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Technical Memorandum

To	Marc Rutten, P.Eng. (CVRD)	Page	1
CC			
Subject	Pump Station Siting Study (Final)		
From	Michael Celli, P.Eng. Ken Moysiuk, P.Eng.		
Date	April 17, 2014	Project Number	60312702.404

1. Introduction

Flow from the Courtenay Pump Station and Jane Place Pump Station currently discharges into a common forcemain. The forcemain is 750 mm diameter at the discharge of the Courtenay Pump Station and increases in size to 900 mm at the tie-in point downstream of the Jane Place Pump Station. After the tie-in, the forcemain runs along the shoreline past Goose Spit, along the Wilemar Bluffs, with final discharge to the Comox Valley Water Pollution Control Centre (CVWPCC).

The Comox Valley Regional District is investigating options for constructing a new pump station to reroute the Courtenay/Comox PS Forcemain away from the Wilemar Bluffs due to shoreline erosion and environmental concerns. A new pump station is required to overcome the elevation gain with this overland route. More details on the forcemain routing can be found in the *Forcemain Re-alignment Study (2005)* prepared by CH2M Hill for the CVRD. The new pump station would also augment the capacity of the Courtenay Pump Station by reducing the forcemain length (i.e. less friction loss). The Courtenay Pump Station is currently operating near maximum capacity during peak wet weather flows.

This memorandum is intended to discuss options for siting the proposed pump station. Two options have been identified: replacing the existing Jane Place Pump Station, and construction of a new pump station near the intersection of Docliddle and Croteau Road.

1.1 Work to Date

This technical memorandum is intended to build upon work completed to date to address the re-routing of the Courtney/Comox PS forcemain (hereafter, forcemain) around the Wilemar bluffs. The work completed includes the following:

- *Forcemain Re-alignment Study (2005)*, CH2M Hill
- *CVRD Sanitary Sewerage Master Plan (2011)*, OPUS DaytonKnight and McElhanney
- *Courtney Pump Station Sewerage Systems Upgrading and Staging Plan (2013)*, AECOM

2. New Jane Place Pump Station Option

2.1 *Scope of Project*

The Jane Place Pump Station was constructed in the early 1980's and services the Town of Comox. The pump station has a capacity of 340 L/s with Courtenay Pump Station offline, and 201 L/s with Courtenay Pump Station operating.

A property has been identified to the northwest of the existing Jane Place Pump Station where a new pump station could be constructed. The property is currently for sale and is of adequate area to construct a pump station that would allow the forcemain to be re-aligned and connected to a new overland route. The scope of work involved with this option would include the following:

- Construction of a new pump station on the property adjacent to the existing Jane Place Pump Station
- Diversion of the existing Courtenay Pump Station forcemain to the proposed Jane Place Pump Station
- Diversion of gravity flows from the existing Jane Place Pump Station to the proposed station
- Construction of a new forcemain along the foreshore from the new pumping station to Croteau Road
- Construction of the proposed inland forcemain realignment from Croteau Road to the Comox Valley Water Pollution Control Centre (CVWPCC)

A photograph of the proposed site is provided in Figure 1.



Figure 1. Proposed Jane Place Pump Station Site

As part of this project, the pumps in the existing Courtenay Pump Station would need to be replaced. The new pump station would significantly reduce the static and dynamic head at the Courtenay Pump Station, and therefore new pumps would be required to prevent operational run-out and pump instability. The new pumps would be specified with the same flow rate, but a lower head, and consequently, smaller motors (150 hp). It may be possible to re-use the existing variable frequency drives (VFDs) and plant piping—this would significantly reduce the upgrade costs to the Courtenay Pump Station.

2.2 Pump Station Layout

The design standard for layout of pumping stations is the Hydraulic Institute Standard for Pump Intake Design (ANSI/HI 9.8-2012). This standard provides several design options and guidelines for the construction of a pumping station wet well.

The property identified for the pump station is narrow, and therefore a trench-style wet-well would be the best fit for this property. It is recommended that two independent trenches operating in parallel be constructed to allow operations staff the ability to take one trench offline for maintenance purposes. A general arrangement for this type of design is provided in Figure 2.

A site plan has been developed to show how this pumping station layout could fit within the proposed property. This site plan is also provided in Figure 2. Key features of the site include:

- A retaining wall constructed on the north side of the site.
- Asphalt roadway and fence around the site with gated access from the existing driveway.
- Building constructed on the north side of the site to house the pumps and any electrical, control, mechanical and odour control equipment.
- Wet wells constructed on the south side of the site with H₂O loaded hatches to allow vehicle traffic and access.
- Inlet manhole on the site to take the combined flow from the Courtenay Pump Station Forcemain and the existing gravity flow to the Jane Place Pump Station.
- Walking trail built along the south side of the pumping station to meet the Town of Comox's long term objective of connecting the waterfront with a trail open to the public. The trail would be separated from the pumping station by vegetation and fencing.

2.2.1 Site Elevation

The property identified is at approximately the same elevation as the existing Jane Pump Station would be constructed to operate within the same range of water levels as the existing Jane Pump Station to prevent any impacts on the existing gravity sewer system.

2.3 Constructability Issues

2.3.1 Pump Station Construction

The proposed pump station site is essentially green-field and therefore construction of the pump station can be performed without significant conflicts. The only utility that would need to be relocated

is a gravity sewer line that runs along the site. This line could be diverted into the pump station wet-well or inlet manhole.

The site is located at the foreshore and the groundwater elevation is expected to be near the surface. As a result, site dewatering during construction is expected to be a significant challenge. Methods of site dewatering would be determined as part of a geotechnical investigation. It is expected that sheet piling would need to be erected around the excavation, with dewatering pumps operating to keep the site dry during construction of the wet well, drywell and building foundation.

2.3.2 Forcemain Tie-ins

Construction challenges will occur during tie-in to the existing forcemain. There is an isolation valve on the forcemain near the Marina Park at Port Augusta Street. The isolation valve would be closed to allow construction and tie-in of a new forcemain diversion chamber. The diversion chamber would allow flow to be redirected to the proposed pump station once construction of the chamber and pump station are complete.

The forcemain is constructed of Hyprescon pipe— a reinforced concrete pipe with tensioned steel reinforcement. Specific design and construction guidelines must be followed in accordance with the manufacturer's recommendations when cutting or otherwise breaking into this type of pipe for forcemain tie-ins.

2.3.3 Forcemain Alignment

The proposed pump station will discharge into a new forcemain that will run along the foreshore to Croteau Road, with a total length of approximately 1200 m. It is not recommended to reuse the existing forcemain due to the higher operating pressures in the line.

The most suitable material for this proposed forcemain is High Density Polyethylene (HDPE) due to its ease of construction and lower relative cost. HDPE can be butt fuse welded in sections to form a continuous pipe that can be lowered into open trench. It can also accept standard pipe flanges for mechanical connection to valves, fittings, etc. The forcemain size will be approximately 1050 mm diameter in accordance with the CH2M Hill forcemain routing study (2005). The wall thickness would be determined during the design phase based on the operating pressure.

The forcemain would be buried along the foreshore and therefore specialized construction practices would need to be followed to excavate, backfill and anchor the pipe. The final construction details for the forcemain installation would be determined during the civil design phase and following a geotechnical investigation of the alignment. In addition, environmental assessment work and permitting would also be a requirement (i.e. the Department of Fisheries and Oceans and Ministry of Environment would need to be notified and necessary approvals obtained before the project is started).

2.4 Aesthetic Impacts / Considerations

2.4.1 Pump Station

The proposed pump station is located in a residential area with single family homes. To the north of the pumping station are houses situated on the bluff. The view corridors would need to be maintained by limiting the station height.

Given the close proximity of houses to the proposed pumping station, an odour control system would need to provide a very high level of treatment. A well designed carbon scrubber would provide the necessary level of treatment.

It is recommended that acoustical panels and equipment insulation be incorporated into the design to mitigate noise impacts on the surrounding area. An acoustical engineer would be engaged to specify materials and construction details to ensure that the total noise emission is acceptable to the Town of Comox.

Upon completion of construction, the existing Jane Place Pump Station building could be demolished which would improve the overall neighborhood aesthetics—this would likely be well received by the local residents.

2.4.2 Construction

Construction will have significant impact (i.e. noise and traffic) on the local neighborhood. The proposed site is within a quiet residential area with construction vehicles having to use Jane Street to access the pump station.

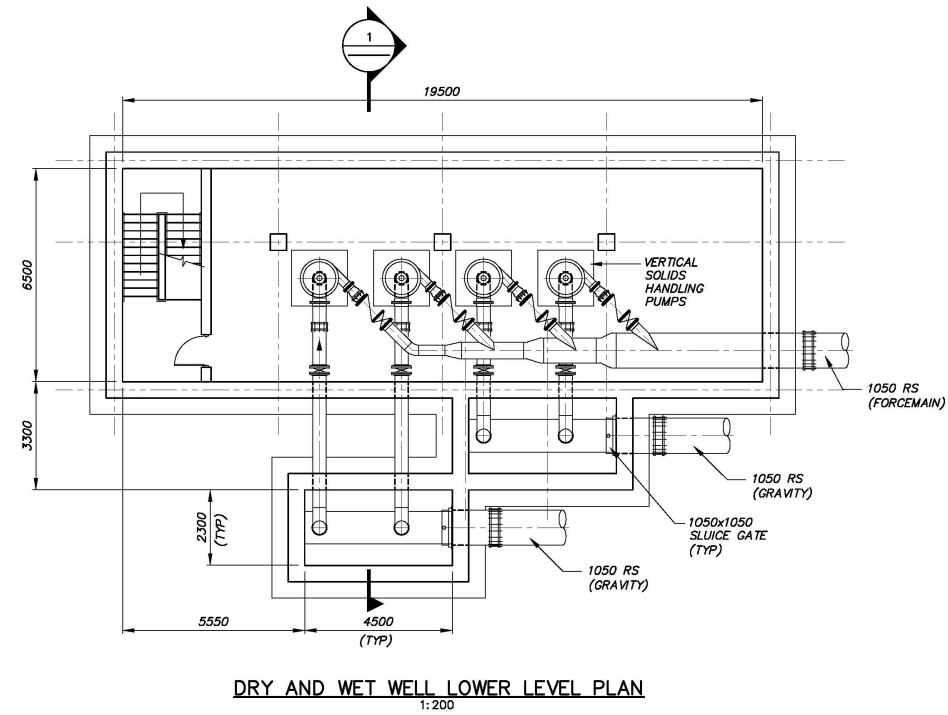
There will be significant noise impacts to the houses around the proposed site during construction of the pump station. The contract documents would need to place limitations on timing and methods of construction to keep noise within bylaw requirements.

The overall construction duration would be approximately 20 months. The noisiest periods with the most traffic impacts would be during excavation and concrete work. This work would occur primarily during the initial stages of construction, over the first 6 months.

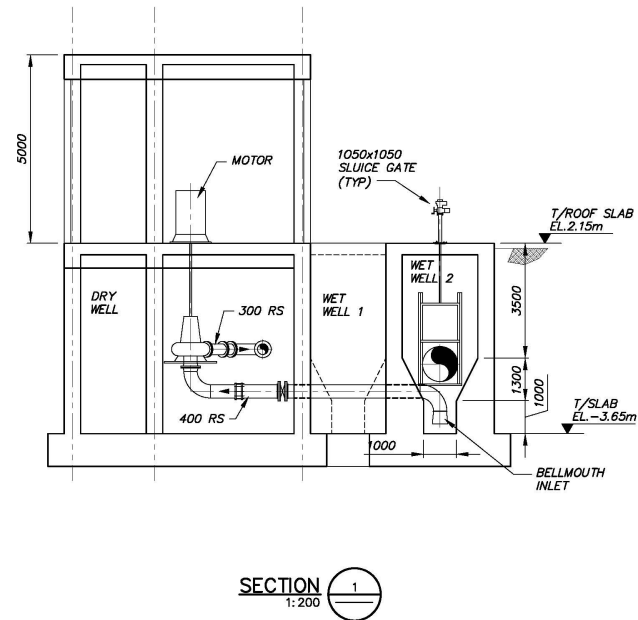
An environmental assessment (EA) would be required for the project and it is recommended that it be undertaken during the preliminary design phase. The EA would cover off such items as sediment control, species assessment, air emissions, etc. and proposed mitigation measures.

Project Management Initials: Designer: MC Checked: KM Approved: KM
ANSI D 508 6mm x 893 6mm

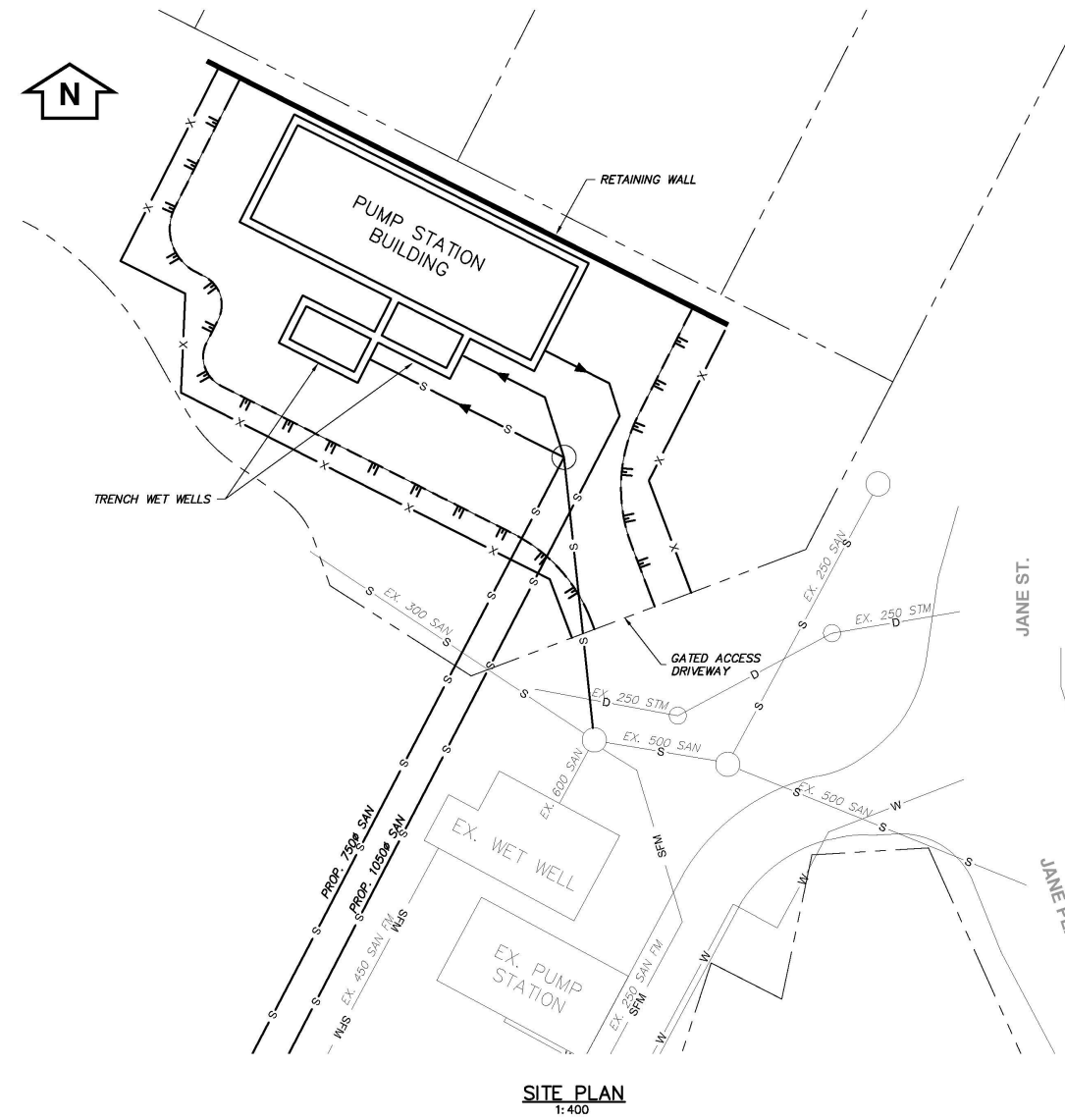
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Filename: P:\0312702\003\WORK\010-CAD\05-SKETCHES\JANE FIGURE 2.DWG



DRY AND WET WELL LOWER LEVEL PLAN
1:200



SECTION 1
1:200



SITE PLAN
1:400

AECOM
Figure: 2

JANE PLACE PUMP STATION
GENERAL ARRANGEMENT
COMOX VALLEY REGIONAL DISTRICT
Project No.: 60312702 Date: 2014-02-06

3. Docliddle Pump Station Option

3.1 *Scope of Project*

The concept of constructing a pump station near the intersection of Docliddle and Croteau Road was first identified by CH2M Hill in the 2005 *Forcemain Alignment Study*. This recommendation was carried through the sewer master plan undertaken by Opus DaytonKnight and McElhanney. Under this concept, the Courtenay Pump Station Forcemain would be diverted up Croteau Road to a new pump station. The station would pump all flows from the Courtenay and Jane pump stations via the proposed overland forcemain route to the CVWPCC.

A site has not yet been identified for a proposed Docliddle Pump Station. It is understood that siting this pump station may be challenging given the land use and ownership in this area; however, the advantage of this area is that there are few existing utility conflicts and a lesser amount of constructability issues (e.g. dewatering, site access).

A photograph of Croteau Road looking south from the area identified as a possible location for the Docliddle Pump Station is shown in Figure 3.



Figure 3. Croteau Road Facing South Towards the Foreshore

The scope of construction for the Docliddle Pump Station would include the following:

- Construction of a new pump station near the intersection of Docliddle and Croteau Road.
- Diversion of the existing Courtenay Pump Station up Croteau Road to the proposed Docliddle Pump Station.
- Construction of the proposed inland forcemain realignment from the Docliddle Pump Station to the CVWPCC

3.1.1 Work Not Required

This option has a reduced scope of overall work when compared to the option of constructing a new Jane Place Pump Station. Items not required for this option include:

- **Pump Replacement at the Courtenay Pump Station** – The Courtenay Pump Station would be able to deliver flow to the Docliddle Pump Station using the existing pumps. The pump station capacity would increase due to the reduced dynamic head (i.e. friction loss) from a shorter discharge forcemain. Refer to the CVRD Sanitary *Sewerage Master Plan* and *Courtney Pump Station Sewerage Systems Upgrading and Staging Plan* documents for an explanation of the impact to the overall pumping capacity.
- **Construction of a Forcemain from Jane Pump Station to Croteau Road** – This section of forcemain running along the shoreline would not need to be replaced as it would continue to operate within its original design pressure.
- **Diversion of the Courtenay Pump Station Forcemain at the Jane Pump Station** – There would be no need to divert the forcemain at this location. The proposed Docliddle Pump Station would be near the alignment of the proposed forcemain along Croteau Road, limiting the total length of new forcemain construction.

For clarity, all of the items listed above would be required under the previously studied option of constructing a new Jane Place Pump Station.

3.2 Pump Station Layout

The design standard for layout of pumping stations is the Hydraulic Institute Standard for Pump Intake Design (ANSI/HI 9.8-2012). This standard provides several design options and guidelines for the construction of a pumping station wet well and would be applied for the design of a Docliddle Pump Station.

A site has not yet been selected for the Docliddle Pump Station, and therefore a layout specific to the site could not be developed. Figure 4 provides a conceptual layout based on a property along Croteau Road that would be considered suitable for the Docliddle Pump Station. The CVRD may use this layout to assist with property acquisition for the pump station.

3.2.1 Site Elevation

A key consideration when siting the Docliddle Pump Station is the site elevation. The proposed operating water level for the Docliddle Pump Station is 12 m geodetic based on the previous studies completed to date. Therefore, a site should be selected that allows for operating the wet well at this elevation.

When selecting a site there is flexibility in the final site grade, given that the pumping station wet well could be buried deeper or extended above grade to meet the design water level. Allowing 2.7 m for freeboard and access for cleaning and 0.3 m for roof slab thickness, the top of concrete elevation for the pump station roof is estimated to be 15 m geodetic. It would be reasonable to select a site where

grade is 2 m higher or 1 m lower than this elevation, and therefore a site with an elevation of **14 m to 17 m** at grade would be within the acceptable range for this pump station.

3.3 Constructability Issues

3.3.1 Pump Station Construction

The proposed pump station site is essentially green-field and therefore construction of the pump station can be performed without difficulty. The proposed area is on well water, septic tanks and overhead power; therefore utility conflicts are not expected to be an issue. Three phase power may be available on Croteau Road, and if not, it is likely available close by on Lazo Road.

3.3.2 Forcemain Tie-ins

Construction challenges will occur during tie-in to the existing forcemain. The nearest upstream isolation valve on the forcemain is near the Marina Park at Port Augusta St. The isolation valve would be closed to allow tie-in of a forcemain diversion chamber; however the long pipe length to the valve would mean significant time would be required to drain the forcemain in this area. The forcemain diversion chamber would allow flow to be redirected to the proposed pumping station. The chamber would be overbuilt on the forcemain, and the forcemain broken into once construction of the chamber and pumping station is complete.

The forcemain is constructed of Hyprescon pipe—a reinforced concrete pipe with tensioned steel reinforcement. Specific design and construction guidelines must be followed in accordance with the manufacturer's recommendations when cutting or otherwise breaking into this type of pipe for forcemains.

3.4 Aesthetic Impacts / Considerations

The pump station could be designed architecturally to fit in with the local area to limit aesthetic impacts. An attractively designed building and landscaped site would likely be better received by local residents.

Odour control would be a key consideration for the pump station given its close proximity to residents. A carbon scrubber would be a suitable technology for odour control. Treated air could be discharged above the pump station building roofline through a dispersion stack. This would address any aesthetic issues with the treated air being discharged away from residents.

The pump station would be constructed with acoustical panels and insulation to attenuate noise on site. An acoustical engineer would specify materials and construction details to ensure that the total noise emission is within an acceptable range.

3.4.1 Construction

Croteau Road is a residential area, similar to the area surrounding the Jane Place Pump Station. However, Croteau Road is less densely populated with larger lot sizes and therefore construction

would have a lesser impact on local residents. Further, Croteau Road is wider and would allow easier access for construction vehicles.

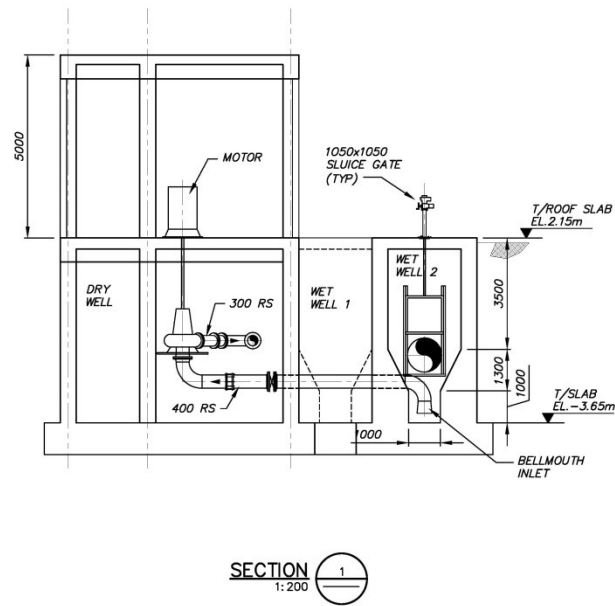
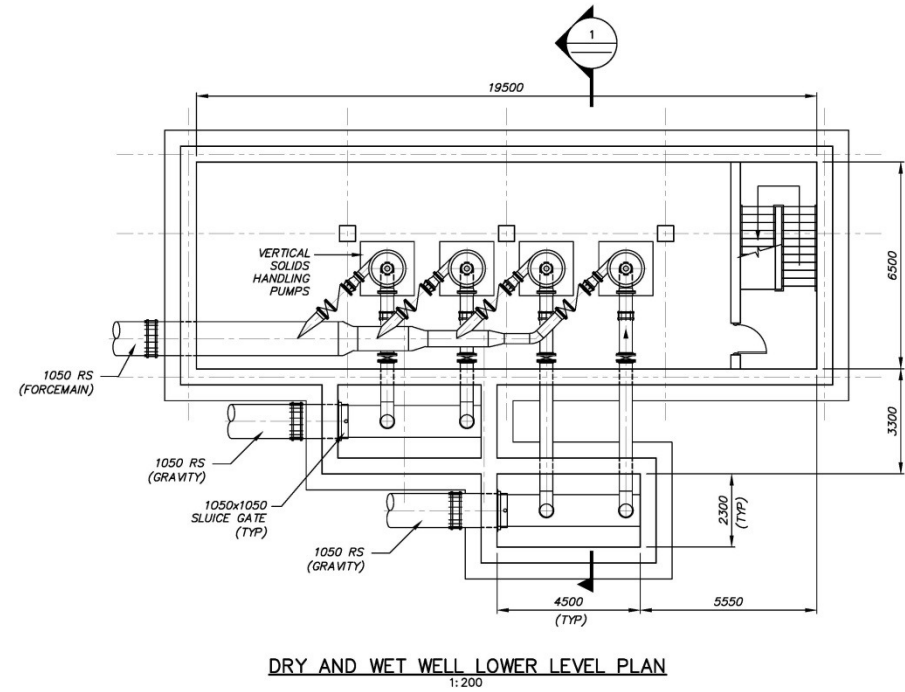
There will be significant noise impacts to the neighbourhood around the proposed site during construction of the pump station. The contract documents would need to place limitations on timing and methods of construction to meet current noise bylaws.

The overall construction duration would be approximately 20 months. The noisiest periods with the most traffic impacts would be during excavation and concrete work. This work would occur primarily during the initial stages of construction, over the first 6 months.

An environmental assessment (EA) would be required for the project and it is recommended that it be undertaken during the preliminary design phase. The EA would cover off such items as sediment control, species assessment, air emissions, etc. and proposed mitigation measures.

Project Management Initials: Designer: MC Checked: KM Approved: KM ANSI D 568.8mm x 863.6mm

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Filename: P:\60312702\603-WGR\03\10-CAD\05-SHEET\05-DOCLIDDLE FIGURE 4.DWG



AECOM
Figure: 4

DOCLIDDLE PUMP STATION
GENERAL ARRANGEMENT
COMOX VALLEY REGIONAL DISTRICT
Project No.: 60312702 Date: 2014-02-06

4. Cost Implications

AECOM previously estimated that a new Pump Station constructed near the intersection of Docliddle and Croteau Road would have a capital cost of approximately **\$5.9 million** (Ref. *Pumping Upgrade and Staging Plan 2013*). Further, the cost of an overland forcemain to the Comox Valley Water Pollution Control Centre (CVWPCC) would cost **\$7.4 million**. Combined, the total capital cost for this upgrade was estimated to be **\$13.3 million**.

4.1 Jane Place Pump Station

The proposed pump station option at Jane Place is of the same hydraulic capacity as the Docliddle Pump Station. Therefore, the wet well construction and pump sizes would be the same. However, the pump station would have a higher discharge head and therefore a greater electrical load. This will increase the overall electrical and mechanical cost. AECOM estimates that the capital cost for the pump station would be **\$7.0 million** accounting for higher electrical, mechanical and construction costs (e.g. dewatering).

In addition to construction of the pump station, a new forcemain diversion to the pump station, and shoreline forcemain from the pump station to Croteau Road would be required. The forcemain diversion would be 750 mm diameter and approximately 100 m long. The new shoreline forcemain would be 1000 mm diameter and approximately 1200 m long. Based on a unit price of \$24 / cm diameter / lineal m (including engineering) for a shoreline forcemain, the capital cost is estimated to be **\$3.1 million**.

New pumps would be required at the Courtenay Pump Station to prevent operation at run-out. The pumps would be a direct replacement for the existing pumps at the Courtenay Pump Station but with smaller 150 hp motors. AECOM estimates a cost of **\$500,000** for pump replacement, including supply and installation. Further, it is anticipated that additional work on the pump station would be required by 2028 to upgrade electrical / control equipment and to rehabilitate the wet well. A budget allowance of **\$1.0 million** has been made for this upgrade.

The Courtenay Pump Station forcemain was original constructed in 1982. It will likely require replacement by 2032. The estimated cost from the *Pumping Upgrade and Staging Plan (2013)* to replace the entire forcemain is **\$7.5 million**. If the Jane Place Pump Station option is constructed, then only partial replacement would be required as 1200 m would be replaced during construction of the new pump station. In this case, the capital cost estimate would be reduced to **\$5.5 million**.

4.2 Docliddle Pump Station

As previously mentioned, the capital cost for the Docliddle Pump Station is estimated to be **\$5.9 million**. Further, the capital cost estimate for the inland forcemain is **\$7.4 million**.

In addition to construction of the Docliddle Pump Station, the Courtenay Pump Station will require an upgrade in the future to meet the projected design flows. Based on the *Pumping Upgrade and Staging Plan (2013)* document, it is estimated that upgrade to the Courtenay Pump Station will be required between 2020 and 2028, depending on the actual rate of population growth. This upgrade is estimated to have a capital cost of **\$3.7 million**.

Similarly, the Jane Place Pump Station would also require upgrade in 2023 to meet population growth. The estimated capital cost for upgrading the Jane Pump Station is **\$1.2 million**.

The Courtenay Pump Station forcemain was original constructed in 1982. It will likely require replacement by 2032. The estimated cost from the *Pumping Upgrade and Staging Plan (2013)* to replace the entire forcemain is **\$7.5 million**.

4.3 Summary

Table 1 outlines the conceptual capital cost estimate for each pumping station option including all of the above considerations. Staging of the works over the next 20 years is also considered.

Table 1. Pumping Station Upgrade Options – Cost Estimate

Item	Year	Option	
		Jane Place Pump Station	Docliddle Pump Station
Pump Station Upgrade Cost	2015	\$7.0 million	\$5.9 million
Inland Forcemain Cost	2015	\$7.4 million	\$7.4 million
Shoreline Forcemain Cost	2015	\$4.1 million	-
Courtenay Pump Replacement	2015	\$500,000	-
Courtenay Pump Station Upgrade	2020 - 2028	\$1.0 million	\$3.7 million
Jane Pump Station Upgrade	2023	-	\$1.2 million
Forcemain Replacement	2032	\$5.5 million	\$7.5 million
Total Cost		\$25.5 million	\$25.7 million

All of the above costs are in 2014 dollars, and no consideration has been made for discounting or inflation. All of the above estimates are conceptual in scope and expected to be accurate within a ± 35% margin.

5. Summary and Conclusions

The CVRD is investigating options to allow the Courtenay Pump Station forcemain to be realigned up Croteau Road to the Comox Valley WPCC in order to avoid the Wilemar Bluffs. This upgrade will also address capacity issues at the Courtenay Pump Station. The options considered, and their scope of work are:

Option 1 – Replace Jane Place Pump Station	Option 2 – Docliddle Pump Station
<ul style="list-style-type: none"> ○ Construction of a new pump station on the property adjacent to the existing Jane Place Pump Station ○ Diversion of the existing Courtenay Pump Station forcemain to the proposed Jane Place Pump Station ○ Diversion of gravity flows from the existing Jane Place Pump Station to the proposed station ○ Construction of a new forcemain along the foreshore from the new pump station to Croteau Road ○ Construction of the proposed inland forcemain realignment from Croteau Road to the CVWPCC 	<ul style="list-style-type: none"> ○ Construction of a new pump station near the intersection of Docliddle and Croteau Road. ○ Diversion of the existing Courtenay Pump Station up Croteau Road to the proposed Docliddle Pump Station. ○ Construction of the proposed inland forcemain realignment from the Docliddle Pump Station to the CVWPCC
Pump Station Construction Cost (2015)	
\$7.0 million	\$5.9 million
Forcemain and other upgrade costs (2015)	
\$12 million	\$7.4 million
Total long term upgrade cost (2032)	
\$25.5 million	\$25.7 million

The option to replace Jane Place Pump Station presents more significant constructability issues given the site location and constraints. The site is located along the foreshore, which can present challenges for excavation due to the high ground water, difficult soil conditions, and environmental concerns. Further, the site is constrained with limited access, which will limit design options for the pump station in order to fit within the site footprint. Lastly, this option requires more work be done upfront, with the replacement of the forcemain along the foreshore.

Notwithstanding the aforementioned issues, both of the above options are considered feasible. The total long term cost for each option is comparable and within the margin of error for a conceptual scope cost estimate ($\pm 35\%$). The final decision should be made based on land availability and public acceptance; however, if a suitable site can be purchased, the Docliddle Pump Station option is recommended based on the constructability challenges facing the Jane Place site.