Intake, Raw Water Pump Station, and Transmission Mains

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COPY TO: Regional District of Nanaimo

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DATE: October 21, 2014

PROJECT NUMBER: 476148

1.0 Introduction

1.1 Scope

To meet regulatory requirements and expand the jointly owned water system serving the City of Parksville and the Regional District of Nanaimo (RDN), the Englishman River Water Service (ERWS) is developing a new river water supply coupled with Aquifer Storage and Recovery (ASR). This innovative approach meets the ERWS's mission for "An Environmentally Sensitive Use of Water to Improve Fish Habitat and Domestic Water Supply."

Work carried out previously by other consultants includes water quality monitoring, water treatment pilot testing, and preparation of a conceptual design for the project. Pilot testing of the ASR is ongoing and expected to be completed by the beginning of 2014.

The purpose of this Technical Memorandum (TM) is to confirm the design basis, present proposed design alternatives, and recommend a design for the raw water intake, pump station, and transmission main to the Englishman River Water Treatment Plant (WTP).

1.2 Existing System and Proposed Development

The Comparison of Intake and Water Treatment Plant Siting Options report prepared by Associated Engineering in 2011 describes the past and proposed development of the existing Englishman River water system.

Figure 1-1 shows the location of the existing drinking water infrastructure. In brief, drinking water is currently derived from municipal wells and an intake in the Englishman River. Treatment is limited to chlorination of the river water.

With the limited availability of water supply sources in the area, the Arrowsmith dam is a critical element of the water supply system. The dam collects and stores water during the winter for release back to the Englishman River during the summer for fisheries enhancement and drinking water use.

The proposed development of the ERWS is intended to address the City of Parksville's and RDN's need for additional drinking water, and the Vancouver Island Health Authority's (VIHA) requirement for additional water treatment by December 16, 2016. This project will involve design and construction of:

- A surface water intake on the Englishman River to replace the existing intake and raw water pump station
- A membrane filtration WTP
- Watermain upgrades and installation on new water supply lines

Development of ASR wells are also part of the overall project; the ASR design is currently being completed by Associated Engineering under a separate contract.

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The ASR wells have an estimated potential capacity of 15 ML/d, and will allow treated water from the new WTP to be pumped into an aquifer during the winter months and stored until the summer when water demands are at their highest. As such, they will provide a third source of supply to supplement the river intake, in addition to the existing groundwater wells which will remain in operation after the WTP has been commissioned.

1.3 References

The following reports and documents were reviewed during the preparation of this TM:

1. Comparison of Intake and Water Treatment Plant Siting Options, Associated Engineering, May 2011
2. Site Development – Water Transmission and Distribution, Koers & Associates Engineering Ltd., May 2011
3. Arrowsmith Water Service Englishman River Water Intake, Treatment Facilities and Supply Mains, Phase 1 – Conceptual Planning, Budgeting and Scheduling, Associated Engineering, Kerr Wood Leidal, Koers, April 2011
4. Environmental Assessment of Alternative Water Intake Sites in Englishman River, LGL Ltd., May 2010
5. British Columbia Building Code, 2012
6. Flood Hazard Area Land Use Management Guidelines, Ministry of Environment, 2004
7. Freshwater Intake End-of-Pipe Fish Screen Guidelines, Department of Fisheries and Oceans, 1995
8. WorkSafeBC Occupational Health and Safety Regulation

2.0 Design Basis

This section details the proposed design basis for the intake, raw water pump station, raw water transmission main, and access road. The design basis was formulated using industry standards, best practices, and regulatory requirements; where applicable, specific documents have been referenced in this section. At the project chartering and intake site review meeting, the following project objectives were presented and agreed upon by ERWS:

- Acceptable to the public
- Cost-effective solutions
- Facilities fit into the surrounding environment
- Facilities are simple to operate
- Easy access from the WTP to the pump station and intake

These project objectives were also taken into consideration for the design basis.

2.1 General

2.1.1 Raw Water Demands and Phasing

The Ministry of Forest, Lands and Natural Resource Operations (MFLNO) has approved the proposed water withdrawal and point of diversion from the Englishman River through the conditional water license (C129170) that was issued on January 17, 2013 and is included as Appendix A. The license allows for withdrawal of flows up to 48 ML/d, which is the ultimate capacity of the new intake and water supply system to the WTP.

However, given the uncertainty in actual future water demands and the potential for ASR to supplement future water demand, the ERWS has decided to install pumping capacity at the intake to withdraw up to 28.8 ML/d (0.33 m^3/s) at the current time. This maximum rate is based on nominal maximum daily average demand of 24 ML/d (0.28 m^3/s) with an allowance for +/-20% instantaneous peak flow variation to account for fluctuations in flow rate for the water treatment plant process. It is understood that application for regulatory approvals for the intake are based on maximum withdrawal rate of 28.8 ML/d with the understanding that any future increase in withdrawal capacity will trigger an additional approval process in

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the future. The ultimate design flow of 48 ML/d is shown in this memorandum for information purposes only.

Providing a cost-effective solution was identified as one of the critical success factors at the project chartering meeting with ERWS. An effective phasing strategy will minimize costs by evaluating capital costs in the first phase against potential savings in future phases. Table 2-1 shows the proposed sizing and phasing of the intake, pump station, transmission mains, and WTP to ultimate build out.

TABLE 2-1
Proposed Sizing and Phasing of Infrastructure

	Capacity	
	Initial Phase, 2016-2035	**Ultimate Phase, 2036-2050**
Raw Water Flow		
Intake Screen	28.8	48
Raw Water Pump Station	28.8	48
Raw Water Supply Main to WTP[a]	48	48

[a] WTP waste flows are expected to be approximately 1%.

This phasing strategy will be practical to construct and matches community spending with needs in an affordable manner. For instance, the raw water main from intake to WTP will be designed to carry the ultimate design flow of 48 ML/d, which is greater than the maximum capacity of the intake pumps at 28.8 ML/d, as increasing capacity of the raw water main would be more costly and disruptive in the future.

2.1.2 Seismic Requirements

The intake and raw water pump station will be designed to the 2012 BC Building Code which designates water treatment facilities as post-disaster structures.

2.1.3 Flood Protection Level

The flood protection level is based on the Ministry of Environment (MOE) *Flood Hazard Area Land Use Management Guidelines (2004).* This guideline recommends a freeboard of 0.6 m over the 200 year peak flood for public utilities; however, due to the “flashy” nature of the Englishman River and the potential for debris, a freeboard of 1.0 m is recommended.

The 200 year peak flood level was updated as part of this project. Details of this analysis can be found in TM2A Intake Hydrology and Hydraulics.

2.2 Intake

2.2.1 Location

The river reach upstream of the Island Highway (Highway 19) bridge has been identified as the most suitable location for the proposed raw water intake. This is based on a thorough and systematic constraint mapping and detailed site evaluation carried out as part of the Comparison of Intake and Water Treatment Plant Siting Options study carried out by Associated Engineering in 2011. The constraint mapping to develop a short-list of candidate sites was based on equal weighting of the following criteria:

- Land use compatibility
- Heritage/archeological concerns
- Ecological impacts
- Geotechnical considerations
- Water system considerations (i.e., pumping versus gravity feed)

These criteria were reviewed along a 10 km stretch of the Englishman River from the river mouth to the confluence of the South Englishman River with the Englishman River mainstem. Through the constraint mapping process and preliminary screening of the short listed sites based on known site conditions, three

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sites were selected for detailed site evaluation. This detailed evaluation included preliminary environmental, geotechnical, and hydrological assessments as well as conceptual intake/WTP design and cost estimates. Of the three short listed sites, the reach upstream of the Island Highway Bridge is considered to provide the best compromise between limiting ecological impact, limiting contamination risk to municipal water supply as a result of spills, and limiting both capital and on-going operating costs.

In order to select the final intake location within the identified river reach, the following major and minor design criteria were developed for the purpose of evaluating the potential intake locations. These criteria were reviewed with ERWS prior to the site meeting on August 13, 2013.

Major Criteria

- *River Depth*: A minimum water depth less than 0.75 m will likely require a weir to extract the ultimate design flow of 48 ML/d. Installing a weir is less desirable because it increases cost and may affect recreational activities on the river. *River Crossing*: A river crossing will increase costs.
- *Land Ownership*: Land owned by the City of Parksville or the RDN is preferred. Private land ownership will potentially add costs and delays for land acquisition.
- *Site Access*: A site access road that connects the intake and pump station to the WTP is preferred.
- *Flood Protection*: The pump station must be above the 200 year flood plain elevation.
- *Recreation Impacts*: A site with fewer impacts to recreational activities along the river is preferred.

Minor Criteria

- *Existing Water Licenses*: A site without existing water licenses is preferred.
- *Geotechnical*: If rock excavation is required to construct the foundation of the intake and pump station at either site, it will significantly increase the cost. It should be noted that at this stage, minimal geotechnical work has been completed.
- *Riparian Habitat*: A site which requires less riparian habitat to be disturbed is preferable because of lower costs of compensation and potentially less onerous permitting requirements.

2.2.2 Screen

- Initial Design Flow = 28.8 ML/d (per Table 2-1)
- Average Approach Velocity = 0.11 m/s

The approach velocity is based on the DFO *Freshwater Intake End-of-Pipe Fish Screen Guideline (1995)* for subcarangiform fish (trout- or salmon-like swimming mode).

2.2.3 Minimum Downstream Conservation Flow

Historically, minimum conservation flows in the Englishman River have been based on recommendations made by DFO and MoE in response to the original water license application for Arrowsmith Dam and a proposed new intake on the Englishman River in 1992. Both DFO and MoE recommended a preferred minimum flow of 1.13 m^3/s be maintained through the summer from July to October with DFO recommending an absolute minimum of 0.71 m^3/s. MoE refined the preferred minimum flow stating that 1.13 m^3/s should be maintained at or above a 20-year return period drought condition. These minimum conservation flows have provided the basis for the current operating order for Arrowsmith Lake dam which requires specific minimum flows to be maintained at the Englishman River near Parksville Water Survey of Canada Gauge (WSC 08HB002).

Both of these downstream conservation flows requirements have been reviewed as part of a low flow aquatic habitat assessment carried out by LGL Ltd., outlined in the report prepared in October 2014. The LGL report recommended a series of revised minimum downstream conservation flows based on results of habitat simulation modelling. The downstream conservation flows used in the assessment are outlined in Table 2-2.

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TABLE 2-2
Recommended Downstream Conservation Flows Below Proposed Raw Water Intake

Scenario	Downstream Conservation Flow
Above Average Year	1.6 m^3/s
Below Average Year (2-year Return Period to 5-year Return Period Drought)	1.4 m^3/s
Dry Year (5-year Return Period to 20-year Return Period Drought)	1.2 m^3/s
Very Dry Year (greater than 20-year Return Period Drought)	0.9 m^3/s

Current conservation flow downstream of existing intake is 1.13 m^3/s for 20-year return period drought with absolute minimum of 0.71 m^3/s. Arrowsmith Dam was designed to maintain minimum preferred flow of 1.13 m^3/s up to 15-year return period drought condition with minimum flow of 0.9 m^3/s supported using syphon during periods of low lake levels.

2.2.4 Backwash System

- Maintenance: minimal labour requirements for maintenance activities

2.3 Raw Water Pump Station

2.3.1 Location

- Elevation: above the 200 year flood protection level of 17.3 m geodetic (including 1.0 m freeboard)
- Access: easy access to and from the intake and WTP
- Aesthetics: minimize view to recreational park users

2.3.2 Structure

- Expansion: able to accommodate future equipment and piping
- Maintenance: able to provide easy access for maintenance of pumps and equipment

2.3.3 Pump Type and Other Requirements

- Efficiency: cost and power savings through higher efficiency pump types or models
- Design Life: pumps shall last until the end of Phase 1 (20 years)
- Interior Noise Level: less than 78 dBA within the pump station for 8-hour exposure (WorkSafeBC limit is 85 dBA, lower limit is recommended for additional worker safety depending on equipment cost premium)
- Exterior Noise Level: less than the ambient noise level of Highway 19

2.3.4 Pump Sizing

- Initial Design Flow = 28.8 ML/d (per Table 2-1)
- Total Dynamic Head (TDH) = 55 m

Figure 2-1 shows the overall profile from the raw water intake to the WTP. Note that the TDH accounts for the raw water pumps providing pressure for the vortex sand separator, fine strainers, and primary-stage membranes at the WTP.

2.3.5 Mechanical Piping and Valves

- Working Pressure = 690 kPa
- Material: must be suitable for use with potable water (as per AWWA pipe material standards)

2.4 Raw Water Pipeline

2.4.1 Horizontal Alignment

- Length: minimize the overall length of pipeline required (to minimize capital cost)

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- Common Alignment: install the pipeline along same alignment as the access road, unless diverging will reduce installation costs
- Tree Removal: minimize impact on existing forested area as much as practical
- Buffer Area: leave a treed section of land between the Island Highway and the pipe alignment
- Right-Of-Ways: minimize encroachment on the existing Ministry of Transportation (MOT) and Island Corridor Foundation (ICF) rights-of-way (for the Island Highway #19 and the ICF Railway)
- Riparian Area: minimize detrimental impact on the Englishman River riparian area

2.4.2 Vertical Alignment

- Minimum Depth of Cover: must be sufficient to prevent frost and pipe damage from vehicle loading
- Maximum Grade: areas steeper than 10% require installation of a trench dam

2.4.3 Pipe Sizing

- Ultimate Design Flow = 48 ML/d (as per Table 2-1)
- Maximum Velocity = 2.0 m/s

2.4.4 Pipe Material

- Working Pressure = 690 kPa
- Seismic: joints must be fully restrained to provide for seismic reliability
- Material: must be suitable for use with potable water (as per AWWA pipe material standards)

2.5 Access Road

2.5.1 Horizontal Alignment

- Access: provide vehicle access to the intake pump station from the WTP
- Cut/Fill Balance: minimize the total volumes of cut and fill required for construction (to minimize capital cost)
- Slope Stability: minimize detrimental impact on the existing banks of the Englishman River (slope stability to be reviewed as part of the geotechnical report)
- Tree Removal: minimize impact on existing forested area as much as practical
- Buffer Area: leave a treed section of land between the Island Highway and the intake access road

2.5.2 Vertical Alignment

- Maximum grade = 8%
- Elevation: finished grade above the 200 year flood elevation including 1.0 m freeboard
- Vertical Clearance: minimum 5.0 m clearance from finished road grade to underside of railway and highway bridges (as per Ministry of Transportation and Infrastructure typical design guidelines)

2.5.3 Cross Section

- Design Vehicle: The road must accommodate a “rubber tire” crane for removal and installation of the pumps
- Road Structure: The road structure must support the design vehicle
- Road Surface: The road surface must have minimal maintenance requirements
- Road Drainage: The road cross section must be graded to shed water from its surface and prevent pooling of runoff from the hillside

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3.0 Preliminary Design

3.1 Intake

3.1.1 Location

Figure 3-1 shows the four potential intake locations that were previously identified at the conceptual planning stage. Site 1 is downstream of the E&N Railway bridge and Highway 19 bridge. Sites 2, 3, and 4 are all upstream of the bridges.

Site 1 offers the most straightforward construction and route to the WTP, but was eliminated to avoid any risk of contamination from transportation accidents immediately upstream of the intake. Site 4 was eliminated because it requires a longer route to the WTP and offers no other advantages over the other sites. The remaining Sites 2 and 3 were then evaluated and scored based on the criteria described in Section 2.2.1.

Table 3-1 compares Sites 2 and 3 using a scoring system which awards a full point for major criteria, a half point for minor criteria and no points for a tie. More points are better.

TABLE 3-1
Intake Location Comparison Matrix

Criteria	Site 2	Points	Site 3	Points
River Depth	~0.9 m	1	~0.4 m	0
River Crossing	Required	0	Not required	1
Land Ownership	Private / MOTI ROW	0	City Park	1
Site Access	Roundabout access to WTP	0	Direct access to WTP	1
Flood Protection	PS can be built above flood levels	0	PS can be built above flood levels	0
Recreation Impacts	None	1	Weir may be required in future	0.5
Existing Water Licenses	Yes[a]	0	No	0
Riparian Habitat[b]	Remove some vegetation	0.5	Remove mature vegetation	0
Geotechnical[c]	Sandstone bedrock	0	Glacial till over conglomerate bedrock	0.5
Total		**2.5**		**4.0**

[a] Existing water license at Site 2 has a withdrawal rate of less than 1 ML/d. Therefore, it is not expected to significantly affect the withdrawal rate for ERWS.

[b] Since vegetation must be removed from both sites, this criteria is not considered a major factor.

[c] This criteria will be promoted to the major category once more geotechnical information is available.

Based on this comparison and the final onsite review with ERWS and RDN staff, Site 3 is the preferred location for the new intake.

3.1.2 Screen

The intake screens will be designed to protect fish and other aquatic life at the intake, as well as prevent debris from entering the raw water supply. The ERWS has had ongoing maintenance issues with its existing infiltration gallery due to sand and gravel clogging the intake; therefore, this style of intake was not considered for the proposed intake structure.

The intake structure will be divided into two bays so one can be taken out of service for maintenance. There will be two screens per bay for a total of four screen panels. Figure 3-2 shows a plan view of the intake structure.

Based on the design parameters in Section 2.2.2, the proposed sizing and design of the intake screen is as follows:

- Number of Screen Panels = 4

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- Screen Slope = 1.5:1 (H:V)
- Effective Screen Length = 5.2 m
- Screen Opening Size = 2.54 mm
- Effective Depth = 0.60 m (maximum)
- Effective Screen Area = 5.6 m^2 (at maximum depth)
- Maximum Approach Velocity = 0.10 m/s

The detailed screen sizing calculations are summarized in Appendix B. The design screen area is 10% larger than what is required to maintain the maximum allowable approach velocity to account for potential accumulation of debris. The intake screen will be cleaned by an automated air backwash system as described in Section 3.1.3.

3.1.3 Backwash System

The backwash system consists of air piping at the intake and an air compressor located in the pump station. The air piping will be attached to the concrete intake structure as opposed to being welded to the intake screens. This will reduce the weight of the screen panels which will facilitate easier removal. Also, the air piping will not have to be disconnected if the screens are removed.

Screen cleaning will be automated and occur at regular intervals as required. The screen cleaning system will be sized to clear irregular debris loading with a maximum water surface differential across the screen (i.e. during high river levels). The air bursts will start from the upstream screen panel and continue downstream so material caught in one panel does not get trapped in an adjacent panel.

Sizing of the air piping and compressor will be completed at the detailed design stage. Seasonal manual inspections and cleaning will occur at the screen to avoid granular material buildup at the screen. Bed loads are expected to continue downstream past the intake because its location is currently stable and is designed with a geometry that closely matches the existing topography.

3.2 Pump Station

3.2.1 Location

Based on the topography around the intake location and the 200 year floodplain elevation, two alternatives for the pump station location and structure were considered:

- A raised structure which is built on top of the intake; and
- A setback structure built approximately 15 m north of the intake.

The first alternative involves integrating the pump station with the intake in a single structure at the river bank. The second alternative involves setting the pump station approximately 15 m north of the intake structure where the existing ground lies above the 200 year flood level.

Both alternatives would allow easy access to and from the intake and WTP. However, due to the height and steepness of the river bank, the first alternative would result in a much higher, more obtrusive structure; therefore, the second alternative is preferred and proposed for design. Figure 3-4 shows the location in plan, of the proposed location.

3.2.2 Structure

The pump station structure will be designed to accommodate the addition of future equipment and piping. There is little economic benefit to phasing the construction of the pump station structure due to the relatively small area that needs to be added to accommodate future works.

Some recommended features of the pump station are:

- Skylights for removal an re-installation of the pumps for maintenance and repair
- Twin supply lines from the intake with valves to allow isolation of half of the intake and pump station to be taken out of service for maintenance and repair

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- The pump station would house equipment which could potentially be damaged in a flood, including:
  - Electrical, instrumentation and controls equipment
  - Air compressor for backwashing the intake screens

Figure 3-5 shows the preliminary pump station layout.

3.2.3 Pump Type

Submersible and vertical turbine pumps were considered for this project. Submersible pumps are quieter than vertical turbine pumps given that they are located below the floor of the pump station. However, submersible pumps typically have lower efficiencies than vertical turbine pumps which means they will have a higher energy cost over the design life. Therefore, vertical turbine pumps are the preferred type and will be used.

The type of pump drive depends on the requirements of the WTP and the minimum withdrawal rate required. A Variable Frequency Drive (VFD) allows the raw water pumps to provide a fixed flow to the WTP under varying head conditions. In addition, the withdrawal rate of the pumps can be lowered as required to maintain required in-stream flow requirements. Therefore, the raw water pumps will be equipped with VFDs.

3.2.4 Pump Sizing

Three pumps will be installed in the initial phase with an additional pump installed in the ultimate phase. The proposed sizing including the total and firm capacity is shown in Table 3-2. Pump starting and ramp up procedures will be controlled to avoid rapid changes in the withdrawal rate. The pumps will be started one at a time at their low flow rate with flow gradually increased as needed to meet demand. A level sensor will be installed at the intake structure to monitor the river level during pump startup and normal operation.

TABLE 3-2
Proposed Pump Installation Phasing

Year	Initial Phase 2016-2035	Ultimate Phase 2036-2050	TDH m
Pump 1	9.5 ML/d	16 ML/d	55
Pump 2	9.5 ML/d	16 ML/d	55
Pump 3	19.3 ML/d	16 ML/d	55
Pump 4		16 ML/d	55
Total Capacity	28.8 ML/d	64 ML/d	
Firm Capacity[a]	19 ML/d	48 ML/d	
Raw Water Demand	24 ML/d	32 ML/d	

[a] Firm capacity assumes the largest pump is out of service

3.2.5 Mechanical Piping and Valves

The proposed material for the mechanical piping and valves will be Schedule 10S stainless steel.

3.2.6 Electrical Power Supply

The electrical power supply for the pump station and intake will be fed from the WTP. An underground electrical conduit is recommended from the WTP to the raw water pump station which will take advantage of common trench construction with the raw water pipeline.

3.3 Raw Water Transmission Main

3.3.1 Horizontal Alignment

The proposed transmission main alignment is shown on Figures 3-6 and 3-7. The transmission main will generally follow the centre of the proposed access road between the Island Highway (Highway 19) and the

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Esquimalt & Nanaimo Railway. The proposed transmission main alignment has received approval in principle from MOTI but must receive formal approval from MOTI and ICF during the next stage of design.

3.3.2 Vertical Alignment

The proposed transmission main profile is shown on Figures 3-6 and 3-7. The profile was selected using the following design rationale:

- The profile will rise continually from the raw water pump station to prevent sediment accumulation at low points
- In the section along the river (Station 0+000 to about 0+080), the crown of the pipe will be below natural grade to prevent damage to the pipe if the access road is damaged
- In the section between the MOTI and ICF ROWs, the main will be laid at approximately existing grade, and fill will be placed on top to get the required cover, eliminating the need for extensive shoring of the embankment fills during watermain installation

The steepest section of main will be less than 8%; therefore, trench dams should not be required.

The minimum depth of cover for municipalities in the south coast region ranges from 0.9 m to 1.2 m. Given that the access road is subject to minimal vehicle traffic, a minimum depth of cover of 0.9 m for the transmission main is proposed. This depth of cover will also be sufficient for frost protection.

The limited geotechnical information near the highway bridge fill and piers indicates that bedrock is within 1.0 m of the existing ground surface in some locations; therefore, rock blasting will likely be required to install the transmission main. This requirement will be confirmed upon completion of the geotechnical report for this project.

3.3.3 Pipe Sizing

Based on the design flow of 48 ML/d, an inside pipe diameter of 600 mm is proposed. This pipe size results in a maximum velocity of less than 2.0 m/s in the transmission main.

3.3.4 Pipe Material

City of Parksville Bylaw No. 1261 “Subdivision Servicing Bylaw” permits the use of ductile iron or polyvinyl chloride (PVC) pipe for watermains. However, the proposed pipe material for this application is 600 mm diameter (nominal) carbon steel due to the improved repairability and reliability gained with steel pipe.

A working pressure of 690 kPa has been assumed for the pipe. The working pressure for the transmission main will be confirmed once the pump sizing has been finalized. Standard schedule carbon steel pipe has a sufficiently high pressure rating to suit the working pressure.

3.3.5 Valves

Buried isolation (line) valves will be required immediately downstream of the pump station and immediately upstream of the water treatment plant. To minimize costs, the valves will be butterfly style. A 600 mm diameter gate valve is significantly more expensive than a butterfly valve of the same size (typically on the order of 5 times the cost). No additional valves are required on the transmission main.

3.4 Access Road

3.4.1 Horizontal Alignment

The preliminary horizontal alignment of the access road is shown on Figures 3-6 and 3-7. The road crest is at the 200-year flood construction level (FCL) from Station 0+000 to 0+080. The alignment crosses underneath the Highway 19 bridge, goes east up an existing access road between Highway 19 and the E&N Railway, and then goes north across the E&N Railway to the WTP site, crossing through both the MOTI and ICF ROW. The

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proposed alignment has received approval in principle from MOTI but must receive formal approval from MOTI and ICF during the next stage of design. The road will be gated at the rail crossing.

3.4.2 Vertical Alignment

The profile of the preliminary vertical alignment of the access road is shown on Figures 3-6 and 3-7. The maximum grade is less than 6% which will allow the design vehicle (rubber tire crane) to travel between the WTP and the pump station. The elevation gain between the intake and the WTP is approximately 13 m.

The vertical clearance between the proposed road surface elevation and the undersides of the highway and railway is in excess of 5 m, and will not pose a constraint to the placement of the access road.

The estimated volume of fill required to construct the road (based on 1 m of freeboard above the 200 year flood elevation) is approximately 2,100 m^3.

3.4.3 Cross Section

The typical road cross section is shown on Figure 3-7. The proposed road width of 5 m is sufficient for one way traffic for the design vehicle. The road crossfall will be sloped towards the downhill side such that surface flow will be able to run downhill towards the river.

The proposed road structure will consist of a minimum 300 mm thickness of 75 mm minus crushed gravel, capped with a minimum 100 mm thickness of 19 mm minus gravel. Some locations will require the roadway to be over-excavated in order to provide this minimum gravel thickness. The road structure will be confirmed upon completion of the geotechnical report.

In locations where pooling could occur (low points on the road profile), culverts will be installed to convey runoff under the road and onto the downhill side of the slope. It is anticipated that two culverts (approximately 10 to 15 m in length each) will be required. The cross section also shows a ditch on the inside edge of the road which will prevent runoff from the hillside from flowing across the road. The ditch will cross the road at one of the culvert locations.

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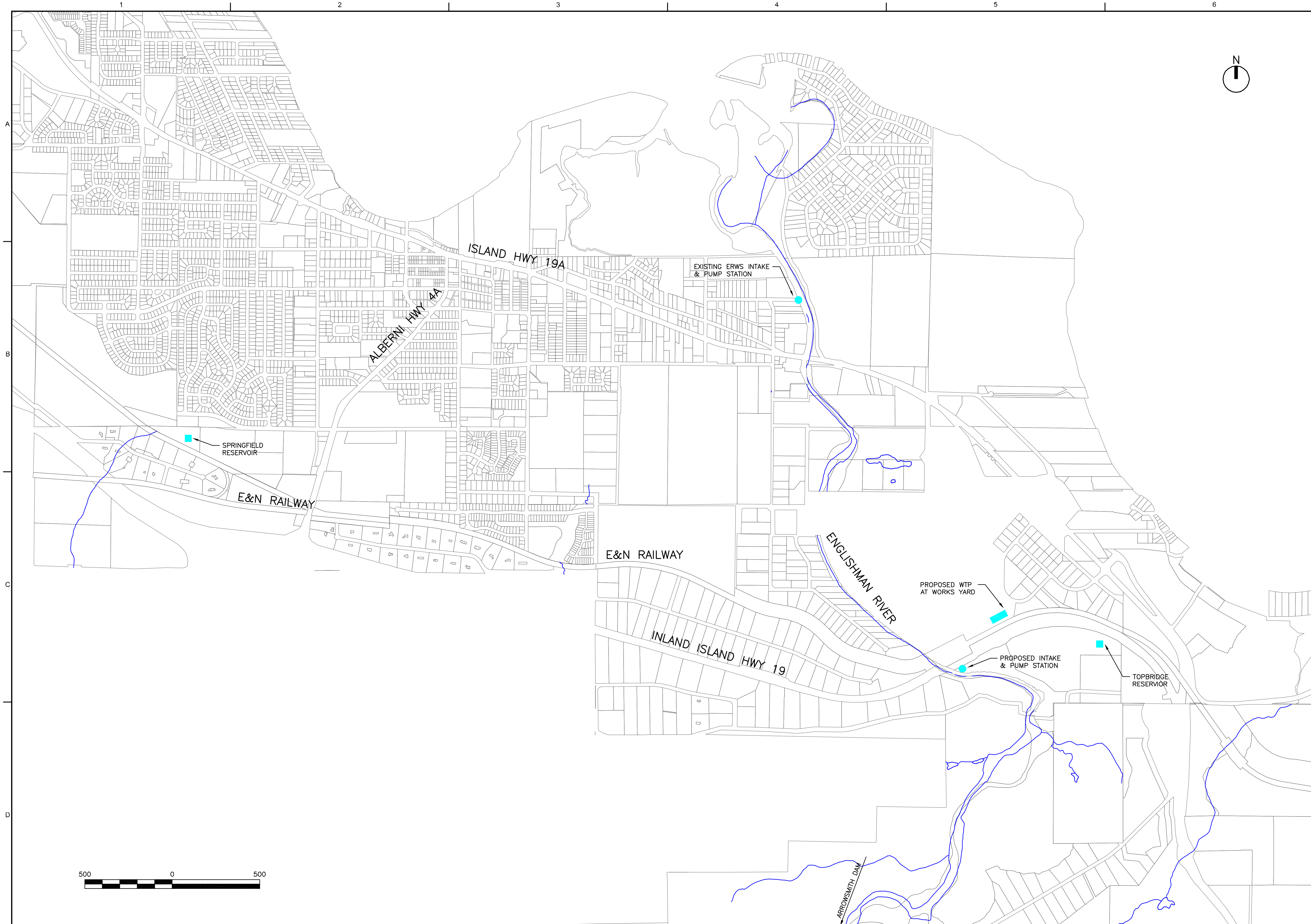
Figures



NO.	DATE	REVISION	BY	APVD

DSGN JC | DR JC | CHK LB | APVD

SEAL NAME

ENGLISHMAN RIVER WATER SERVICE
INTAKE, TREATMENT PLANT
AND SUPPLY MAINS

CIVIL

FIGURE 1-1
MAJOR WATER INFRASTRUCTURE LOCATION PLAN

1:20,000

VERIFY SCALE

BAR IS 25MM ON ORIGINAL DRAWING.
0 25MM

DATE	12/10/13
PROJ	476148
DWG	FIG 1-1
SHEET	SHT NO. of XXX

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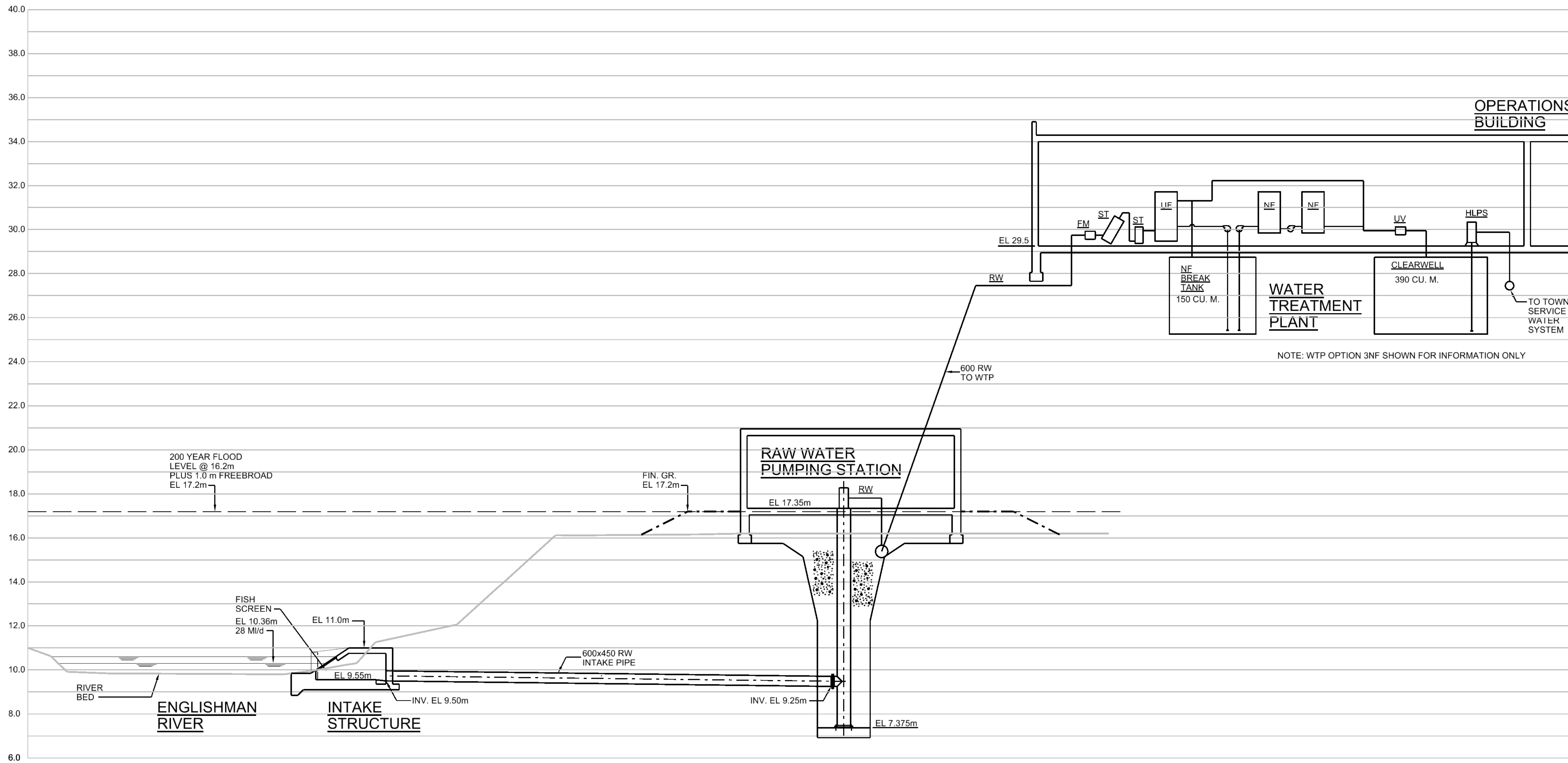

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A	05/12/14	ISSUED FOR PRE-DESIGN REVIEW		

DSGN J.GARCIA/K.MAINS | DR B.COOPER | CHK J.GARCIA | APVD B.ENGLESON

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englishman river WATER SERVICE

ENGLISHMAN RIVER WATER SERVICE INTAKE, TREATMENT PLANT AND SUPPLY MAINS

CH2MHILL

PROCESS
WATER TREATMENT PLANT HYDRAULIC PROFILE
FIGURE 2-1

NOT TO SCALE
VERIFY SCALE
BAR IS ONE 25mm ON ORIGINAL DRAWING
0 25mm

DATE	05/01/14
PROJ	476148
DWG	FIGURE 2-1
SHEET	of

PRE-DESIGN REVIEW

ERWS Intake Treatment and Supply

Legend

- Contour
- Railway
- Proposed Intake Sites
- Treatment Plant Site

KERR WOOD LEIDAL
consulting engineers

200 0 200 (m)
1:5,000

Project No.	Date	Drawn By
468-010	December 2013	PAC

Englishman River Proposed Intake Sites

Figure 3-1

ISSUED FOR PRE-DESIGN REVIEW

- NOT FOR - APPROVAL TENDER OR CONTRSTRUCTION

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MECHANICAL

RAW WATER INTAKE AND WEIR SITE PLAN

FIGURE 3-2

1:50

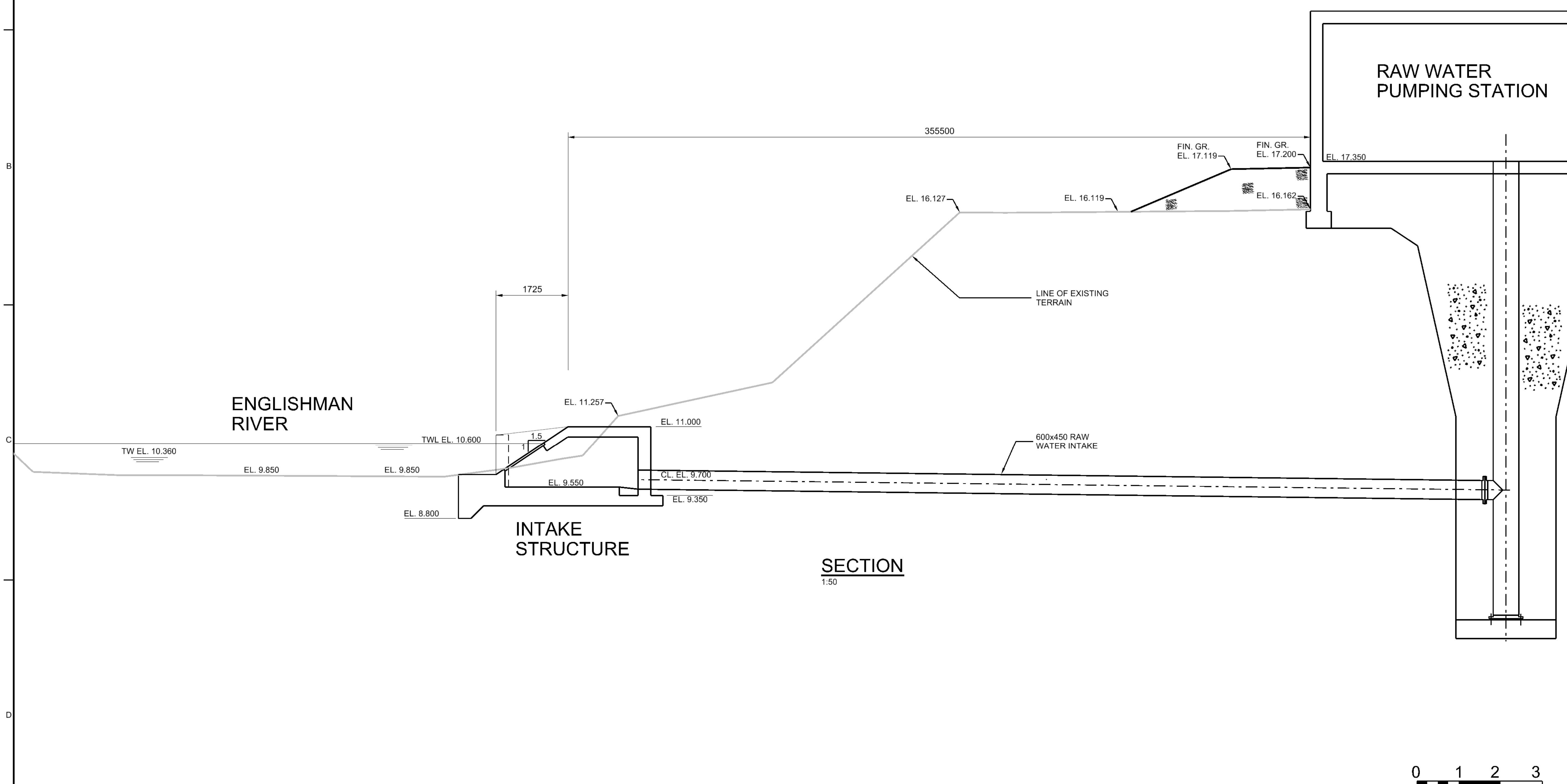
VERIFY SCALE

BAR IS ONE 25mm ON ORIGINAL DRAWING

0 25mm

DATE	05/12/14
PROJ	476148
DWG	FIGURE 3-2
SHEET	of

PRE-DESIGN REVIEW



SECTION
1:50

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NO.	DATE	REVISION	BY	APVD
A	05/12/14	ISSUED FOR PRE-DESIGN REVIEW	JG/KM	BE

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MECHANICAL
RAW WATER INTAKE AND WEIR SECTIONS
FIGURE 3-3

1:100
VERIFY SCALE
BAR IS ONE 25mm ON ORIGINAL DRAWING
0 25mm

DATE 05/12/14
PROJ 476148
DWG FIGURE 3-3
SHEET of

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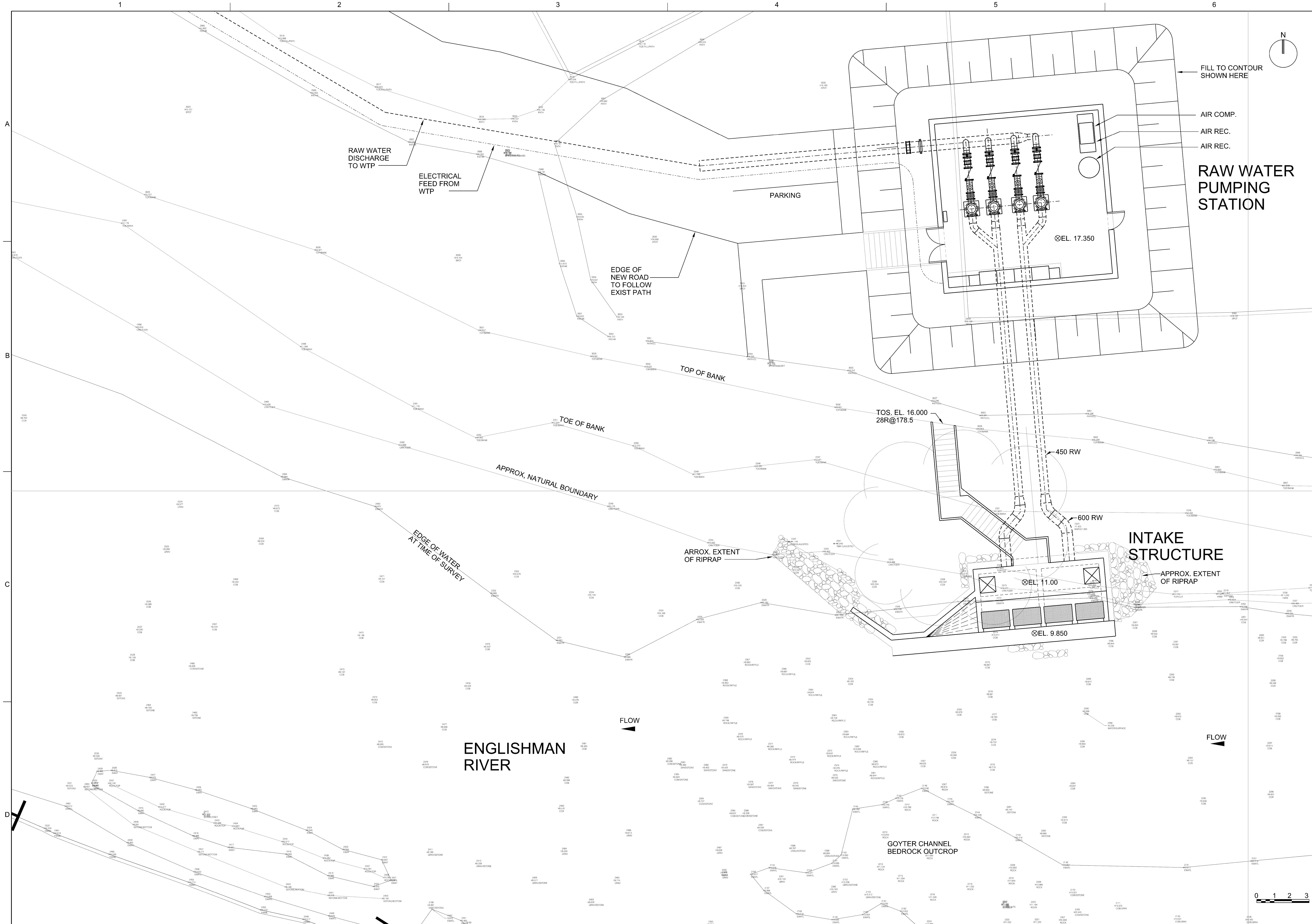
PRE-DESIGN REVIEW



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NO.	DATE	REVISION	BY	APVD
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DSGN	DR	CHK	APVD
J KANYUCHIK MAINS	B COOPER	J GARCIA	B ENGLESON

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ENGLISHMAN RIVER
WATER SERVICE INTAKE,
TREATMENT PLANT AND SUPPLY MAINS

CH2MHILL.

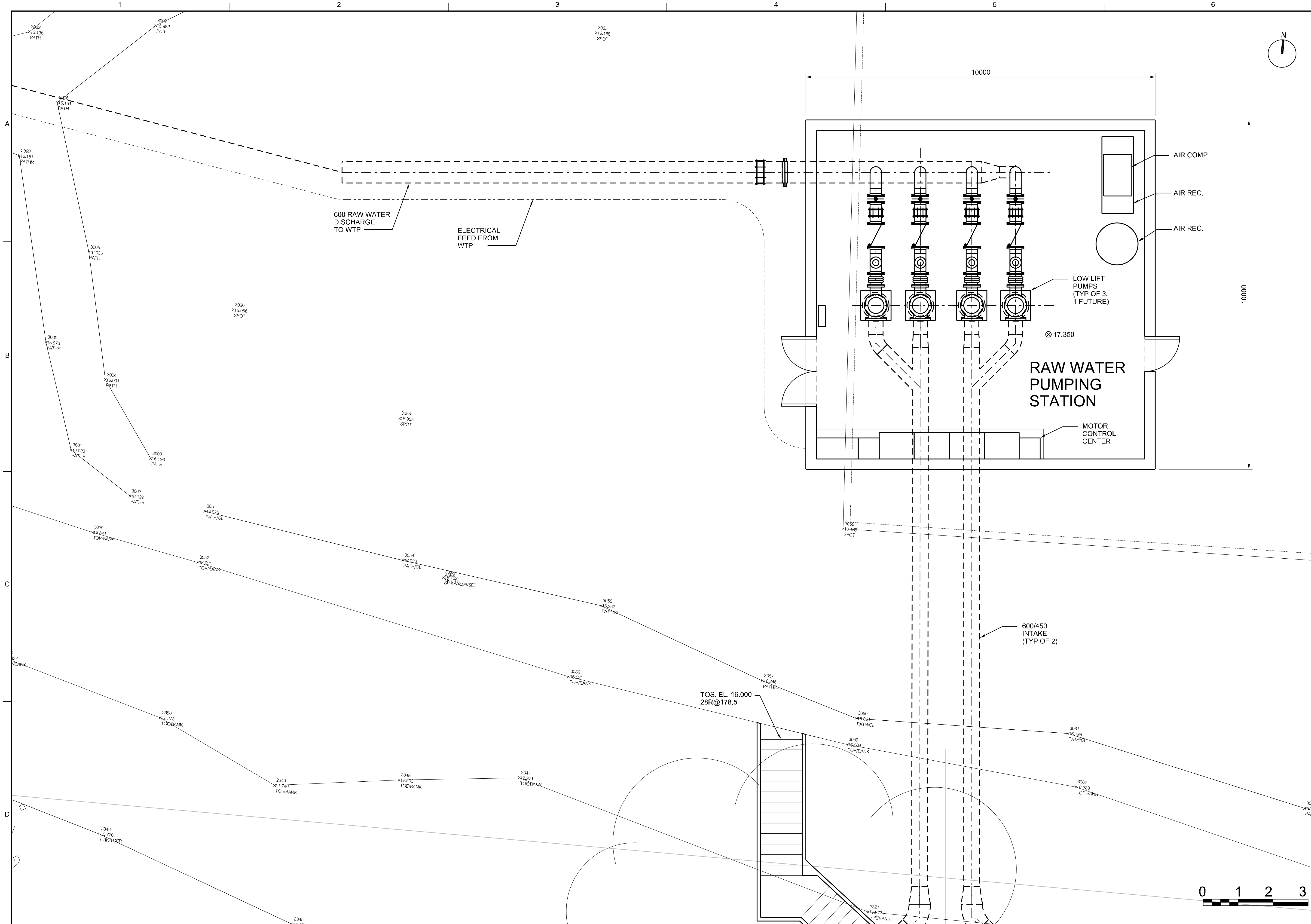
MECHANICAL

RAW WATER PUMP STATION SITE PLAN FIGURE 3-4

1:100
VERIFY SCALE
BAR IS ONE 25mm ON ORIGINAL DRAWING
0 25mm

DATE	05/12/14
PROJ	476148
DWG	FIGURE 3-4
SHEET	of

PRE-DESIGN REVIEW



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NO.	DATE	REVISION	BY	APVD
A	12/10/13	PRELIMINARY DESIGN		

DSGN	DR	CHK	APVD
BEC	BEC	JG	

SEAL NAME

City of Parksville

ENGLISHMAN RIVER WATER SERVICE
INTAKE, TREATMENT PLANT
AND SUPPLY MAINS

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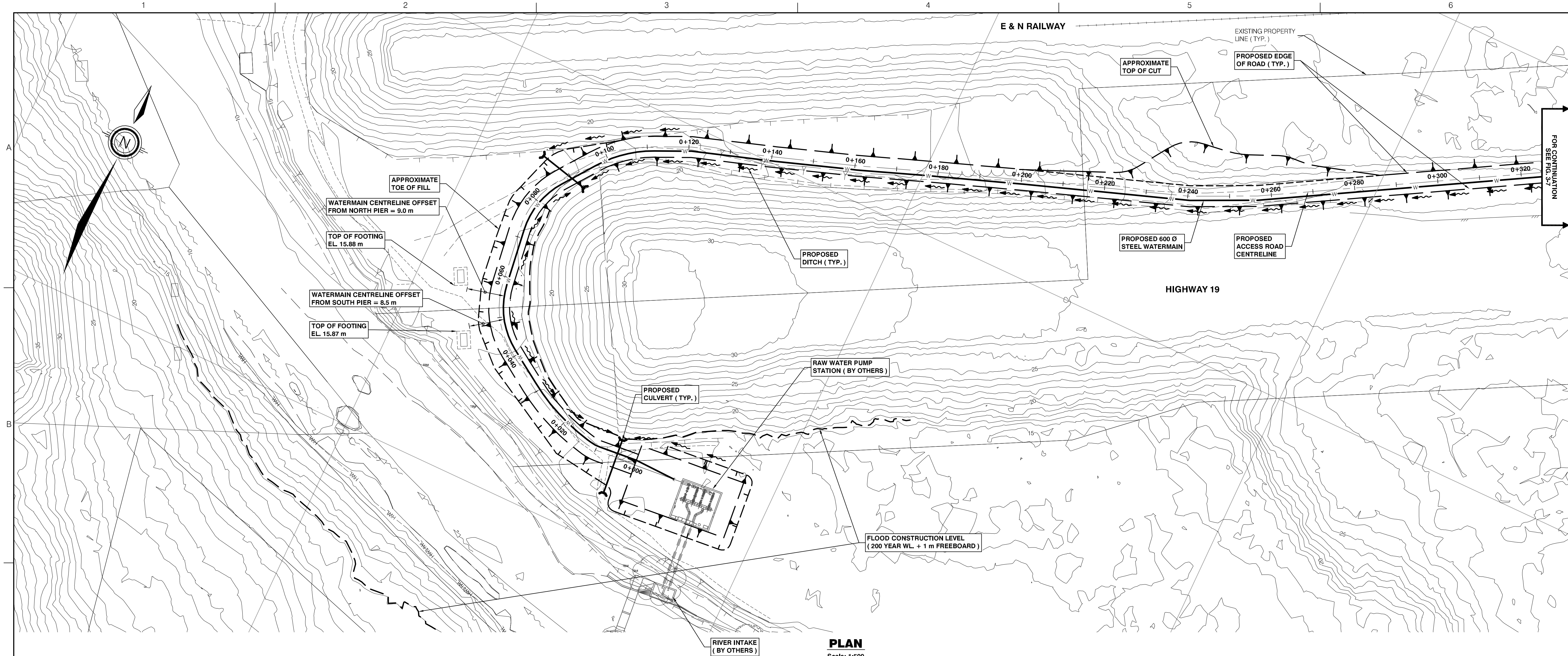
PROCESS
FIGURE 3-5
RAW WATER PUMPING STATION
FLOOR PLAN

1:50
VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

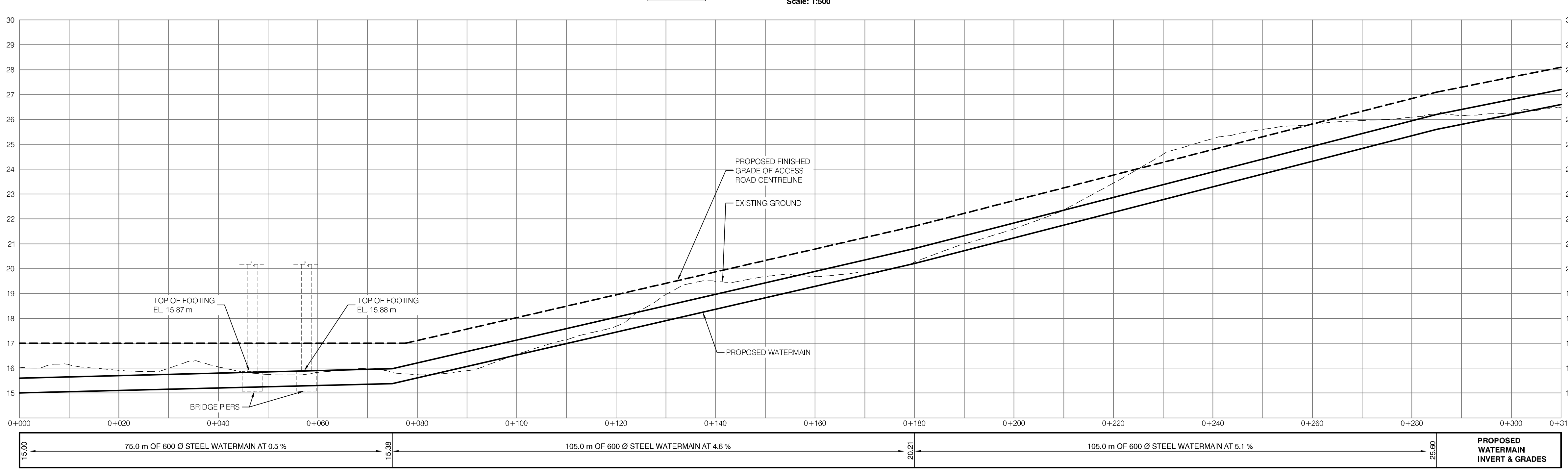
DATE	12/10/13
PROJ	476148
DWG	FIG 3-5
SHEET	SHT NO. of XXX

SCHEMATIC DESIGN



PLAN

Scale: 1:500



PROFILE

Scale: H. 1:500 V. 1:100

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NO.	DATE	REVISION	BY	APVD
D	2014/05/09	REVISED WATERMAIN SIZE AND TYPE		
C	2014/02/21	UPDATE WTP LOCATION, REVISED ACCESS ROAD LOCATION		
B	2014/01/21	PRELIMINARY DESIGN - ADDED BRIDGE FOOTINGS		
A	2013/12/09	PRELIMINARY DESIGN		

DSGN	DR	CHK	APVD
MDM		MP	

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ACCESS ROAD AND UTILITIES PLAN AND PROFILE SHEET 1

1" = X'

VERIFY SCALE

BAR IS ONE 25mm ON ORIGINAL DRAWING

0 25mm

DATE	2014/05/09
PROJ	468-010
DWG	Fig. 3-6
SHEET	

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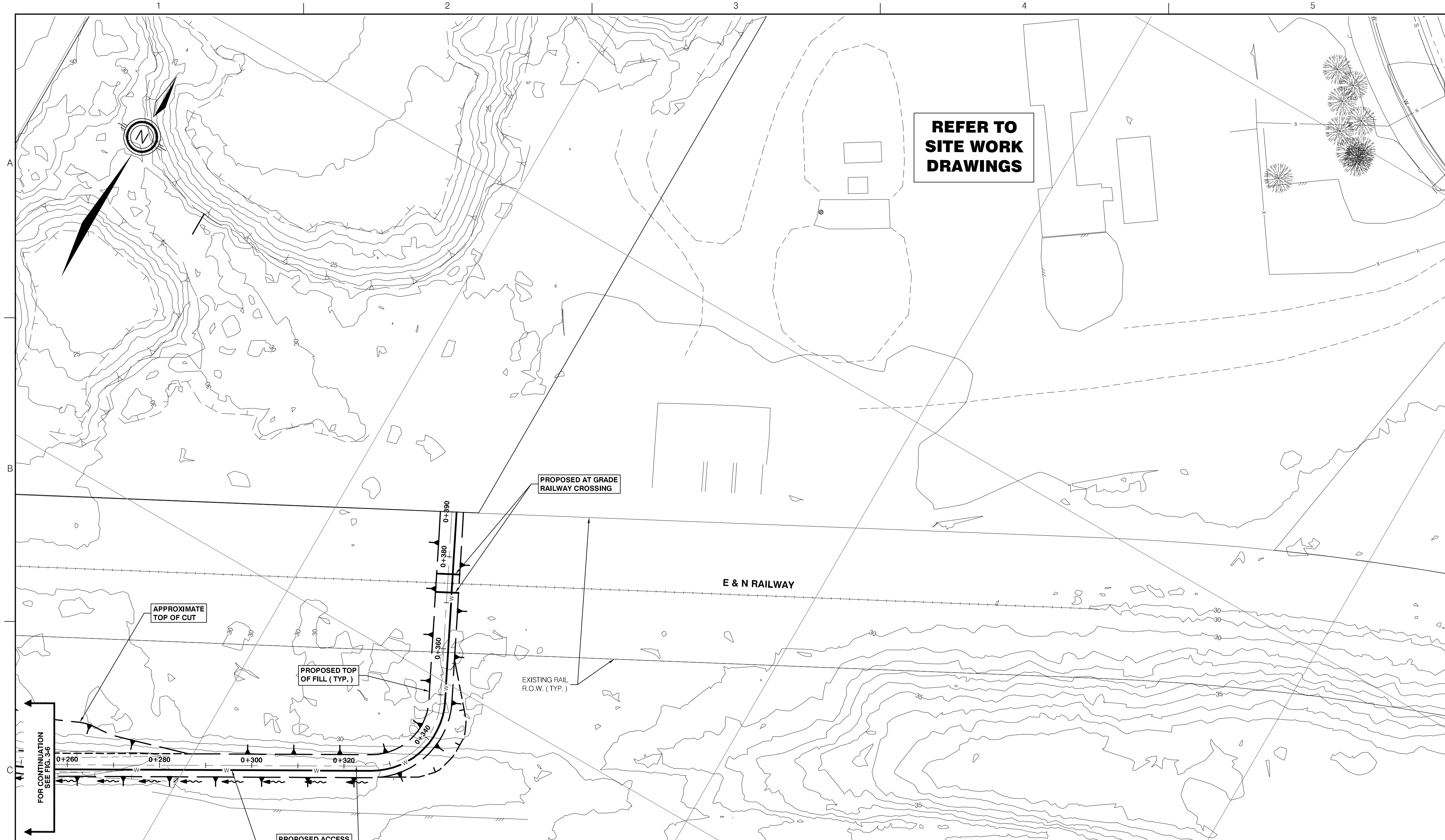
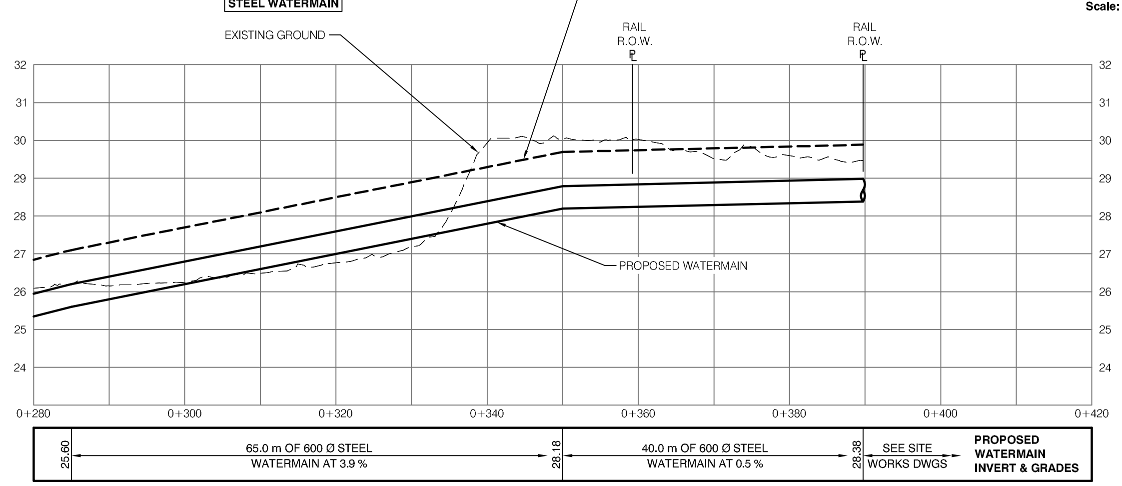
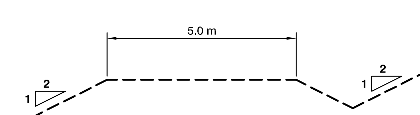


PLAN
Scale: 1:500



PROFILE
Scale: H. 1:500 V. 1:100



TYPICAL ROAD SECTION
N.T.S.

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NO.	DATE	REVISION	BY	APVD
D	2014/05/09	REVISED WATERMAIN SIZE AND TYPE		
C	2014/04/30	REVISED ACCESS ROAD ALIGNMENT UP TO ROW		
B	2014/02/14	UPDATE WTP LOCATION, REVISED ACCESS ROAD ALIGNMENT		
A	2013/12/23	PRELIMINARY DESIGN		

DSGN	DR	CHK	APVD
MDM		MP	

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ACCESS ROAD AND UTILITIES PLAN AND PROFILE SHEET 2

1" = X'

VERIFY SCALE

BAR IS ONE 25mm ON ORIGINAL DRAWING 0 25mm

DATE	2014/05/09
PROJ	468-010
DWG	Fig. 3-7
SHEET	

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Appendix A
ERWS Water License

WATER LICENCE DISPOSITION RECORD

AS OF JANUARY 17, 2013,

WATER LICENCE C110050

HAS BEEN

___ RECORDED AS ABANDONED

___ RECORDED AS EXPIRED

X SUPERSEDED BY C129710

FILE #: 1001868 CAN THIS FILE BE CLOSED? No.

NOTATION BY: AARON DAUR, WRU

DATE: MARCH 5TH, 2013.

Appendix B
Intake Screen Sizing Calculations

CH2MHILL.

PROJECT:	Englishman River Intake	**BY:**	R.E. Gatton **CHK'D BY:** J. Cheng
SUBJECT:	Slant Screen Sizing	**DATE:**	9/19/2013
		PROJECT NO.:	476148.03.35.10.70

Purpose

The purpose of this calculation sheet is to determine the geometry and number of bays needed for slant screens.

Calculation

Design Criteria

Approach Velocity	0.11	m/s	DFO criteria for subcarangiform fish (salmon and trout)
Total Design Flow	0.56	m^3/s	48 ML/d (ultimate capacity)
Effective Water Depth	0.60	m	Depth above effective invert of 10.000 m
Actual Water Depth	0.75	m	Depth above concrete and river bed invert of 9.850 m
Number of Bays	4		

Screen Area Determination Per Bay

Flow Per Bay	0.14	m^3/s	
Required Screen Panel Area	1.27	m^2	
Extra Screen Area	10	%	
Desired Screen Panel Area	1.40	m^2	

Screen Panel Sizing

Screen Slope	1.5	H	
	1.0	V	
Slope Factor	1.8		
Screen Effective Width	1.08	m	Measured along the sloped screen face
Effective Screen Length	1.30	m	Measured upstream to downstream
Effective Screen Area	1.40	m^2	Checks with desired screen panel area

CH2MHILL.

PROJECT: Englishman River Intake
SUBJECT: Screen capacity as a function of river depth

BY: R.E. Gatton **CHK'D BY:** J. Cheng
DATE: 9/19/2013
PROJECT NO.: 476148.03.35.10.70

Purpose

The purpose of this calculation sheet is to determine the diversion capacity of the screens as a funciton of river depth.

Calculation

Effective Invert	10	m
Effective Screen Length	5.20	m
Slope Factor	1.8	
Approach Velocity	0.11	m/s

WS Elev. (m)	Eff. Depth (m)	Eff. Width (m)	Eff, Area (m^2)	Capacity (m^3/s)	Capacity ML/d
10.00	0.00	0	0	0.00	0
10.15	0.15	0.27	1.404	0.14	12
10.30	0.30	0.54	2.808	0.28	24
10.36	0.36	0.648	3.3696	0.33	28.8

CH2MHILL.

PROJECT:	Englishman River Intake	**BY:** R.E. Gatton	**CHK'D BY:** J. Cheng
SUBJECT:	Screen capacity assuming a fixed water surface elevation of 10.60 m	**DATE:** 9/19/2013	
		PROJECT NO.: 476148.03.35.10.70	

Purpose

The purpose of this calculation sheet is to determine the approach velocity at different pumping rates.

Calculation

Effective Invert	10.000	m
Effective Screen Lengtl	5.20	m
Slope Factor	1.8	

WS Elev. (m)	**Eff. Depth (m)**	**Eff. Width (m)**	**Eff, Area (m^2)**
10.36	0.36	0.648	3.3696

Capacity (ML/d)	**Capacity (m^3/s)**	**Approach Velocity (m/s)**
28.8	0.33	0.10
24	0.28	0.08
18	0.21	0.06
12	0.14	0.04
6	0.07	0.02