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Technical Memorandum: Summary of Conceptual Design Rationale for Onsite Sewerage System Servicing

Project: Ocean Estuary

Client: KRA and Merchant House

Date: December 10, 2021

Introduction

The client has retained TRAX to undertake a review of the technical feasibility of onsite sewerage system servicing for re-development of two lots in Fulford, Saltspring Island, 2661 and 2621 Fulford Ganges Road.

TRAX has completed a review of technical feasibility and conceptual design of treatment and ground discharge systems under the context of the Sewerage System Regulation (SSR) (with design flows of <22.7 cmpd) and to meet potential site and receiving environment constraints.

Based on earlier memos and conceptual layout drawings from TRAX the Islands Trust Local Trust Committee has approved a Development Variance Permit (DVP) to allow placement of the sewerage system dispersal bed for the 2661 site and the tanks for the 2621 site within setbacks defined by the Salt Spring Island Land Use Bylaw (LUB).

The purpose of this memo is to provide a description summarizing the performance-based design approach necessary to address site constraints, and to illustrate the way in which the performance based approach was used during development of a conceptual design with risk management for these sites. This memo also links the objectives of the conceptual design to the objectives for protection of fresh and marine water receiving environments in the Salt Spring Island Official Community Plan (OCP) and Land Use Bylaw with the intent of supporting application for development permits on the sites.

In general, the approach taken to conceptual design was based on the same rationale, calculation procedures and references utilized for development of the Ministry of Health BC Sewerage System Standard Practice Manual (BC SPM) Version 3 standards, and where necessary follows a performance-based design approach as defined by the EGBC Practice Guidelines, Onsite Sewerage Systems (2012) (EGBC Guideline).

Refer to the 30th November 2021 draft conceptual design sketch plan for layout and other information related to the sewerage systems (provided as an attachment to this memo and electronically in CAD format to the client).

Limitations

This report is subject to the attached statement of general conditions.

The reader is cautioned that this memo relates only to potential site uses, and technical feasibility of onsite sewerage system servicing. The reader is cautioned that application of regulations and development permissions is contingent on decisions by the Islands Trust, the Capital Regional District, the Archaeology Branch and other government agencies. These decisions are outside the control of TRAX.

Stormwater systems design is addressed by McElhanney Consulting Services, the project civil engineers. Geotechnical aspects of development, including seismic recommendations, is addressed by Ryzuk Geotechnical, the project geotechnical engineers. TRAX has not undertaken flood modeling for the site, this memo does not establish level of flood risk—risk is discussed based on CRD reports and Ian Ralston's seal applied to this memo does not apply to flood risk analysis by others.

A. Intent of the conceptual design

The intent of the conceptual design is to illustrate a technically feasible onsite sewerage system for the development which, during construction and operation, would meet the following performance objectives:

- To follow standard practice as defined by the BC SPM.
- To protect human health, with risk management meeting provincial regulatory requirements, standards and guidelines.
- To protect the receiving environment, with risk management meeting provincial water quality guidelines and site and project specific objectives established by the project biologists.
- To minimize impact during construction, including impact on steep slope areas.
- To allow for sustainable operation over the system life.

In order to support this intent, a performance-based design approach was selected.

The Islands Trust Official Community Plan (OCP) and Land Use Bylaw enact protections for water bodies from impact by sewerage systems. The intent of the conceptual design is aligned with these regulatory protections, and the design is intended to meet these requirements.

To address concerns related to system performance and resilience during a hypothetical future flood event we explain in this memo specifications and characteristics of the conceptual design which support risk management for extreme flood events.

This memo and the attached draft sketch plan discuss two sewerage systems, one for 2661 and one for 2621 Fulford Ganges Road. Although both systems are discussed in this memo, both systems follow a similar performance based design approach and both are shown conceptually on the sketch plan, this is for convenience and coordination only. The two systems will be entirely and completely separate and are to be designed and filed separately under the Sewerage System Regulation. Either system could be built and operated alone. Based on information provided by the client, the daily design flow for each system is expected to be less than 22.7 cmpd in accordance with the Sewerage System Regulation.

A- 1 PERFORMANCE BASED DESIGN APPROACH

This approach consists of establishing site and project specific water quality objectives for the receiving environment (including objectives for the protection of human health) and objectives for effluent and water quality at points in the sewerage system. Steps include the following:

- Site use is established and wastewater characteristics (quantity and quality) are estimated. Note that this memo does not describe site use or the basis for design flow estimates.
- Site and soil evaluation is carried out to characterize the capability of the site.
- Design of the system is then undertaken, considering site capability and constraints, with the objective that the constructed system will achieve the established objectives, using modeling and calculation to estimate system performance.
- Operation of the system includes monitoring of performance to meet design objectives and automated reporting and control of the system to meet continuously monitored performance indicators or surrogates.

For initial, conceptual, design a conservative approach has been taken. In particular, estimated minimum sand media depth has been increased beyond the minimum depths resulting from modeling. At detail design, sand media depth and other aspects of the design may be adjusted based on further site and soil evaluation and analysis.

A- 1.1 Performance and water quality objectives

The BC SPM and the EGBC Professional Practice Guideline, Onsite Sewerage Systems as well as design manuals such as the USEPA *Onsite Wastewater Treatment Systems Manual* emphasize the need for water flowing from an onsite sewerage system dispersal area to meet defined water quality objectives at defined performance boundaries. Following this approach, onsite systems sustainably recycle water back to the environment.

The intent is for treated effluent to be applied to a dispersal area, where final polishing treatment occurs in the soil vertical separation (unsaturated soil or sand media depth below the distribution system) and the resulting percolate meets water quality objectives. This water is no longer considered effluent or wastewater, and gradually joins other shallow groundwater flowing from the area.

BC SPM standards for vertical separation, loading rates and other factors are based on this performance approach with setting of objectives and modeling performance to meet objectives.

Following this approach also allows a professional to establish custom, site and project specific vertical and horizontal separations and loading rates while providing for adequate environmental and health protection. This is defined by the EGBC Guideline as an alternative approach where the simplistic standards of the BC SPM are not practically applicable, and this approach is supported as policy by the Ministry of Health.

For example, for the conceptual design custom horizontal separation to receiving area relief drains is needed in order to maintain design vertical separation and so improve overall system performance. Reduced separation to the ocean or Soule Creek in relation to the Islands Trust Land Use Bylaw (for the 2661 site dispersal system) must also be supported. In these cases, BC SPM standards are not applicable and a custom design must be undertaken—with one of the considerations of the custom design being that the system meet the objectives equal to or better than those forming the performance basis of the BC SPM.

To establish performance objectives for system design, appropriate site and project specific water quality objectives need to be selected.

Performance objectives are to be set for:

- Daily discharge flow from the system, and weekly average discharge.
- Treatment system performance (effluent quality objectives), including nitrogen species levels in effluent.
- Environmental performance (ambient water quality objectives), particularly pathogen indicator and nitrogen species levels in water flowing from the dispersal bed to the shallow groundwater table below the site.

Constituent mass loading or concentration objectives are to be defined to provide adequate protection to the receiving area, based on BC Water Quality Objectives and recommendations or comments to be made by the project biologist and or hydrogeologist.

As part of detail design, we will continue to work with the project biologists to establish detailed rationale for selection of final performance design objectives—including annual and seasonal nutrient mass loading objectives for the estuary, creek and water flowing toward the ocean based on long term monitoring and assessment of eutrophication risk.

For conceptual design we established conservative objectives based on the BC SPM rationale, BC Water Quality Guidelines, the EGBC Guideline, consultation with the project biologists and other sources. Preliminary modeling of performance for the conceptual dispersal systems was then used to compare performance outcomes to objectives. This approach and initial objectives were reviewed by the project hydrogeologist, Michael Payne PEng PGeo as part of our quality assurance procedures.

Environmental performance objectives for these sites also need to address the intent behind the Islands Trust Land Use Bylaw, OCP and related development permit areas. For conceptual design we considered that the intent of these local bylaws would be met by conformance with the above noted standards and guidelines, and this was confirmed by the Local Trust Committee in their issuance of a DVP for siting of the 2661 dispersal bed (citing the below noted performance objectives).

The objectives set for conceptual design included the following median objectives, applying to water moving from the dispersal systems at the base of the dispersal system post water table mounding vertical separation and prior to dilution in the receiving environment:

- Fecal coliform indicator bacteria, acute <200 CFU/100mL
- Fecal coliform indicator bacteria, chronic <0.2 CFU/100mL
- Nitrate nitrogen, chronic <6 mg/L as N
- Ammonia nitrogen, chronic <0.1 mg/L as N

These objectives may be measured at the outlet of the receiving area relief drainage system, representing water flowing from the dispersal bed's sand media to the receiving area.

To further manage risk, vertical separation will be monitored continuously by a datalogging system. This allows vertical separation to be used as a surrogate for performance, as well as allowing automated control of the system. Automated control will include alarm in case of vertical separation not meeting design standards and the provision of a discharge interlock to prevent effluent discharge in case of alarm.

A- 1.2 Monitoring and operation

Performance based design requires monitoring of system performance to the specified objectives. System performance monitoring would be mandated by the system maintenance plan, to include:

- Effluent quality monitoring for BOD, TSS and total Nitrogen.
- Flow monitoring for primary equalization and discharge, with data logging control of equalization system
- Monitoring of site water use, allowing detection of infiltration to the collection system
- Monitoring of water table depth below the dispersal bed (vertical separation monitoring), using continuous monitoring with datalogging, alarm and discharge interlock provisions
- Monitoring of Fecal coliform or E. coli levels and Nitrogen levels in water flowing from the receiving area relief drainage systems to confirm environmental performance in water moving from the dispersal bed to the receiving area.

The maintenance plan is to include specified actions in case of the system not meeting performance objectives. Due to the size of the sewerage systems, professional supervision of maintenance is required by the SSR.

The approved DVP for siting of the 2661 site dispersal bed requires monitoring under professional supervision, to meet the above noted performance objectives.

A- 1.3 Benefits of ground discharge to the receiving environment and shallow groundwater flow objectives

The intent of the recommended design approach for both sites is to allow water from the onsite system to return to the ground without any negative impact on the receiving environment—Soule Creek, Fulford Creek Estuary and the ocean.

A potential advantage of the onsite sewerage system is that this ground discharge will result in recharge of shallow groundwater below the site, which could improve water status in the riparian area adjacent to Soule Creek and the Fulford Creek Estuary as well as adding to base stream flow.

Receiving area shallow relief drainage is planned for both sites to control water table mounding caused by system flows and at the same time minimize impact on the existing seasonal water table. Managing risk of impact will primarily be through shallow placement of these relief drains, to avoid significantly lowering existing water table level (particularly at the 2661 site, which has more permeable soil and fill materials at depth and so would be more likely to see water table lowering with deeper drainage). Relief drainage water from each site is to be exfiltrated via a wetland system, mimicking a natural spring line and contributing water to the riparian area toward Fulford Creek Estuary, to mitigate impact on natural water flow patterns, and to potentially provide enhanced base flow.

As part of the final design we will continue to work with the project biologists to maximize these potential benefits from the dispersal system, and to minimize impact.

A- 1.4 Performance objectives for treatment system

Treatment system performance objectives are to be established based on dispersal system design, ultimately on required environmental performance.

A conceptual design of a mechanical treatment system was developed for each site. This system would be installed in subsurface tanks and a typical layout is provided on the attached sketch plan to allow an appreciation of the area needed for tankage. Actual treatment configuration will vary between the two sites based on wastewater characteristics, particularly due to the need to treat wastewater from commercial kitchen use on the 2661 site.

Note that this area would not be alienated from other uses (except buildings), and can be landscaped to restore native vegetation, because the tanks are below grade.

Typical expected performance (objectives) for the treatment system, measured at discharge to the dispersal system, would be as follows:

- BOD_5; 7.5 mg/L median, maximum10 mg/L
- TSS; maximum 10 mg/L
- Total nitrogen N; 90% to 95% removal, to median 8 mg/L
- Total phosphorous P; median 10 mg/L (no special removal in treatment)
- Oil and Grease; removal to a maximum concentration of 10 mg/L

These values were utilized during conceptual design of the dispersal system.

A- 2 PERFORMANCE OBJECTIVES FOR PRELIMINARY CONCEPTUAL DESIGN

A- 2.1 2661 Fulford Ganges Road dispersal bed and receiving environment

The planned location of the dispersal bed is in a similar area to the existing 2661 site septic field. This low lying area is located to the north of Soule Creek. Based on topography the planned dispersal area appears to drain toward Soule Creek, Fulford Creek Estuary and the ocean. Ditching of Soule Creek appears to have been carried out in the past, presumably in part to drain the area near the dispersal area.

It is estimated that water flowing from the proposed dispersal area would flow through sand media, existing fill and native soils toward the ocean, Fulford Creek Estuary and Soule Creek.

Water table mounding (above the existing seasonal water table level) would be controlled by a receiving area relief drainage system. The intent of receiving area relief drainage is to control water table mounding below the dispersal bed, improving system performance, while avoiding significant diversion of existing shallow groundwater flows.

As noted above, drainage water from receiving area relief drains would also exfiltrate from a small constructed wetland through a subsurface/surface flow swale (by others) in the riparian area toward Fulford Creek Estuary. Water in Fulford Creek Estuary will then flow to the ocean.

While the relief drains will exfiltrate some shallow groundwater from the dispersal area, the underlying shallow groundwater table is expected to continue to flow as it does at present.

Soule Creek at the south edge of the site discharges immediately to the ocean via a culvert below the Fulford Ganges Road. Water extraction points exist on Soule Creek, but these are upstream of the proposed dispersal bed. No water extraction points exist on Fulford Creek Estuary downstream of the site. No other downstream uses are evident.

A- 2.2 2621 Fulford Ganges Road dispersal beds and receiving environment

The planned location of the dispersal beds is in a plateau area near to the Fulford Ganges Road, above the Fulford Creek Estuary. Based on topography, this area appears to drain toward the Fulford Creek Estuary with the potential of some flow toward Soule Creek.

It is estimated that water flowing from the proposed dispersal bed would flow through sand media and existing native soils toward the Fulford Creek Estuary or Soule Creek.

Water extraction points exist on or next to Fulford Creek, but these are upstream of the proposed dispersal bed. No downstream uses are evident.

Water table mounding (above the existing seasonal water table level) would be controlled by a receiving area relief drainage system. The intent of receiving area relief drainage is to control water table mounding below the dispersal bed, improving system performance, while avoiding significant diversion of existing shallow groundwater flows.

As noted above, drainage water from these receiving area relief drains would also exfiltrate from a small constructed wetland through a subsurface/surface flow vegetated swale (by others) in the riparian area that eventually flows toward the Fulford Creek Estuary. Water in the Estuary will then flow to the ocean.

While the relief drains will exfiltrate some shallow groundwater from the dispersal area, the underlying shallow groundwater table is expected to continue to flow as it does at present.

The planned location of the 2621 dispersal beds is outside of all regulatory setbacks and outside of development permit areas (DPA) which are relevant to siting of sewerage system components. However, the same performance based approach has been taken for design of this system, and the same performance objectives utilized, in order to mitigate risk to the receiving environment. For the purpose of this memo, the design approach for both dispersal systems and treatment systems is the same.

A- 2.3 Setting of performance objectives

Preliminary discussions with the project biologist and review of BC Water Quality Objectives and the EGBC Professional Practice Guideline, Onsite Sewerage Systems resulted in establishment of performance objectives for water flowing toward Soule Creek, Fulford Creek Estuary and the ocean.

Because the receiving area contains both fresh and ocean water, for preliminary conceptual design objectives are based on priorities for both environments. During detailed design further development of objectives can be undertaken based on monitoring of the receiving environment.

Two sets of objectives are to be selected for detailed design, as follows:

- Acute objectives are related to avoiding toxicity and impact on human health. For preliminary design these are applied to water at the base of the design vertical separation for the dispersal beds.
- Chronic objectives are related to avoiding impact due to long term exposure and long term increase in background nutrient or pathogen levels. These would be applied during detailed design to water in the hyporheic zone at the edge of Soule Creek (for example, for the 2661 site), and so could include consideration of some treatment and dilution in the immediate receiving environment. For preliminary design chronic objectives are established for the base of the design vertical separation based on an expectation of minimum 2:1 dilution to a standing fresh water body to represent the worst case in low flow or estuarine conditions, based on guidance provided in the EGBC Guideline.

A- 2.4 Objectives for preliminary conceptual design

Fecal coliform indicator bacteria; 200 CFU/100 mL acute objective based on primary contact objectives and aligned with the BC SPM performance objective to meet recreational water quality standards at the base of the design vertical separation. For conceptual design a target chronic objective of 3 Log10 below this value was set to reduce the need for routine monitoring and improve health protection—particularly, in respect of uncertainty regarding virus attenuation, objective 0.2 CFU/100 mL.

Nitrate nitrogen N For water in Soule Creek or the Fulford Creek Estuary; Acute objective 33 mg/L maximum, chronic objective 30 day median maximum 3 mg/L. Based on expectation of minimum 2:1 dilution at entry to creek chronic objective for base of vertical separation established at 6 mg/L median.

Note that full nitrification is expected in treatment and in the dispersal bed sand media and so consideration of nitrite N and ammonia N was not included. Based on the *British Columbia Approved Water Quality Guidelines: Aquatic Life, Wildlife & Agriculture, Summary Report*, Ministry of Environment, January 2017 and personal communication with project biologists, following guidelines for acute short term maximum and 30 day average concentration to protect freshwater aquatic life (Table 26A): Ammonia nitrogen N; Chronic objective median <0.1 mg/L. As noted above, ammonia N above this level is not expected except in case of system malfunction.

Phosphorous, total P; objective not established because the receiving environment does not include standing water bodies that might be subject to eutrophication impact due to phosphorous inputs.

However, there may be risk of eutrophication in the Fulford Creek estuarine environment at the mouth of the estuary, which is under the influence of water flowing from Fulford and Soule Creeks. During detailed design monitoring of phosphorous levels in the near shore and estuarine environment and assessment by the project biologists of controlling factors for eutrophication may lead to establishment of a phosphorous objective for the project. During conceptual design, maintenance of low HLR and the use of micro dosing has been proposed and this is expected to result in effective removal of phosphorous within the design vertical separation to median <1 mg/L, which meets EGBC guideline values recommended for generic application to water flowing toward a standing fresh water body. Further removal will occur in the immediate receiving environment and so at this stage phosphorous is not considered to be likely to control design of the system.

These objectives are conservative, because they are based on objectives for water in Soule Creek or the Fulford Creek Estuary flowing toward the ocean, while for preliminary design they were applied to the base of the design vertical separation below the dispersal bed.

In operation, during summer conditions improved system performance is expected due to increased vertical separation due to lower water table conditions, and due to increased treatment capacity in the receiving area. During wet season conditions dilution by rainfall and streamflow is expected.

For nitrate nitrogen, the receiving environment is expected to provide good removal due to the presence of organic matter and availability of anoxic microsites. Shallow placement of relief drains is expected to enhance this action at the 2661 site particularly.

A- 2.5 Objective summary

See Section A- 1.1 for a summary of objectives.

B. Site and soil parameters

B- 1 METHODOLOGY

It is considered that the key constraints to placement of dispersal systems on the sites are related to the need to meet environmental performance objectives and satisfy concerns and regulatory requirements of the Islands Trust and the Archaeology Branch, rather than to uncertainty over soil parameters for design. Awaiting an archaeological permit for detailed test pitting, and waiting for wet season monitoring of water table levels would have introduced an unacceptable delay to the client's schedule. Based on this consideration, after discussion with the client we proceeded on the following basis.

We have based conceptual design on records of previous soil test pitting and permeability testing by H_2O Environmental and Madrone Environmental, supplemented by auger testing and evaluation of exposed soils and cutbanks on site and with site reconnaissance (with observation of seasonal water table) during wet season conditions. Further, we have compared observed and reported conditions with our experience at similar sites in the Gulf Islands and Vancouver Island.

Using this information, we selected conservative site and soil parameters for conceptual design, with a view to allowing for a less conservative approach during detail design and construction.

B- 2 2661 FULFORD GANGES ROAD

B- 2.1 Site

The site is generally very low slope, consisting of raised beach and probable filled lagoon area. During the past, parts of the site have been deeply filled, soils have been disturbed and large parts of the site are covered by asphalt or the foundations of the old buildings. Toward Fulford Creek an old log retaining wall supports the interpretation of filling.

A small grassed area to the south of the site was previously in use as a septic field. This area shows evidence of less than perfect drainage and borders a seasonal fresh water body, with a SPEA constraining use of this area.

Archaeological constraints have been identified and will need to be addressed as part of the development process.

The site is further constrained by horizontal separations to water extraction points on Soule Creek, the natural boundary of the ocean toward Fulford Harbour and in the estuary of Fulford Creek. The Islands Trust Land Use Bylaw requires a minimum 30 m setback for septic fields from water bodies, including the ocean, resulting in the need for a variance to allow placement of a new dispersal system (this variance has been approved by the Local Trust Committee).

B- 2.2 Sea level rise and flood risk

Flood modeling for this site is outside our scope, and outside the scope of typical conceptual design for site facilities.

To consider risk related to our conceptual design we referred to the CRD "Task 2 – Sea Level Rise Modeling and Mapping Report, Version 2.0", October 2021. This report establishes flood construction level (FCL) for 0.5m 1m and 2 m sea level rise with consideration of wave action, storm surge, rise in sea level and freeboard. The values are presented based on a 1:200 year return period.

Based on this report and our conceptual design it appears that the dispersal and tank area are not likely to be subject to flooding or scouring, but that the transient water table elevation in a 1:200 year flood event may be close to or slightly above the dispersal system infiltrative surface.

The SPM recommends consideration of the 1:20 return period flood level for system protection. At detail design we plan to source or interpret data for an appropriate 1:20 year return period maximum water level based on 1 m seal level rise in order to inform setting of automated control of effluent discharge.

We have included transient high water table and flood condition considerations within our risk management strategy for the conceptual design. See Section B- 2.7, below.

B- 2.3 Soils

Due to past site disturbance and filling, soil conditions are expected to be highly variable over the site and this is confirmed by evidence of reported test pitting.

Given the low elevation of the site in relation to the ocean, and the risk of sea level rise and or elevated water table during high tide/high streamflow conditions it is considered likely that available soil depth is limited by seasonal or short term water table conditions close to the general ground surface. For conceptual design we have selected 60 to 70 cm BGS as depth to seasonal high water table (SHWT), a shallower depth may be considered for detailed design—which would result in the system being higher above grade.

This is supported by the following observations:

- Current high water mark established by the project biologist in the Fulford Creek estuary is at approximately 1.5 m elevation, the site plan shows a 2.5 m contour (CDVD28) within the existing septic field area. Allowing for some water table mounding during rainfall conditions it is likely that existing vertical separation to seasonal water table may be less than 1 m based on these measurements.
- Observed water table in the eastern (low lying) part of the 2621 site are at approximately 2 to 2.5 m elevation based on the site plan, with water at grade in some parts of the area.
- The potential dispersal bed location is elevated only slightly above Soule Creek.
- Mottling shown in test pit photograph provided in the Madrone Environmental report of test pitting in the potential dispersal area at approx. 60 to 70 cm BGS.
- Sea level rise and flood risk may result in short term saturation of soils, and potentially to higher seasonal water table levels. This has been addressed within the design concept through the use of a conservative SHWT level basis and, for unusual flood events or other transient water table rise, risk management, consistent with the SPM standards rationale, as discussed in Section B- 2.7, below.

Available soils information shows soils in the existing dispersal and nearby areas to consist of sandy or gravelly sandy fill in the upper part of the soil, to up to 60cm depth. In the existing septic field area a layer of spread midden material is reported below this fill in Sandy Silt, and above Very Gravelly Sand which appears from reports and photographs to be similar to the local beach conditions.

Observation of the exposed soils at Fulford Creek suggest that parts of the area may be underlain by Silty Clay Loam and Silty Clay soils of low permeability. This was also reported in one of the H_2O test pits in the lower area of the 2621 site.

Some evidence of mottling in photographs of pits indicates risk of seasonal water table at 60 to 70 cm BGS—and this is somewhat confirmed by observation of wet area vegetation in a depressional area in the existing septic field.

The sands and sandy fill materials are reported to show a Kfs of 2400 mm/day (H_2O Environmental reported test results for field saturated hydraulic conductivity).

For deeper soils, worst case may be disturbed Silt Loam midden soils with Poor structure and consistence category, based on SPM HLR table rationale Kfs for these soils estimated at 400 mm/day (to be confirmed when site evaluation is permitted), to inform drainage design. This is considered to be conservative based on observations reported of Very Gravelly Sand similar to beach sand at depth.

We have based our design on the use of imported sand media with an above grade system, relying on polishing treatment in the sand media only, rather than relying on native or in place soils, for the following reasons:

- The very limited site area available is expected to result in a need for receiving area relief drainage systems to control groundwater mounding below the dispersal bed, particularly in wet season conditions.
- During wet season conditions water table mounding and or intermittent high water table conditions may saturate native soils below the system, resulting in treatment in sand media only.
- Sea level rise may result in reduction in available soil depth and may necessitate the use of an above grade system even where soils are favorable.
- An above grade system may be needed or be preferable in order to reduce risk of archaeological impact.
- Reliable prediction of soil conditions under the whole dispersal bed and immediate receiving area is not practical due to the disturbed nature of the site and the presence of mixed fill, and for preliminary design due to archaeological constraints.
- To provide adequate system length and meet siting constraints installation of part of the dispersal bed within currently paved areas will be needed, soils in these areas are likely to be compacted.

The native or fill soils below grade may, however, be usable for water flow from the water table mound below the dispersal bed to the receiving area whether saturated or not. The conceptual and preliminary design has considered an allowance for water flow from the dispersal system toward the receiving area and receiving area relief drains in a 70 cm deep layer of existing sandy soil fill. This is based on the following:

- High water mark for Soule Creek or Fulford Creek 1.5 m elevation
- Base of drain trenches at 1.5 to 1.80 m elevation (allowing for slope on drain from west and east ends to centerline, with discharge from centerline of drain, slope 0.75% approx.)
- Existing ground surface in proposed bed alignment 2.5 to 3 m elevation
- Depth of soil from base of drain to original grade, based on highest drain elevation of 1.80 m, 0.70 m.
- Depth to top of drain (15 cm drainage material) 0.55 m minimum, typical 0.6 m or better.
- Probable drain discharge elevation (at exfiltration wetland) 2.15 m.
- Priority to avoid significantly lowering existing seasonal water table elevations by relief drainage, so as to not unduly disturb existing shallow groundwater flow regime, resulting in a need to keep relief drains shallow to existing grade.

Note that this placement of receiving area relief drains and exfiltration elevation is expected to result in seasonal water table at similar elevation to the current seasonal water table, and saturated flow toward the relief drains. This saturated flow is expected to improve nitrogen removal, particularly where drainage media is enhanced with organic matter.

It is considered likely that during all or parts of the year flow to permeable native soils and fill below the site and toward the ocean will form part of water recycling and add natural discharge capacity to that provided by the recommended relief drainage system.

B- 2.4 Location for dispersal bed

For conceptual design a location was chosen for the dispersal bed on top of the existing septic field, and extended onto the 2621 site to provide a suitable aspect ratio.

This location was chosen as being in an area which the developer has indicated would be available for use based on placement below parking stalls, while maximizing horizontal separation to the Fulford Creek estuary. The location also benefits from opportunity for water flow toward Soule Creek and the ocean and already has in place some favorable fill material (based on reported test pit logs).

Since this location is already the site of a septic field, replacement of the dispersal system in situ minimizes further site impact.

The potential bed layout is shown on the conceptual design sketch plan, avoiding the defined SPEA to Soule Creek, maintaining a 30 m separation to the drinking water extraction points on Soule Creek to the south of the road, with slightly smaller setback to the ocean than for the existing system and maintaining a setback to Fulford Creek Estuary of over 30 m.

With suitable landscaping and raising of the parking area, the use of this area is not expected to negatively impact other site uses.

We propose extending the dispersal bed across the lot line to the 2621 site in order to increase system length and reduce width, improving VS performance. An easement will be necessary over the 2621 site in favor of the 2661 site to allow placement, operation and maintenance of the dispersal bed and receiving area relief drains. It is our understanding from correspondence with Islands Trust that this approach will be acceptable. In our previous experience this approach has also been acceptable to Island Health, however, as noted in the introduction, TRAX cannot guarantee outcomes.

B- 2.5 Receiving area relief drainage

To achieve polishing treatment in sand media and or native soils below a dispersal bed it is important to have adequate unsaturated permeable soil depth (vertical separation) below the system.

Because the potential area for bed construction is constrained by limited available length, and because there is a risk of shallow depth to seasonal or intermittent high water table (and because there is a priority to maintain that water table at its natural level), vertical separation will be constrained by water table mounding below the dispersal system.

To maintain adequate vertical separation for performance and provide improved sand media and soil based polishing treatment it is therefore necessary to provide relief drainage in the immediate receiving area to manage water table.

Based on discussions with the project biologists it has been determined that it is preferable for additional water flowing from the receiving area relief drainage system to flow toward Soule Creek. However, Islands Trust staff have indicated that they are concerned to avoid this. So, the outlet of the receiving area relief drains is planned be led to an exfiltration wetland system toward Fulford Creek Estuary. This exfiltration wetland is intended to enhance the Fulford Creek Estuary riparian area, and is planned to be vegetated with native plants.

B- 2.6 Tank locations

Tank locations are flexible to development needs, and the conceptual design sketch plan shows the size of tanks laid out for comparison purposes only—tanks could be moved to any convenient location as long as statutory setback (30 m) to wells is maintained and any necessary local government development permissions addressed.

For the 2661 site, given the risk of high water table conditions on the site, it is important that the collection system be designed and implemented to avoid inflow and infiltration. A pump will be used to lift effluent from the equalization tank, reducing risk of water table around subsequent tanks by keeping tanks as high as practical. Relief drainage may be utilized to control water table in the tank area, and tanks which may be empty will be protected from floating by flanges or other restraints.

B- 2.7 System risk management related to flood or transient high water table risk

As noted above, there is a risk of transient rise in seasonal water table due to extreme weather events, and in unusual circumstances the dispersal area and tank area may be subject to shallow flooding.

System conceptual design includes a number of considerations and features which will both reduce risk of damage to the system components and manage risk of negative impact to health or the environment.

These include the following:

- System electrical components will be placed well above grade in the building and not subject to flooding risk.
- If there were a transient rise in water table level at the tanks, or even shallow flooding, the watertight tanks would not release effluent or sewage to the water table or to surface flood waters.
- If the tank area were subject to high water table or flooded, the tank anti-flotation provisions would prevent tanks floating and so avoid subsequent leakage risk.
- The location of the dispersal system below parking and landscape/hardscape areas reduces risk of damage to the system during transient high water table or even flooding, and during recession. Safe dewatering of the area would be assisted by the relief drains during recession.
- Continuous vertical separation monitoring will be in place, and a higher than design water table would lead to an alarm.
- Using the vertical separation monitoring, a control point will be set to prevent operation of the system equalization and discharge pumps at a specified water table elevation. So, there will be no discharge of effluent to the dispersal area if vertical separation is inadequate to meet standards set by the performance based design.
- During extreme flood events sewage flow from the building to the system are likely to be very low or zero due to reduced use of the building. However, if the system is not discharging effluent, the large equalization tanks are available to temporarily store any wastewater flows that do occur from the building.
- Any wash out of contaminants to transient high water table from the dispersal area sand media and soils would be minor, due to the protection of the dispersal area, and dilution of any contaminants by flood waters would be very high.

The proposed approach is consistent with the rationale for SPM standards and guidelines for system placement and design in areas of flood risk. The consideration of a 1:200 year event, with conservative sea level rise, together with additional provision for discharge prevention goes above and beyond SPM standards and guidelines, in consideration of the sensitive receiving environments at this site. The level of risk mitigation planned is significantly higher than that for a typical onsite sewerage system.

B- 2.8 Power outage risk management

The site may be subject to short and moderate term power outages. It is our understanding that the client plans a back up generator system and that the system will be connected to the generator in case of outage.

The large flow equalization tank capacity planned also provides a significant buffer in case of generator failure or occasional shut down.

Discharge control systems and pumps will be protected from voltage fluctuations and dirty power.

B- 3 2621 FULFORD GANGES ROAD

B- 3.1 Site

The site is consists of a plateau area in the SW part, with a steep bank to the Fulford Creek Estuary to the north. On the east part of the site, below the steep bank, a flat area with some local depressions borders the estuary. This area may have been created by past filling and is largely cleared with some bush and tree growth near the estuary, some bank reinforcement is reported along Fulford Creek Estuary.

The western part of the site, with a surface well and a bridge to the neighboring property, is likely to require additional development permissions because it is in a different zone.

For the dispersal system, the area to the west of the bridge is of little utility due to the need to maintain a 30 m separation to the water well and due to topographical constraints.

A drilled well is reported next to the road on the south of the site, but this is planned to be decommissioned. The site is constrained by separations to the Fulford Creek Estuary, Soule Creek and the existing water well. The project biologist reports the upper limit of the estuary to be approximately at the bridge location.

The upper plateau is cleared, and was reportedly used for agriculture. A house remains on the plateau area. An existing sand mound dispersal area is observed to the west of the existing house.

The steep bank area does not show any signs of slips or erosion, old trees are present and appear upright suggesting that the bank is historically stable. Some cuts have been made in the bank toward the east end of the bank area and a deep cut was made at the west end for the road serving the bridge over Fulford Creek. Much of the bank is covered by shrubs and some trees. TRAX has not reviewed slope stability and such a review is outside of our scope, see Section B- 3.3, below.

As noted in Section D- 3, below, the 2621 site is divided between two land use zones. Based on advice from KRA and information provided via KRA from Islands Trust planners we have shown the dispersal field extending across the zone dividing line.

B- 3.2 Soils

The lower area to the east of the site is not considered suitable for ground discharge to native soils, as water table is observed near or at the surface in wet season conditions and drainage is not likely to be practical given the low elevation of this area. Reported and observed soils are mixed native soils and fill within the upper 70 cm plus. Observation of the exposed soils at Fulford Creek suggest that parts of this lower area may be underlain by Silty Clay Loam and Silty Clay soils of low permeability. This was also reported in one of the H_2O test pits in the lower area.

The plateau area is not considered likely to be affected by flooding, but shows evidence of poor drainage in the central and southern parts. This poor drainage is interpreted to be due to the relatively low permeability of the soils and the low slope nature of the area. Soils are reported and observed to be Silt Loam and Clay Loam with a reported Kfs of median 350 mm/day.

The top of the steep bank area was evaluated using auger testing and the remainder of the bank evaluated based on cut banks at the west and east ends. Soils were found to be similar to those reported for the plateau area, but with greater depth to seasonal water table. The improved usable soil depth is interpreted to be due to the undisturbed nature of these soils (in comparison to the area used for agriculture) and the positive drainage provided by the steep bank receiving area.

Typical surficial soils were Loam (GR/2 VFR) or Silt Loam (GR/3, FR) with some areas of Loamy Fine Sand reported in earlier test pits. These soils transitioned at 45 to 60 cm depth to Silty Clay Loam (ABK/3, FR) and then to Clay Loam (ABK/2, FR). Soils generally showed <15% coarse fragments. Usable soil depth observed from cutbanks was over 150 cm to seasonal high water table. Although the soils in the steep bank area are of relatively low permeability, they are of types which are considered to provide effective polishing treatment, particularly where dosed to avoid saturation, and constitute a favorable receiving area.

Based on our evaluation and previous reported information we selected the following soil parameters for conceptual design:

- Soil type Silt Loam and Clay Loam, Favorable structure and consistence category (for HLR selection)
- Soil permeability for HLR selection and consideration of contour length, Kfs 350 mm/day
- Soil depth to SHWT > 75 cm in all observed locations and >150 cm was observed in some areas.
- Shallow groundwater flow from the plateau appears, based on test pit logs, to be toward the steep bank and Fulford Creek Estuary.

B- 3.3 Location for dispersal area

During conceptual design we identified the area along the top of the steep bank as the preferred location for a dispersal bed for this site, due to favorable soils, water table conditions and topography. We recommended a Development Variance Permit to allow placement in this location (within 30 m of Fulford Creek Estuary). However, due to concerns expressed by Islands Trust planners with respect to a Development Variance Permit for placement of the dispersal area along the top of this bank we have relocated the proposed dispersal area to the above noted plateau area toward the Fulford Ganges Road.

This proposed location places the dispersal area outside of Islands Trust setbacks and we understand it also places the system outside of development permit areas related to sewerage systems.

The conceptual design recommends use of imported sand media bioretention mixture to form dispersal beds in an area subexcavated from the plateau, with final grade only slightly raised above the current site grade in order to reduce impact on other planned site development and to allow for subexcavtion of damaged surficial soils in parts of the area. The dispersal beds would be placed in landscaped areas, outside of paved or parking areas.

B- 3.4 Receiving area relief drainage

To achieve polishing treatment in sand media and or native soils below a dispersal system it is important to have adequate unsaturated permeable soil depth (vertical separation) below the system.

Because the potential dispersal area is constrained by limited available length, and because there is a risk of shallow depth to seasonal or intermittent high water table in low permeability soils below the bed area, vertical separation will be constrained by water table mounding below the dispersal system.

To maintain adequate vertical separation for performance and provide improved sand media and soil based polishing treatment it is therefore necessary to provide relief drainage in the immediate receiving area to manage water table.

The intent of receiving area relief drainage will be to control water table mounding while minimizing impact on existing shallow groundwater flows toward the Fulford Creek Estuary. This will be achieved by shallow depth to relief drains, as for the 2661 site.

Since existing shallow groundwater flows from the plateau area appear to be largely toward Fulford Creek Estuary, and since additional base flow toward the estuary may benefit the estuary riparian area it is planned that water from receiving area and tank relief drains be led to flow toward the estuary. The outlet of the receiving area and tank area relief drains is planned be led to an exfiltration wetland system below the steep bank, which will flow via a subsurface/surface flow swale (by others) in the riparian environment to the estuary. This exfiltration wetland is intended to enhance the Fulford Creek Estuary and it's riparian area.

B- 3.5 Tank locations

Tank locations are flexible to development needs, and the conceptual design sketch plan shows the size of tanks laid out for comparison purposes only—tanks could be moved to any convenient location as long as statutory setback (30 m) to wells is maintained and local government regulations met.

For the 2621 system, given the location of the proposed development on two levels it is recommended that collection sewers be led to two primary settling tank systems, and the effluent from the lower area (from the loft units) discharged to the upper area by pump to the equalization tanks. Given the high water table conditions on the site, it is important that the collection system be designed and implemented to avoid inflow and infiltration. Tanks in the upper area should be installed in a partially drained tank nest to reduce risk of water table accumulation around the tanks (drain not shown in drawing), and anti-flotation restraints used as necessary. Tanks in the lower area should be installed as close to grade as practical, and drainage used to maintain seasonal water table levels below the tank lid joint elevation together with anti flotation restraints.

The location of the 2621 site tanks within Land Use Bylaw property line setbacks has been allowed by the approved DVP.

B- 3.6 Power outage risk management

The site may be subject to short and moderate term power outages. It is our understanding that the client plans a back up generator system and that the system will be connected to the generator in case of outage.

The large flow equalization tank capacity planned also provides a significant buffer in case of generator failure or occasional shut down.

Discharge control systems and pumps will be protected from voltage fluctuations and dirty power.

C. Environmental performance and health protection

C- 1 CONCEPTUAL DISPERSAL BEDS DESIGN SUMMARY

C- 1.1 2661 Fulford Ganges Road

Design flow for peak day discharge, 21,750 L/day.

Dispersal bed location is per the approved Development Variance Permit.

The layout and design concept for this site is based on an above grade sand media bed.

Distribution to the bed would be by subsurface drip dispersal (SDD). SDD uses small diameter (16 mm) flexible pipe with pressure compensating emitters molded into the pipe every 30 to 60 cm. This pipe is installed close to grade (15 to 20 cm below grade in landscaped areas, deeper below parking areas) and micro doses the dispersal area sand or soil with effluent. The emitters are protected from root intrusion. SDD was selected for conceptual design because it provides improved treatment performance in the sand media, reduces depth of sand and system height above grade required and allows for flexibility in landscape plantings.

The site is severely constrained by regulatory setbacks and by areas of soils shallow to SHWT. As illustrated the conceptual layout results in the need for part of the dispersal bed to be placed under parking stalls and a short section to be below a paved area. It is our understanding that parking stalls will use permeable paving to allow for oxygen transfer to the bed. The ends of the bed will be accessible outside of paved areas to allow for maintenance, and suitable structure will be used over the bed to protect the bed from vehicle loading. Passive and active aeration piping will be installed to ensure gas transfer in the dispersal bed.

Conceptually designed bed configuration, based on an HLR at DDF of <36 mm/day at peak day discharge is as follows:

- Length 66 m at bed, 70 m overall (based on extending the bed across the property line to the 2621 site).
- Width 9.5 m to outer edge of bed.
- Sand media depth minimum above existing grade 65 cm. Additional depth is necessary for cover soil (20 cm total) and cover structure under paved or parking areas.
- Overall typical height of final grade in bed area above existing grade ~125-130 cm within parking area, placing top of parking stalls at ~ 3.9 m minimum elevation over the bed.
- Bed below parking area to be actively aerated, with air distribution piping leading air from blowers to provide necessary air supply for in media polishing treatment. This aeration to be enhanced by used of impermeable paving system (to retain distributed air).
- Width to receiving area relief drains from edge of bed, 2 m. Relief drain soffit target minimum 55 cm below existing grade, where practical. Where impractical, increased system height may be required.

Based on this loading rate and micro dosing, preliminary modeling indicates that defined performance objectives (see Section A- 1.1) is expected to be met for Fecal coliform indicator bacteria and nitrogen species. Performance outcomes during normal operation are modeled to chronic objectives and during heavy rainfall events to meet acute objectives.

C- 1.2 2621 Fulford Ganges Road

Design flow for peak day discharge, 10,800 L/day.

Dispersal area location is based on siting outside of Land Use Bylaw setbacks.

The design concept for this site is based on a below grade bioretention sand media bed over subexcavated native soils in the landscaped portion of the plateau area near the Fulford Ganges Road.

Distribution to the bed would be by subsurface drip dispersal (SDD). SDD uses small diameter (16 mm) flexible pipe with pressure compensating emitters molded into the pipe every 30 to 60 cm. This pipe is installed close to grade (15 to 20 cm below grade) and micro doses the dispersal area sand or soil with effluent. The emitters are protected from root intrusion. SDD was selected for conceptual design because it provides improved treatment performance in the sand media and native soil, reduces depth of sand and system height required and allows for flexibility in landscape plantings. Further SDD is tolerant of off slope or out of level installation (to allow better conformance to existing grade).

For conceptual design the bed design was based on that for the 2661 site, with a loading rate of <36 mm/day at peak day flow. Bed configuration (with some allowance for layout losses) may be as follows:

- Two parallel beds to address length constraint.
- Length total average 50 m at beds, each bed at average 25 m.
- Width 6.6 m to outer edge of bed for each bed.
- Sand media depth typical above native soils 60 cm minimum 50 cm, with subexcavation of 45 to 60 cm into native soils, sand media base cambered to drains.
- Final grade in bed area, typical 20 to 30 cm above existing grade.
- Width to receiving area relief drain from edge of bed, 2 m. Receiving area relief drain base typical 90 cm below existing grade, with discharge controlled to result in drainage to 75 cm BGS average (to reduce diversion of existing shallow groundwater flow).

Based on this loading rate and micro dosing, preliminary modeling indicates that defined performance objectives (see Section A- 1.1) will be met for Fecal coliform indicator bacteria and nitrogen species. Performance outcomes during normal operation are modeled to meet chronic objectives and during heavy rainfall events to meet acute objectives. Sand media depth is based on exceeding acute pathogen attenuation objectives within the sand media only for a worst-case situation.

C- 2 CONCLUSION

For both sites it is our opinion that a sewerage system constructed and operated following this conceptual design is expected to meet the design intent and the water quality performance objectives established for this project (see Section A- 1), with monitoring after treatment and at the receiving area relief drainage systems.

Based on the systems meeting these objectives and intent, the systems are expected to allow for on site sewerage system servicing without creation of a health hazard or negative impact on water quality in the receiving environment.

This performance based approach is intended not only to protect the receiving environment, but also to conform to the approved Development Variance Permit to permit placement of sewerage system dispersal area for the 2661 site closer to water bodies than otherwise allowed by the Salt Spring Island Land Use Bylaw.

D. Regulatory constraints

D- 1 SEWERAGE SYSTEM REGULATION AND MINISTRY OF HEALTH POLICY

The conceptual design as described follows the standards of the SSR. The recommended approach for these sites, based on Ministry of Health policy, is for a professional to design the system in compliance with EGBC Guidelines. This is the approach that has been followed for conceptual design and will be followed at detail design.

D- 2 RIPARIAN AREA PROTECTION REGULATION

The conceptual design layout is intended to place all sewerage system components outside the SPEA as defined by the project biologist (see attached plan). As noted, the part of Fulford Creek downslope of the bridge near the NW corner of the property is considered an estuarine environment and does not fall under the RAR. See Section D- 5.2, below.

However, at detail design we would continue to work closely with the project biologists to ensure the sewerage system did not negatively impact the receiving environment. As noted above we also propose working with the project biologists to identify potential benefits of ground discharge and designing the system in a manner that enhances those benefits.

D- 3 ISLANDS TRUST LAND USE BYLAW, APPROVED DVP

The local Salt Spring Island Land Use Bylaw establishes in Section 4.5.1 a setback from any water body to a septic field of 30 m. A variance was therefore required for dispersal area construction for the 2661 site.

This DVP has been approved by the Local Trust Committee, allowing siting of the dispersal area as shown, with conditions that include adherence to the proposed performance based design approach and a requirement for monitoring to meet the established performance objectives shown in Section A- 1.1 of this memo.

When considering the objectives of the Land Use Bylaw and the Official Community Plan we considered statements in the OCP for protection of drinking water sources, and also referred to the objectives of the OCP development permit areas (DPA) related to protection of water bodies. Performance objectives related to human health protection and to environmental protection were developed considering these community objectives, see Section A- 1.1.

The Land Use Bylaw also establishes property line setbacks for structures. We have been informed by the Islands Trust planner that the Islands Trust consider subsurface sewerage system tanks to be "structures". We have also been informed that dispersal beds and piping are not considered "structures". For 2661 separation from tanks to property lines is unlikely to encroach on structure setbacks. For 2621 a variance was needed to allow placement of tanks closer to property lines in order to place tanks in appropriate locations. This variance has been approved.

The local Land Use Bylaw also regulates removal of soil and placement of fill material. Excavation, and placement of fill, is necessary for construction of a properly functioning sewerage system at both of the sites. Imported sand media fill will be used to provide improved polishing treatment in dispersal, and, in the case of 2661, to address elevation considerations. It is recommended that the site development permit expressly allow for the construction of the sewerage systems, with associated excavation and filling.

For the 2661 site dispersal of effluent occurs within the same zone (CA2(b)) as the use based on the plans provided. For the 2621 site the sewerage system is partially in the area to the west of the CA zone, Islands Trust staff have indicated no issue with this.

In respect of the Land Use Bylaw, we note that sewerage system design for these sites will involve professional design and professional supervision (field review) of construction and maintenance. The client has indicated that this approach will be followed, and in any case the SSR requires this approach due to the size of the systems.

D- 4 WATER SUPPLY WELLS

As noted above, the water supply well near the south center of the upper property is planned to be decommissioned. Other than this well the conceptual layout respects the SSR regulatory 30 m separation between sewerage system components and domestic drinking water supply wells, and any parallel 30 m setback to wells requirement of the Islands Trust's.

D- 5 DEVELOPMENT PERMITS

The site is subject to several development permit areas (DPA), and siting of the sewerage system components may need to be considered during the development permit process. When this is under consideration, we recommend that the Local Trust Committee continue to base decisions on the performance based design approach that is being used, which they have already supported through issuance of the approved DVP. The following sections address sewerage system dispersal bed and tank placement, and receiving area relief drainage placement in the context of the OCP DPAs.

D- 5.1 Water bodies (DPA 3 and 4)

Conceptual layout places the sewerage system dispersal beds ("septic fields") and tanks outside of the DPA 3 (Shoreline) and DPA 4 (Lakes, Streams and Wetlands) setback (10 m) areas to the ocean and other water bodies. However, as noted above, we considered protection of fresh and marine water bodies as part of objective setting for performance of the sewerage systems.

The planned exfiltration wetlands for both sites are outside the DPA 4 10 m setback and also over 15 m from Fulford Creek Estuary and the ocean.

A subsurface/surface flow swale is planned downslope of each of the wetlands to facilitate flow of water toward the creek or estuary.

All wetlands and swales are to be vegetated in natural vegetation, to be selected by the landscape architect in consultation with the design engineer and project biologist.

Risk management is explained in this memo. Based on the performance-based design approach, we consider that the conceptual design meets the intent and objectives of the OCP for protection of water bodies from impact by sewerage systems, including protection of human health and of the environment related to water quality. Receiving area relief drainage systems design also considers mitigation of impact on existing seasonal water tables and existing shallow groundwater flow.

D- 5.2 Riparian area (DPA 7)

DPA 7 is based on the Riparian Areas Regulation (RAR) requirement for protection of riparian areas around streams. All proposed development within a Riparian Assessment Area of 30 m from Soule Creek was evaluated by the project biologist, Swell Environmental, in their RAR report. This evaluation included the construction of the 2661 site dispersal bed, with fill materials, and the installation of receiving area relief drainage systems.

In this report Swell has established a SPEA for Soule Creek of 10 m and for Soule Creek ditch of 2 m. All components of sewerage systems (tanks, dispersal bed, piping) are to be placed outside the defined SPEA for Soule Creek. All components of the receiving area relief drains are also to be placed outside the SPEA for Soule Creek.

Risk management is explained in this memo. Based on the performance-based design approach, and on the report by Swell Environmental the conceptual design is intended to meet the intent and objectives of the OCP and the RAPR for protection of water bodies from impact by sewerage systems construction and operation, including protection of human health and of the environment.

D- 5.3 Steep slope

The sewerage system dispersal beds, tanks and other components for both sites is outside any steep slope area. It is our understanding that DPA 6 relates to steep slope areas, so should not be applicable to the sewerage systems as proposed.

Please do not hesitate to contact the undersigned for clarification.

Ian Ralston P.L.Eng

TRAX

Attached:

Statement of general conditions

Draft sketch plan showing sewerage system conceptual layout overlaid on redevelopment plans (draft not sealed)

Statement of General Conditions

Scope of this Report

This review report satisfies only those objectives stated in the introduction. TRAX Developments Ltd. (TRAX) has not conducted a Site Investigation, Hydrogeology Study or Environmental Impact Assessment.

Use of this Report

This TRAX Developments Ltd. (TRAX) report pertains only to a specific project. If the project is modified, then our client will allow us to confirm that the report is still valid. We prepared this report only for the benefit of our Client and those agencies authorized by law to regulate our Client's activities. No others may use any part of this report without our written consent. To understand the content of this report, the reader must refer to the entire, signed report. We cannot be responsible for the consequences of anyone using only a part of the report, or referring only to a draft report. This report reflects our best judgement based on information available at the time. Any use of this report, or reliance on this report, by a third party is the responsibility of that third party. We accept no responsibility for damages, if any, suffered by a third party as a result of decisions made or actions taken based on this report.

Reliance on Provided Information

TRAX has relied on the accuracy and completeness of information provided by its client and by other professionals. We are not responsible for any deficiency in this document that results from a deficiency in this information.

Logs of Test Holes and Subsurface Interpretations

Ground and ground water conditions always vary across a site and vary with time. Test hole and well logs show subsurface conditions only at the locations of the test hole or well.

Descriptions of Geological Materials and Water Wells

This report includes descriptions of natural geological materials, including soil, rock, and ground water. TRAX based these descriptions on observations at the time of the study. Unless otherwise noted, we based the report's conclusions and recommendations on these observed conditions. Construction activities on the site or adjacent sites may change or alter these geological materials.

Changed Conditions

Conditions encountered by others at this site may differ significantly from what we encountered, either due to natural variability of subsurface conditions or construction activities. Our client will inform us about any such changes, and will give us an opportunity to review our recommendations. Recognizing changed soil and rock conditions, or changed well conditions, requires experience. Therefore, during construction or remediation, a ROWP or qualified professional should be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

Recommendations

We recommend that our client engage TRAX to review all design drawings and constructed works that are based on our conclusions

Risks and Liability

TRAX carries commercial general liability insurance to an amount of $2M.

TRAX carries insurance for errors and omissions in the amount of $1M. In all cases the liability of TRAX and/or Ian Ralston is limited to the fees charged. By accepting and using this report the client acknowledges this declaration of insurance and also accepts that TRAX and Ian Ralston's liability are limited in this way.

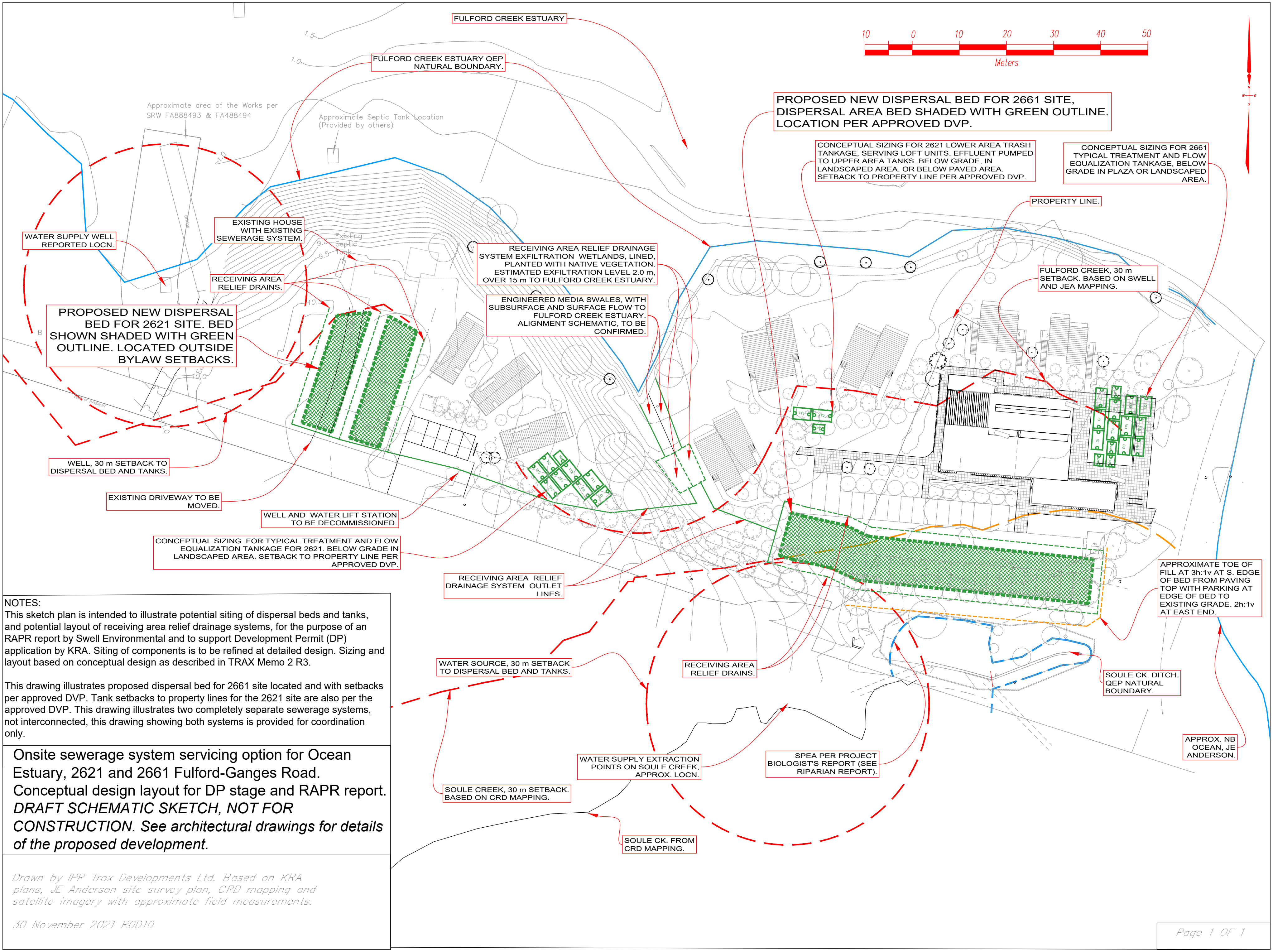
Declaration of interest

Ian Ralston is, in a personal capacity, a manufacturer's representative for Geoflow Inc. (a subsurface drip dispersal equipment manufacturer). TRAX undertakes to ensure that no bias toward this equipment manufacturer will be shown during design or specification for a sewerage system.

Engineering Limited License scope

Ian Ralston holds a License from EGBC to practice engineering within the following scope of practice:

Civil Engineering. Limited to: Design, construction and maintenance of sewage systems, including site and soil evaluations for these systems. Systems of 22.7 cubic meters per day or less.



NOTES:

This sketch plan is intended to illustrate potential siting of dispersal beds and tanks, and potential layout of receiving area relief drainage systems, for the purpose of an RAPR report by Swell Environmental and to support Development Permit (DP) application by KRA. Siting of components is to be refined at detailed design. Sizing and layout based on conceptual design as described in TRAX Memo 2 R3.

This drawing illustrates proposed dispersal bed for 2661 site located and with setbacks per approved DVP. Tank setbacks to property lines for the 2621 site are also per the approved DVP. This drawing illustrates two completely separate sewerage systems, not interconnected, this drawing showing both systems is provided for coordination only.

Onsite sewerage system servicing option for Ocean Estuary, 2621 and 2661 Fulford-Ganges Road. Conceptual design layout for DP stage and RAPR report. *DRAFT SCHEMATIC SKETCH, NOT FOR CONSTRUCTION. See architectural drawings for details of the proposed development.*

Drawn by IPR Trax Developments Ltd. Based on KRA plans, JE Anderson site survey plan, CRD mapping and satellite imagery with approximate field measurements.

30 November 2021 R0D10