98	15.36	15.80	16.29	16.83	17.42	18.06	18.76	19.50	20.30	21.14	22.03	22.98	23.97
Condition B, 2 Pump	13.40	13.43	13.53	13.67	13.87	14.12	14.42	14.77	15.17	15.62	16.11	16.65	17.24	17.88	18.56	19.28	20.05	20.87	21.74	22.64
Condition C, 2 Pump	12.95	12.98	13.07	13.20	13.38	13.61	13.89	14.21	14.58	14.99	15.45	15.95	16.49	17.08	17.71	18.38	19.09	19.85	20.65	21.49
Condition B, 1 Pump	13.40	13.45	13.59	13.80	14.10	14.48	14.93	15.46	16.06	16.74	17.49	18.31								
Overflow Condition, 2 Pump	0.70	0.73	0.83	0.97	1.17	1.42	1.72	2.07	2.47	2.92	3.41	3.95	4.54	5.18	5.86	6.58	7.35	8.17	9.04	9.94

Flow Demand Data (For Graph)

Dieppe 20 Year Peak Flows

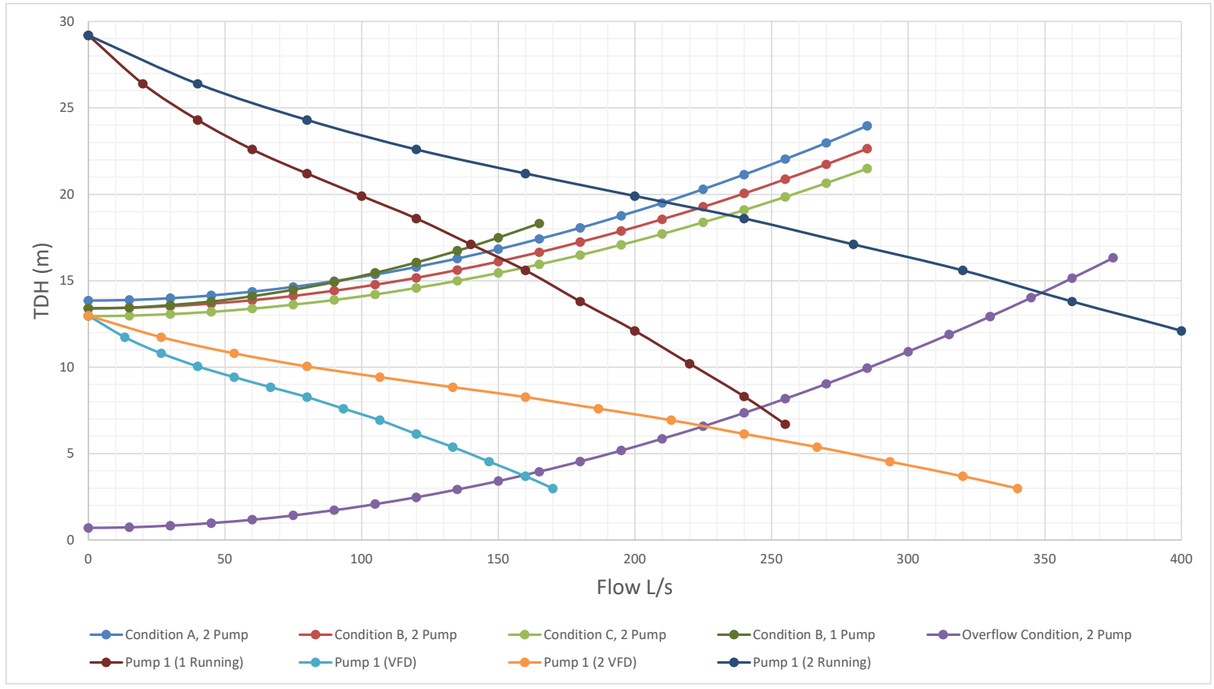
Maximum flow through for Head

150.000	0
150.000	16.83
150.000	16.83

Pump Curve Data

Pump 1 (1 Running)		Pump 1 (VFD)		Pump 1 (2 Runnin		Pump 1 (2 VFD)	
Flow	Head	Flow	Head	Flow	Head	Flow	Head
0	29.2	0	12.98	0	29.20	0	12.98
20	26.4	13.33	11.73	40	26.40	27	11.73
40	24.3	26.67	10.80	80	24.30	53	10.80
60	22.6	40.00	10.04	120	22.60	80	10.04
80	21.2	53.33	9.42	160	21.20	107	9.42
100	19.9	66.67	8.84	200	19.90	133	8.84
120	18.6	80.00	8.27	240	18.60	160	8.27
140	17.1	93.33	7.60	280	17.10	187	7.60
160	15.6	106.67	6.93	320	15.60	213	6.93
180	13.8	120.00	6.13	360	13.80	240	6.13
200	12.1	133.33	5.38	400	12.10	267	5.38
220	10.2	146.67	4.53	440	10.20	293	4.53
240	8.3	160.00	3.69	480	8.30	320	3.69
255	6.7	170.00	2.98	510	6.70	340	2.98

Flygt NT 3202 MT3~641 354 mm | Hz | 40

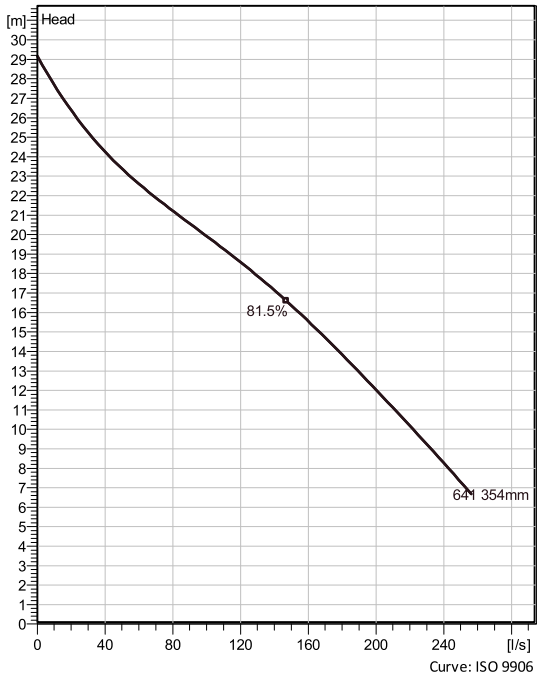


NT 3202 MT 3~ 641

Patented self cleaning semi-open channel impeller, ideal for pumping in waste water applications. Modular based design with high adaptation grade.

Technical specification

Curves according to: Water, pure Water, pure [100%],4 °C,1 kg/dm³,1.569 mm²/s



Curve: ISO 9906

Nominal (mean) data shown. Under- and over-performance from this data should be expected due to standard manufacturing tolerances.
Please consult your local Flygt representative for performance guarantees.

Configuration

Motor number
N3202.800 30-37-6IE-D IE3 44hp

Installation type
T - Vertical Permanent, Dry

Impeller diameter
354 mm

Discharge diameter
200 mm

Pump information

Impeller diameter
354 mm

Discharge diameter
200 mm

Inlet diameter
250 mm

Maximum operating speed
1185 1/min

Number of blades
2

Max. fluid temperature
40 °C

Material

Impeller
Grey cast iron

Project	Xylect-21386358	**Created by**			
Block	0	**Created on**	11/3/2023	**Last update**	11/3/2023

NT 3202 MT 3~ 641

Technical specification

Motor - General

Motor number N3202.800 30-37-6IE-D IE3 44hp	**Phases** 3~	**Rated speed** 1185 1/min	**Rated power** 33 kW
ATEX approved No	**Number of poles** 6	**Rated current** 44 A	**Stator variant** 3
Frequency 60 Hz	**Rated voltage** 600 V	**Insulation class** H	**Type of Duty** S1
Version code 800			

Motor - Technical

Power factor - 1/1 Load 0.76	**Motor efficiency - 1/1 Load** 94.5 %	**Total moment of inertia** 0.629 kg m²	**Starts per hour max.** 30
Power factor - 3/4 Load 0.68	**Motor efficiency - 3/4 Load** 94.8 %	**Starting current, direct starting** 325 A	
Power factor - 1/2 Load 0.55	**Motor efficiency - 1/2 Load** 94.3 %	**Starting current, star-delta** 108 A	

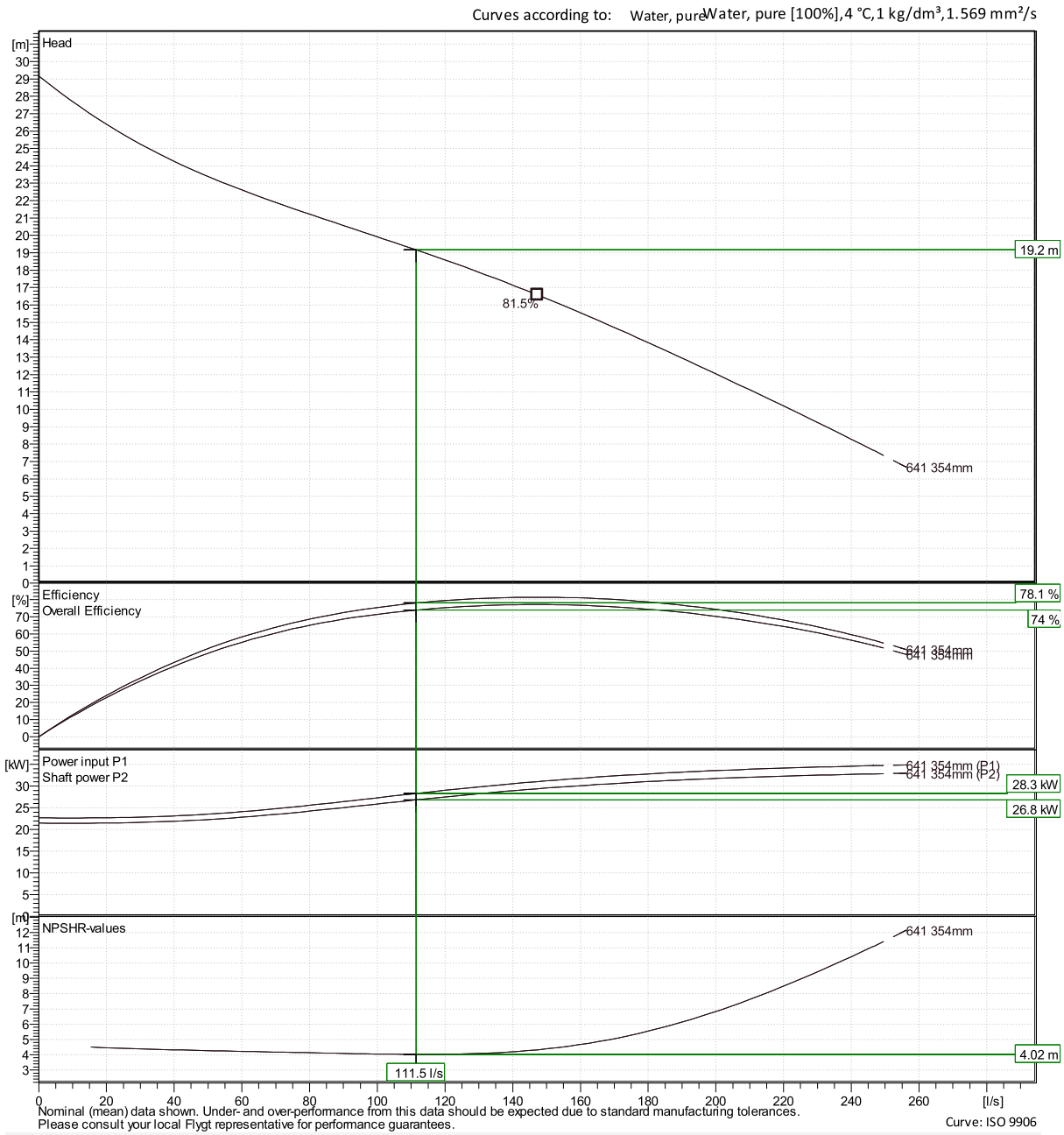
Project	Xylect-21386358	**Created by**			
Block	0	**Created on**	11/3/2023	**Last update**	11/3/2023

NT 3202 MT 3~ 641

Performance curve

Duty point

Flow	Head
111 l/s	19.2 m



Nominal (mean) data shown. Under- and over-performance from this data should be expected due to standard manufacturing tolerances.
Please consult your local Flygt representative for performance guarantees.

Curve: ISO 9906

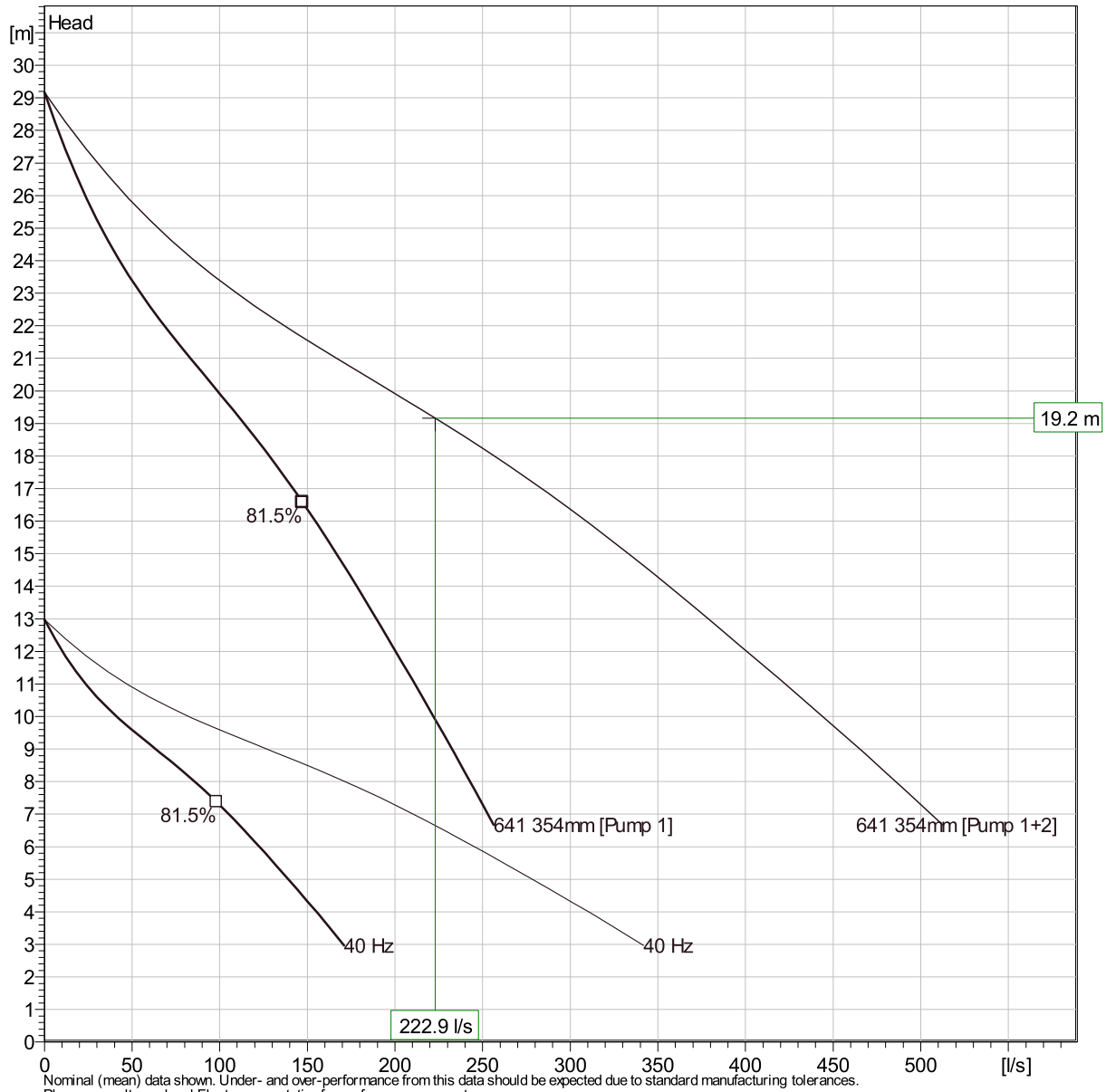
Xylect-21386358

0 **Created on** 11/3/2023 **Last update** 11/3/2023

NT 3202 MT 3~ 641

Duty Analysis

Curves according to: Water, pure [100%] ; 4°C; 1kg/dm³; 1.569mm²/s



Nominal (mean) data shown. Under- and over-performance from this data should be expected due to standard manufacturing tolerances.
Please consult your local Flygt representative for performance guarantees.

Operating characteristics

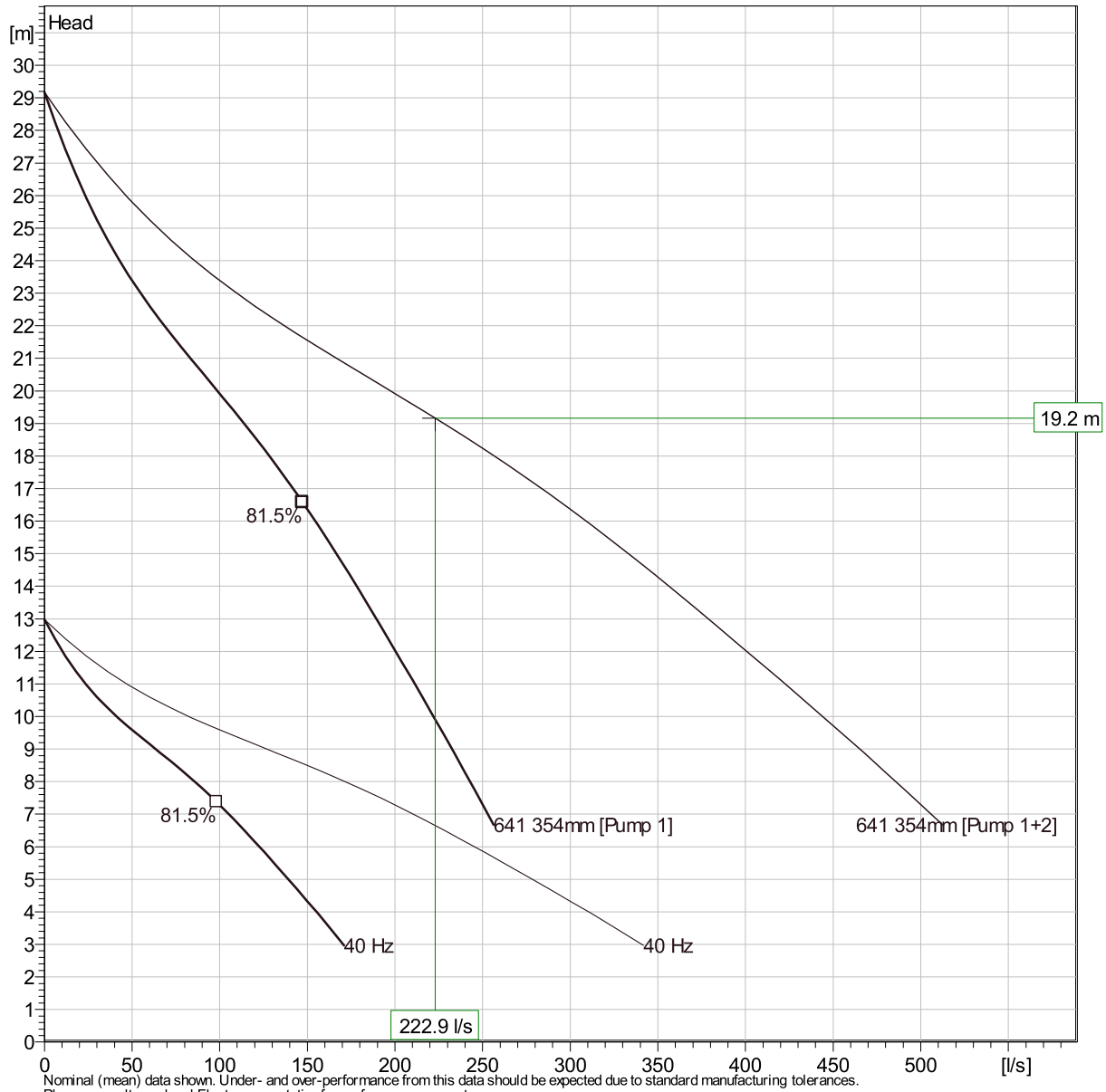
Pumps / Systems	Flow	Head	Shaft power	Flow	Head	Shaft power	Hydr.eff.	Spec. Energy	NPSHre
	l/s	m	kW	l/s	m	kW		kWh/l	m
2 / 3	172	14.5	30.7	345	14.5	61.4	79.8 %	5.23E-5	5.16
1 / 3	246	7.71	32.8	246	7.71	32.8	56.7 %	3.92E-5	11
2 / 2	96.5	20.1	25.6	193	20.1	51.2	74.5 %	7.77E-5	4.06

Project		**Created by**			
Block	Xylect-21386358	**Created on**	11/3/2023	**Last update**	11/3/2023

NT 3202 MT 3~ 641

Duty Analysis

Curves according to: Water, pure [100%] ; 4°C; 1kg/dm³; 1.569mm²/s



Nominal (mean) data shown. Under- and over-performance from this data should be expected due to standard manufacturing tolerances.
Please consult your local Flygt representative for performance guarantees.

Operating characteristics

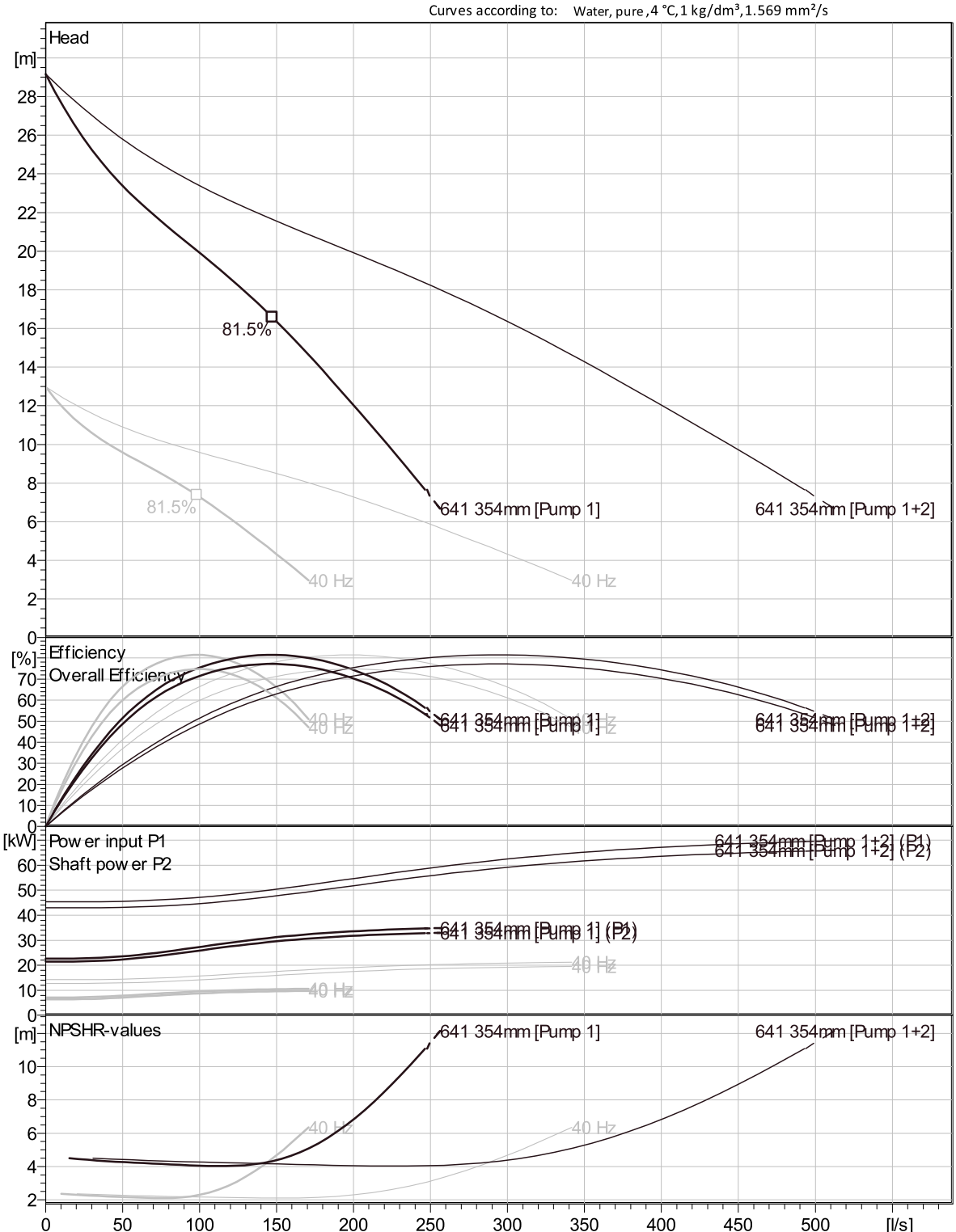
Pumps / Systems	Flow	Head	Shaft power	Flow	Head	Shaft power	Hydr.eff.	Spec. Energy	NPSHre
	l/s	m	kW	l/s	m	kW		kWh/l	m
1 / 2	142	17	29	142	17	29	81.4 %	6.02E-5	4.22
2 / 1	111	19.2	26.8	223	19.2	53.7	78.1 %	7.06E-5	4.02
1 / 1	153	16.1	29.7	153	16.1	29.7	81.4 %	5.7E-5	4.46

Project		**Created by**			
Block	Xylect-21386358	**Created on**	11/3/2023	**Last update**	11/3/2023

NT 3202 MT 3~ 641

VFD Curve

Curves according to: Water, pure ,4 °C,1 kg/dm³,1.569 mm²/s



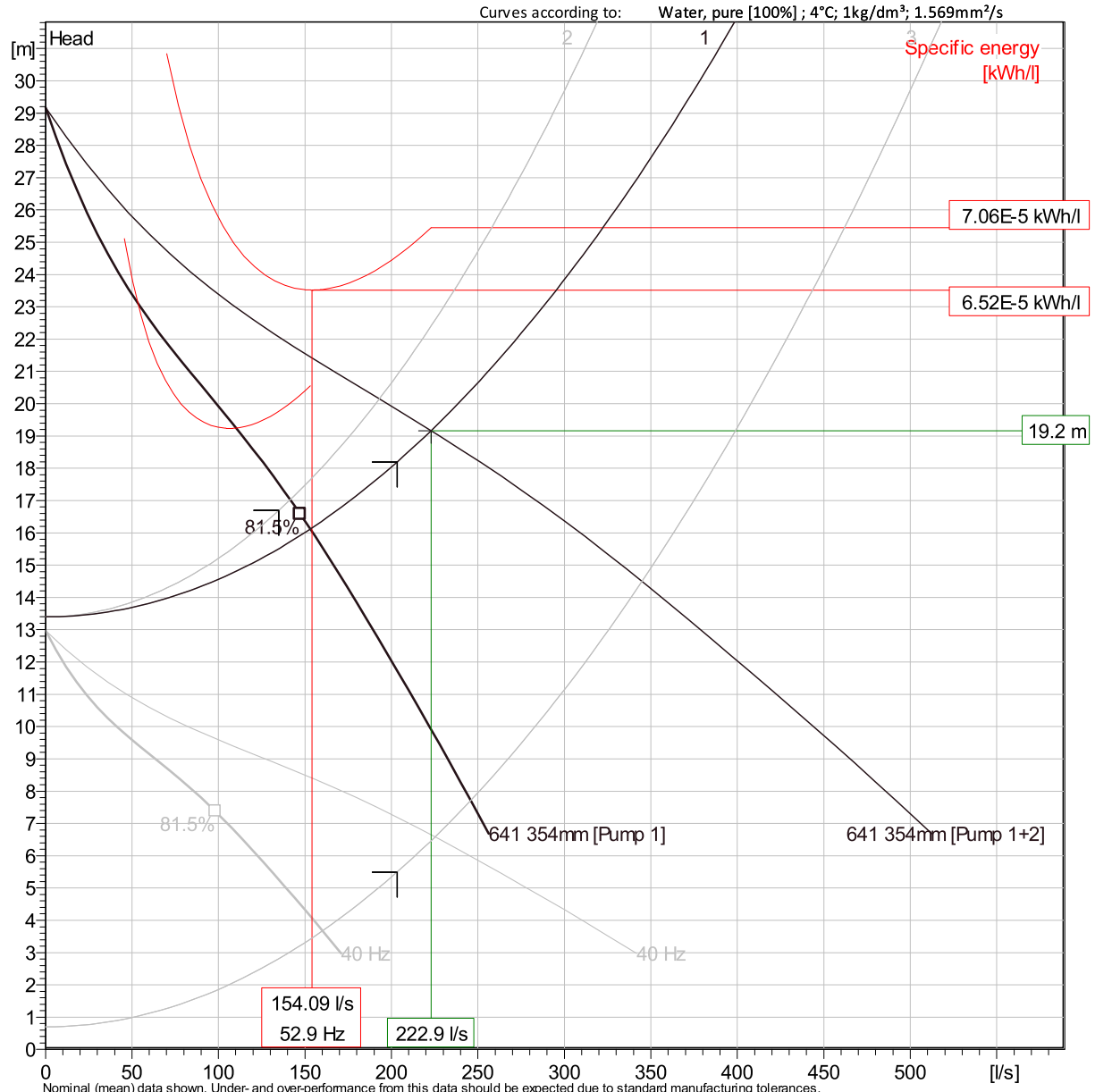
Nominal (mean) data shown. Under- and over-performance from this data should be expected due to standard manufacturing tolerances.
Please consult your local Flygt representative for performance guarantees.

Curve: ISO 9906

Project	Xylect-21386358	**Created by**			
Block	0	**Created on**	11/3/2023	**Last update**	11/3/2023

NT 3202 MT 3~ 641

VFD Analysis



Nominal (mean) data shown. Under- and over-performance from this data should be expected due to standard manufacturing tolerances.
Please consult your local Flygt representative for performance guarantees.

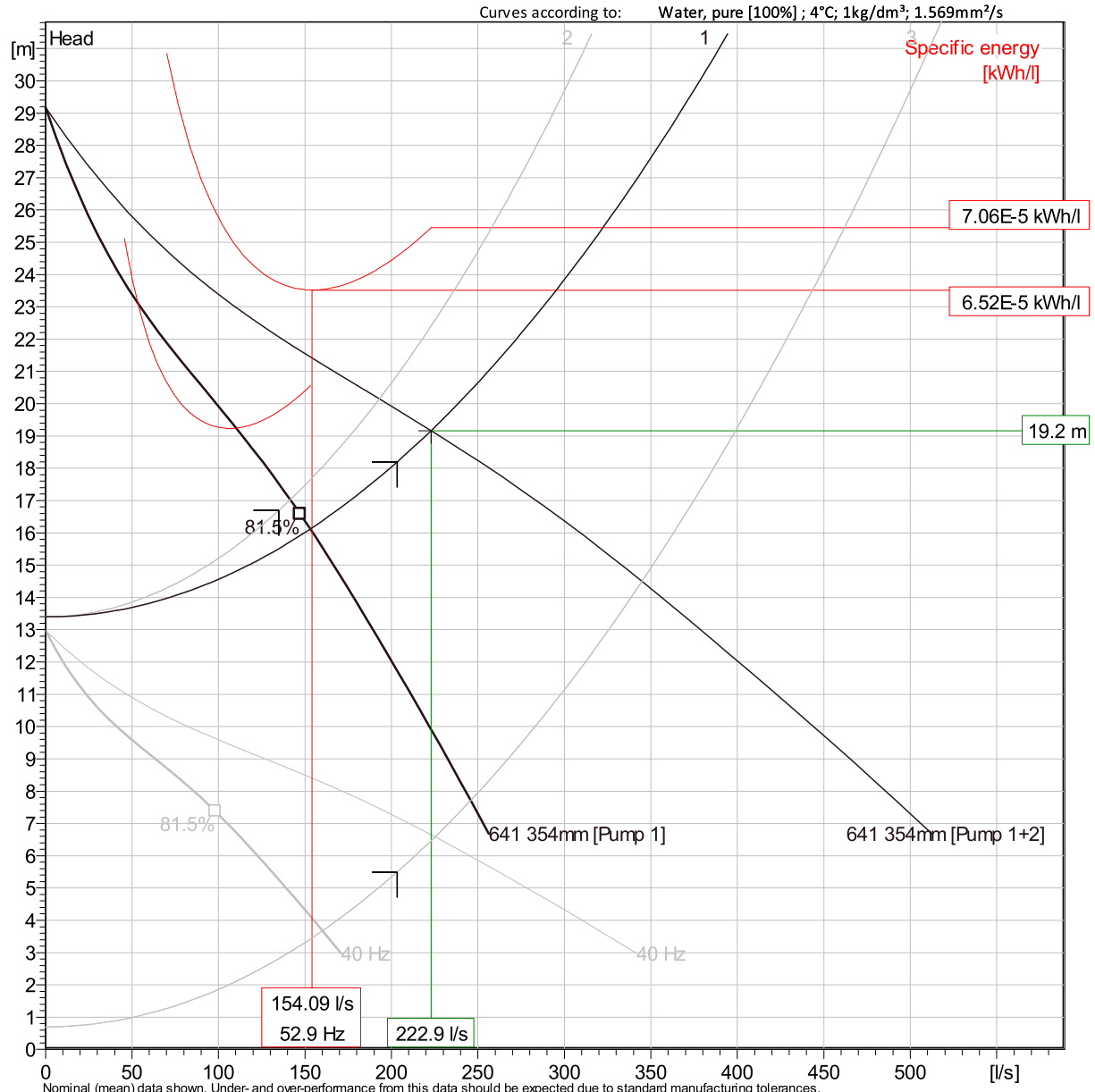
Operating Characteristics

Pumps / Systems	Frequency	Flow	Head	Shaft power	Flow	Head	Shaft power	Hydr.eff.	Specific energy	NPSHre
		l/s	m	kW	l/s	m	kW		kWh/l	m
2 / 3	60 Hz	172	14.5	30.7	345	14.5	61.4	79.8 %	5.23E-5	5.16
2 / 3	40 Hz	113	6.58	9.05	225	6.58	18.1	80.3 %	2.43E-5	2.61
1 / 3	60 Hz	246	7.71	32.8	246	7.71	32.8	56.7 %	3.92E-5	11
1 / 3	40 Hz	160	3.67	9.69	160	3.67	9.69	59.6 %	1.82E-5	5.45

Project	Xylect-21386358	**Created by**			
Block	0	**Created on**	11/3/2023	**Last update**	11/3/2023

NT 3202 MT 3~ 641

VFD Analysis



Nominal (mean) data shown. Under- and over-performance from this data should be expected due to standard manufacturing tolerances.
Please consult your local Flygt representative for performance guarantees.

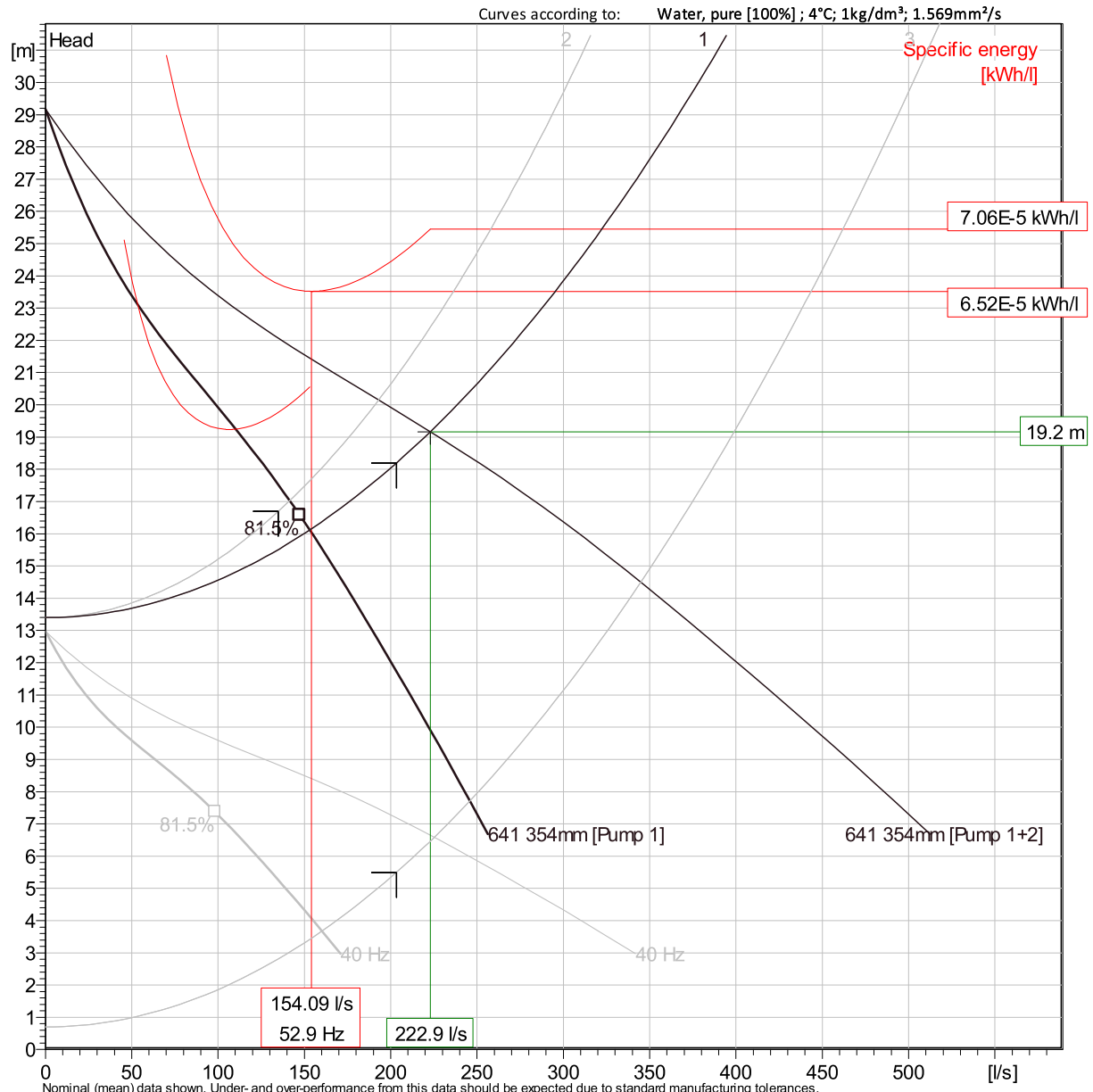
Operating Characteristics

Pumps / Systems	Frequency	Flow	Head	Shaft power	Flow	Head	Shaft power	Hydr.eff.	Specific energy	NPSHre
		l/s	m	kW	l/s	m	kW		kWh/l	m
2 / 2	60 Hz	96.5	20.1	25.6	193	20.1	51.2	74.5 %	7.77E-5	4.06
2 / 2	40 Hz									
1 / 2	60 Hz	142	17	29	142	17	29	81.4 %	6.02E-5	4.22
1 / 2	40 Hz									

Project	Xylect-21386358	**Created by**			
Block	0	**Created on**	11/3/2023	**Last update**	11/3/2023

NT 3202 MT 3~ 641

VFD Analysis



Nominal (mean) data shown. Under- and over-performance from this data should be expected due to standard manufacturing tolerances.
Please consult your local Flygt representative for performance guarantees.

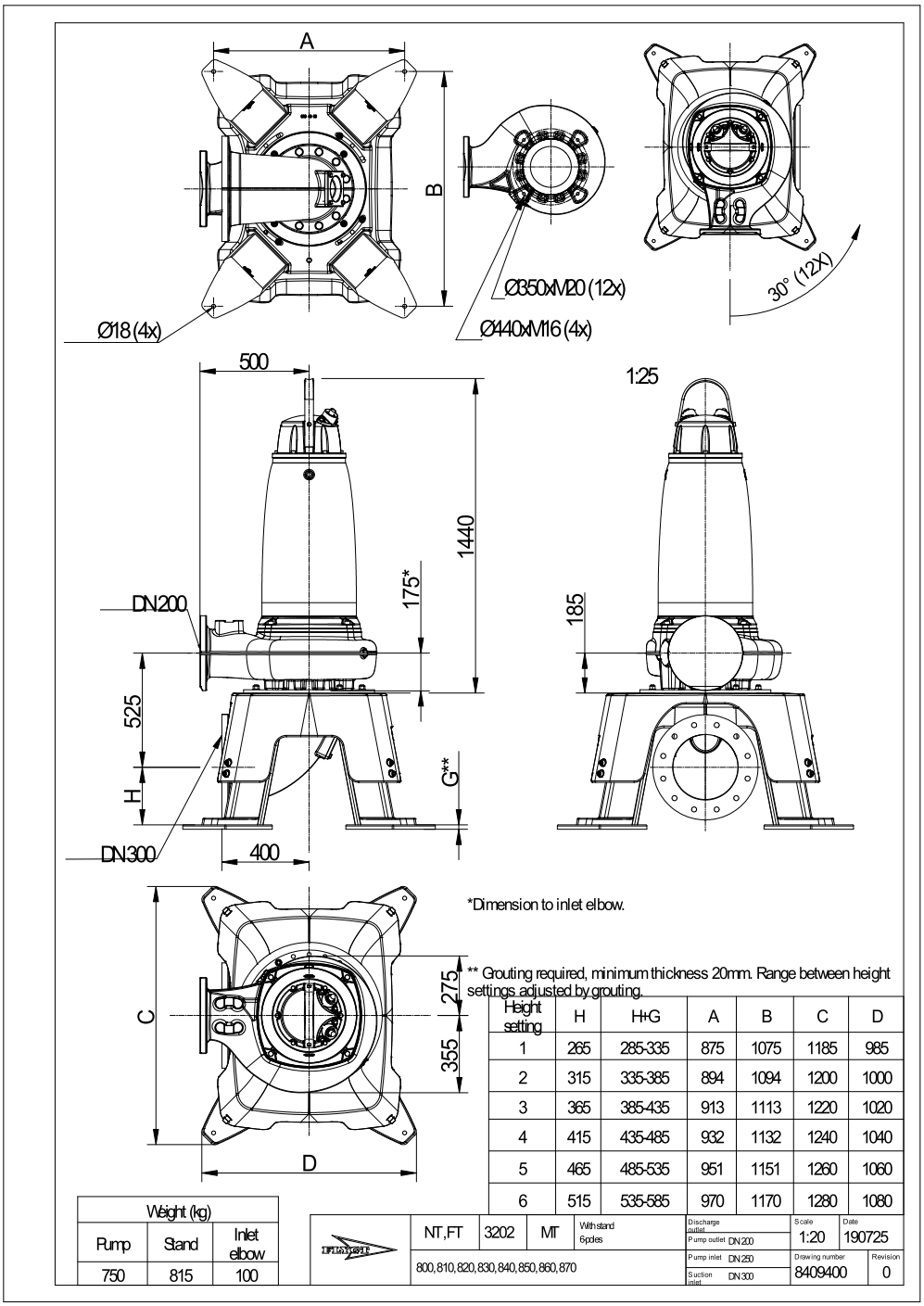
Operating Characteristics

Pumps / Systems	Frequency	Flow	Head	Shaft power	Flow	Head	Shaft power	Hydr.eff.	Specific energy	NPSHre
		l/s	m	kW	l/s	m	kW		kWh/l	m
2 / 1	60 Hz	111	19.2	26.8	223	19.2	53.7	78.1 %	7.06E-5	4.02
2 / 1	40 Hz									
1 / 1	60 Hz	153	16.1	29.7	153	16.1	29.7	81.4 %	5.7E-5	4.46
1 / 1	40 Hz									

Project	Xylect-21386358	**Created by**			
Block	0	**Created on**	11/3/2023	**Last update**	11/3/2023

NT 3202 MT 3~ 641

Dimensional drawing



Height setting	H	H+G	A	B	C	D
1	265	285-335	875	1075	1185	985
2	315	335-385	894	1094	1200	1000
3	365	385-435	913	1113	1220	1020
4	415	435-485	932	1132	1240	1040
5	465	485-535	951	1151	1260	1060
6	515	535-585	970	1170	1280	1080

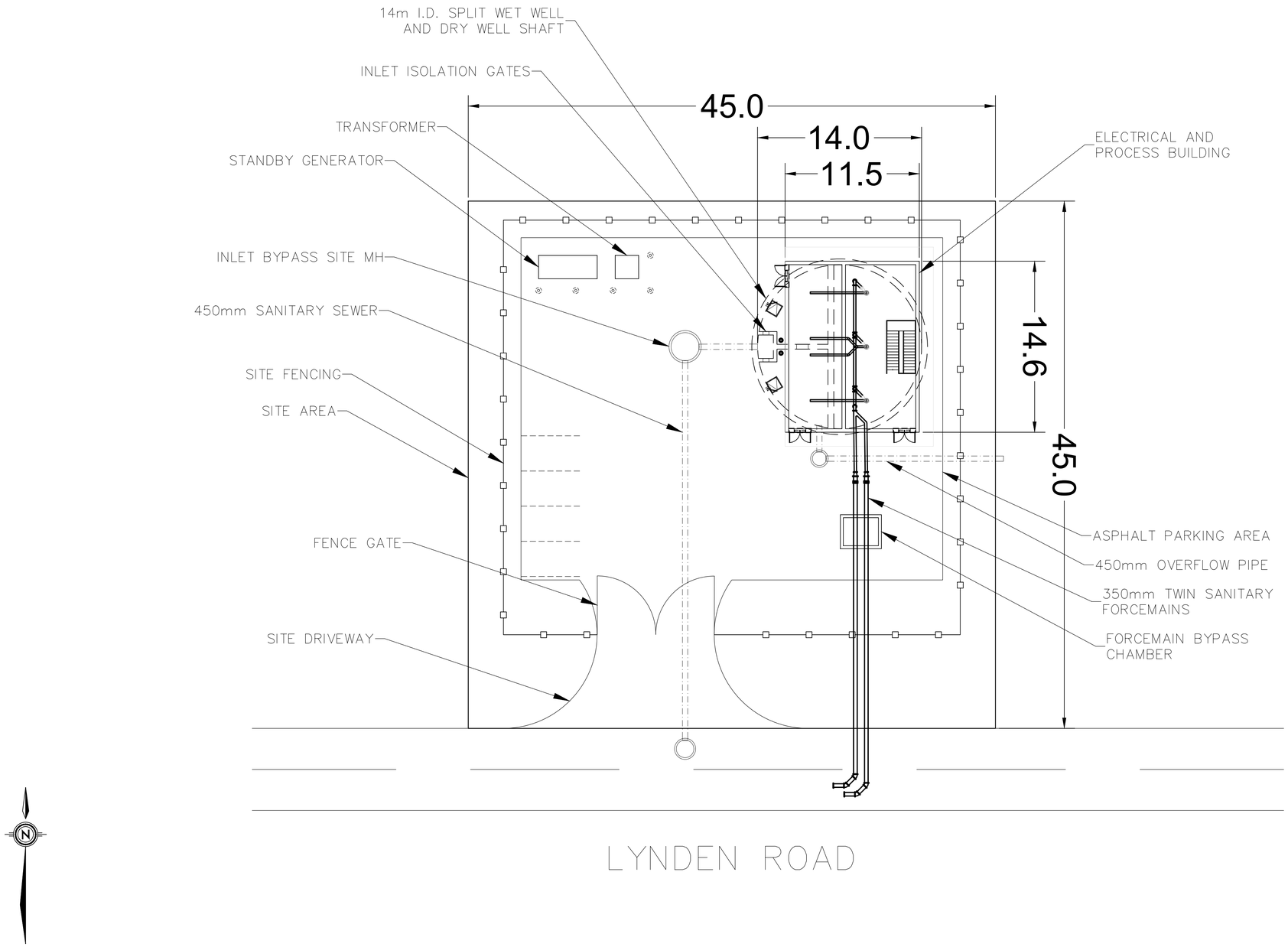
Weight (kg)		
Pump	Stand	Inlet elbow
750	815	100

NT,FT	3202	MT	Withstand 6poles	Discharge outlet	Scale 1:20	Date 190725
800,810,820,830,840,850,860,870				Pump outlet DN200		
				Pump inlet DN250	Drawing number 8409400	Revision 0
				Suction inlet DN300		

Project	Xylect-21386358	**Created by**			
Block	0	**Created on**	11/3/2023	**Last update**	11/3/2023

APPENDIX 4

Conceptual Site Plan Drawing



2m 0 4m 8m

1: 200

NO.	DATE	NAME	REVISIONS
A	2023.11.07	ET	ISSUED FOR CONCEPTUAL DESIGN

DESIGNED: ET
DRAFTED: AC
CHECKED: ET
APPROVED: ET

SCALE
BAR IS 25 mm ON ORIGINAL DRAWING
0 mm — 25 mm
IF NOT 25mm ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

arva | R.V. Anderson Associates Limited
engineering • environment • infrastructure

RVA Project No.
226497

LYNDEN GARDEN BLOCK PS

CONTRACT NUMBER: XX-XXXX-XX
DRAWING NUMBER: XXX

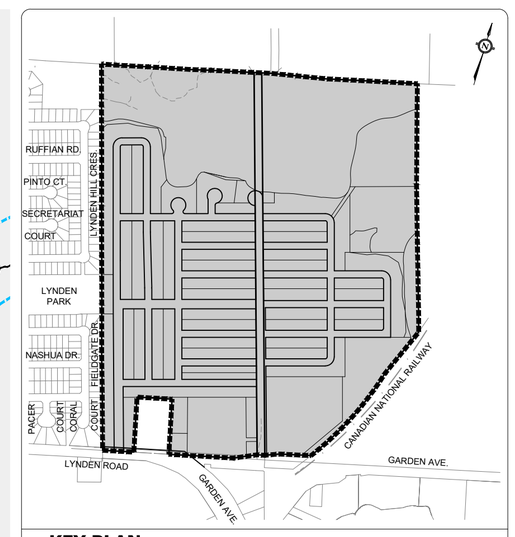
CIVIL
CONCEPTUAL
GENERAL SITE PLAN

SHEET NUMBER: X OF X

File: R:\2022\226497 - Sorbara Group-Lynden SPS\10 CAD\dwg\01 Linear\03 Design\Sorbara-Brantford SPS - Circular W Border.dwg
Plot: 2023-11-07 5:47 PM ####

APPENDIX 5

Lynden Garden Block Subdivision Design Drawings



KEY PLAN
N.T.S.

LYNDEN HILL CRESCENT
RUFFIAN ROAD
PINTO COURT
SECRETARIAT COURT
LYNDEN HILL CRESCENT
FIELDGATE DRIVE
NASHUA DRIVE
FIELDGATE DRIVE
FIELDGATE DRIVE
PACER COURT
CORAL COURT
LYNDEN ROAD
LYNDEN ROAD
GARDEN AVENUE
CANADIAN NATIONAL RAILWAY
CANADIAN NATIONAL RAILWAY
PARK
7456 POP

LEGEND

- LIMIT OF DEVELOPMENT
- PROPOSED SANITARY SEWER
- PROPOSED SANITARY FORCEMAIN
- PROPOSED SANITARY SEWER BY OTHERS
- EXISTING SANITARY SEWER
- PROPOSED SANITARY PUMP STATION
- SAN.MH5A / TOP 90.75m / S 85.00m / N 85.00m / E 85.00m — SANITARY MANHOLE ID; PROPOSED GROUND ELEVATION; PROPOSED SEWER OBVERTS
- SANITARY DRAINAGE BOUNDARY
- 0.32ha / 50 | 16 — DRAINAGE AREA (Ha.); POPULATION; # OF UNITS / OR POPULATION PER HECTARE (p/Ha.)
- FUTURE / EXISTING DEVELOPMENT LANDS

BENCHMARK
ELEVATIONS ARE RELATED TO GEODETIC DATUM AND ARE DERVIED FROM THE MNR
BENCHMARK No. 1196U861
ELEVATION = 208.33

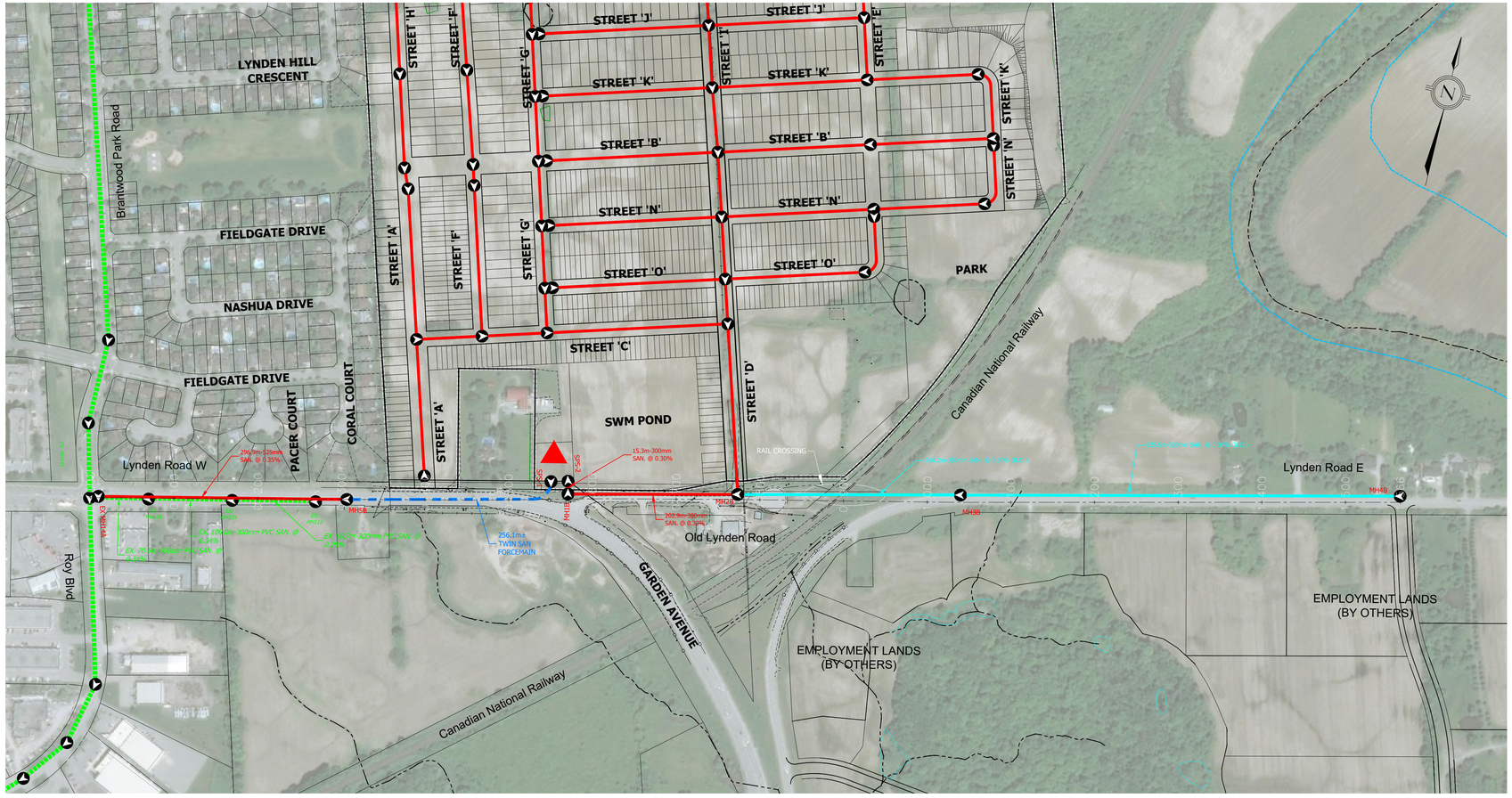
Urbantech® Consulting
A Division of Leighton-Zec West Ltd.
2030 Bristol Circle, Suite 105
Oakville, ON. L6H 0H2
TEL 905.829.8818 • urbantech.com

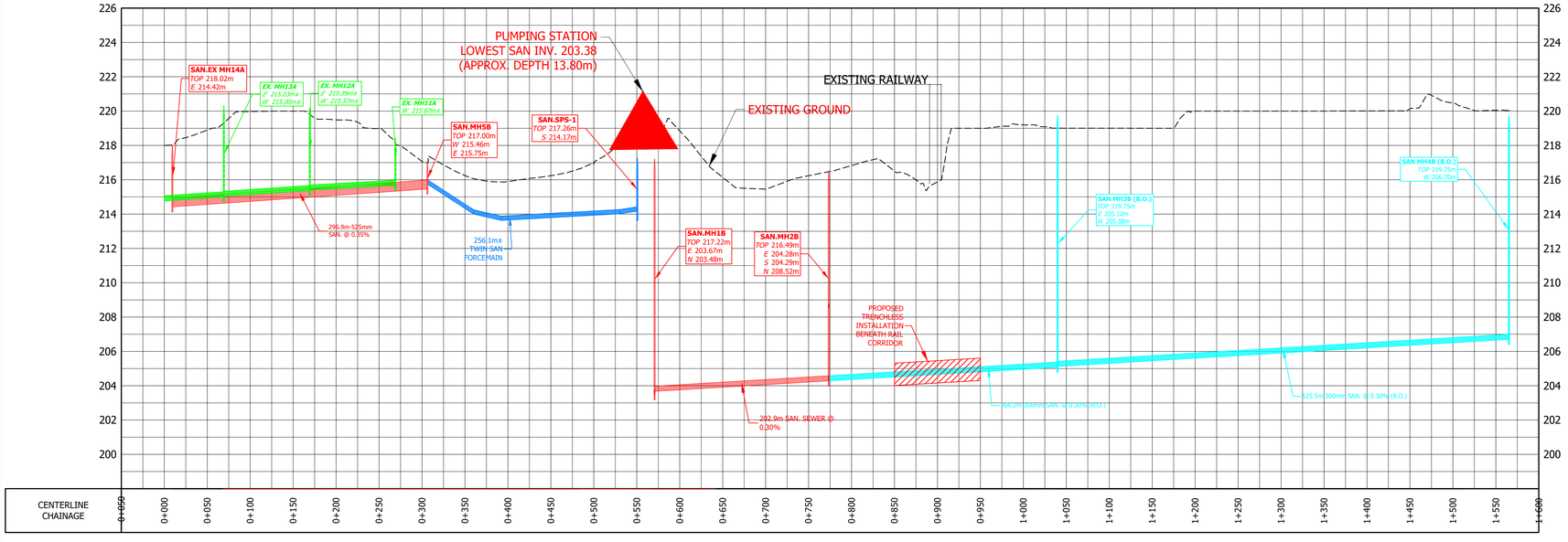
299 LYNDEN ROAD
CITY OF BRANTFORD

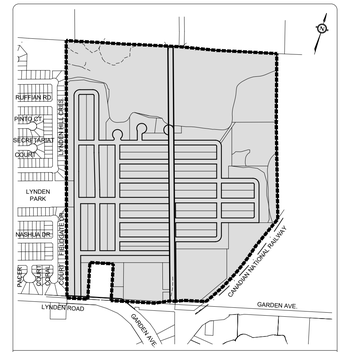
SANITARY DRAINAGE CONCEPT

PROJECT No.	DATE	SCALE	DWG No.
19-617	OCT 2022	1:2000	**SAN-1**

F:\PROJECTS\19-617 (299 LYNDEN ROAD -SOBARA BRANTFORD)\DRAWINGS\PRELIMINARY ENGINEERING & FIGURES\BSS\SAN-3_SANITARY CONCEPT.DWG







LEGEND

- 220.00 — EXISTING CONTOURS
- EXISTING SANITARY SEWER
- GRAVITY SANITARY SEWER
- GRAVITY SANITARY SEWER BY OTHERS
- PUMPING STATION
- TWIN FORCEMAIN LAYOUT

BENCHMARK
ELEVATIONS ARE RELATED TO GEODETIC DATUM AND ARE DERVIED FROM THE MNR BENCHMARK No. 11960861
ELEVATION = 208.33

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A Division of Leighton-Zec West Ltd.
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Oakville, ON. L6H 0H2
TEL 905.829.8818 • urbantech.com

299 LYNDEN ROAD
CITY OF BRANTFORD

EAST EXPANSION LANDS
PUMPING STATION

PROJECT No.	DATE	SCALE	DWG No.
19-617	APR. 2022	H: 1:3,000 V: 1:150	SAN-EXT

F:\PROJECTS\19-617 (299 LYNDEN ROAD -SOBARA BRANTFORD)\DRAWINGS\PRELIMINARY ENGINEERING & FIGURES\850\SAN-EXT_OPTION 2.DWG