TRAX Developments Ltd.
Sewerage System Design notes and summary specifications

Design	Lot 31 Goldstream Heights	August 11, 2023
Revision	Rev. 0	Client: Owner
Notes	System selection and design based primarily on SPM V3 (September 2014) and supporting rationale and calculations (on file). See references for other sources of standard practice utilized.	

Introduction and objectives	TRAX has been retained by the client to provide a design of a sewerage system for a new dwelling unit with suite. **Objective** of this report is to provide a suitable design for a Sewerage System including dispersal area on this site to serve the use defined below. Preliminary site and soil evaluation was carried out by Ian Ralston P.L.Eng and Henry VanHell ROWP (site and soil evaluation summary report attached) and serves as the basis for this design. See also plans (R0). Prior to and during installation, the design engineer may approve design changes. The design engineer and installer will prepare as-built drawings and specifications to confirm these changes. Construction must be supervised (field review of installation) by TRAX, this will be by the design engineer (Ian Ralston) or a subordinate under direct supervision. Prior to installation the design engineer will specify the minimum requirements for field review and for notification of TRAX. Unspecified or contradictory installation details should be confirmed with TRAX (the design engineer). Certain items must be confirmed with TRAX prior to or at installation or may be redesigned during installation by TRAX; these are noted in these specifications or in the plans. For general installation, maintenance, monitoring and operation practice the installation is to follow the SPM V3 **Limitations** This design and site evaluation report is subject to the attached Statement of General Conditions.
Domestic water supply well setback and fresh water setback.	Client reports, and site evaluation did not identify any water wells within 30 m of proposed sewerage system components. The client is to confirm suitable tank location in relation to final building plans, maintaining 30 m minimum separation to the on site well which is located at the top of the property near to Goldstream Heights Drive, as well as to any other well. Prior to installation, the installer is to confirm that no domestic water supply wells are located within 30 m of any proposed sewerage system component. If a well is found closer than this specified distance, the design engineer is to be informed and construction is to cease until instructions are provided. The installer is to also confirm by measurement the presence of any fresh water feature within 30 m of the dispersal bed, and is to inform the design engineer if any are found closer than 30 m to the dispersal bed.
Preliminary design	This is a preliminary design, and may be revised prior to or during system installation. Particularly: Tank location and layout is to be confirmed. Forcemain alignment is to be confirmed. Dispersal bed layout and depth of sand media is to be approved on site, with adapatation of the design as needed to address conditions exposed along the length of the bed during bed preparation and on measurements of soil depth along the dispersal alignment reported by the installer to the designer (to be based on probing). See below for development approvals required.
Attached	Drawings. Site and soil evaluation summary.
Lot legal and GPS	LOT 31 BLOCK 399 PLAN EPP78349 MALAHAT GPS:

PID	030-838-878	Easements or Covenants?	Title on file, see note below on development permissions. Two easements (access easements, CA8721505 and FB120051), are in place which may affect the proposed dispersal system placement. The wording of these easements allows for use of and placement of improvements in the easement area as long as the access road (currently existing, see plan) is not obstructed or impacted, the sewerage system placement is not expected to impact the access road or its use and the client has indicated that they wish to proceed with placement as planned. Note that remainder of site is severely constrained for system placement. We recommend that the client inform the owners who benefit from this easement. See development approvals, below. A covenant, CA8322757, is in place which includes wording that requires approval by the transferee (Earth Corporation) of proposed improvements and placement of fill prior to construction. We have recommended to the client that they obtain these approvals prior to construction, see development approvals, below. A development permit may be registered on the title, see below.

Development approvals, development permit or environmentally sensitive areas	**Any and all development permissions necessary for construction of the sewerage system and for connected facilities are the responsibility of the owner.** This includes ensuring the construction of the sewerage system and its operation comply with all legal instruments registered on title, with any development permit and with any land use bylaw requirements. Compliance with these is specifically excluded from TRAX's scope and we recommend that if any uncertainty arises the client retain legal advice to guide compliance. For the case of the two above noted easements, the client has instructed us that they are willing to place the dispersal system within the easement area based on their understanding of the wording and to assume the risks associated. We recommend that the client consider informing the owners of lots that benefit from the access road of their intention to construct the dispersal system within the easement unless they obtain legal advice to the contrary. For the specific case of covenant CA8322757 we recommend that the client obtain the required approval from Earth Corporation or have this covenant discharged prior to sewerage system construction.
Owners	A.R. Withers

		Address	From CRD mapping, 3631 Goldstream Heights Drive

System selection

Item	Value	Constraint, opportunity, result	Solution and rationale
Site, soils and site use			
Use (existing and planned)	*Type of use*	*Multiple residences*	2 suites in one building. Considered as separate residences as a conservative measure.
	Number of bedrooms	*2*	Per suite.
	Floor area (sq.m)	*232*	Per suite. Based on declared 5000 sqft 4 bedroom building, split to two suites, each occupying one floor and with two bedrooms.
DDF Table II-8 (L/day)	*Bedrooms and area*	*1000*	
Effluent strength		*Normal residential*	No garburators, large tubs or water filter/softener backwash water to flow to the system.
Chosen DDF (L/day)		*2000*	Overall
Chosen ADF (L/day)	*On a maximum 7 day average basis*	*1000*	Overall
Soil texture (<2 mm fraction)	*Sandy Loam*	*Fine Sands, Loamy Fine Sands, Sandy Loams*	For upper soil layers, conservative.
Structure	*Granular*	*F*	Table II-4
Structure grade	*Strong*		
Consistence	*Soft*		
Coarse fragment %	*25%*	*No HLR adjustment*	s. III-4.1.2.2. Highly variable.
Coarse fragment type	*Gravel*	*Gravelly*	
Different soil for LLR?	*No*		Conservative as patches of LS observed in lower soil layer.
Other soil notes			
Kfs or Perc to be used?	*Kfs*	*Kfs*	
Kfs (mm/day)	*2500*	*2500*	
Soil depth (cm)	*60*		Worst case at TP1, to rock layer.
Slope %	*15%*		Typical in immediate receiving area, flow expected in two directions.
Slope shape, location		*Crest, Convex Linear*	Aligned along ridge area, with approximately 7 m width available.
Elevation sewer or pump off to dispersal area		*Dispersal area downslope, approx. 230 ft.*	Suitable for FLOUT dosing. Soil depth not suitable for gravity distribution. Elevations to be confirmed based on final tank elevation.
Temperature	*Low frost risk*		
Net positive evapotranspiration, mm/yr?	*0*	*No ET, ETA, Lagoons*	Table II-6, Farmwest . Location is favorable for summer ET, but winter ET is moderate due to sparse tree cover.
Rainfall, mm/year	*1039*	*No HLR adjustment*	s. III-4.1.4. North Cowichan (Duncan Forestry Station), Environment Canada

System selection and loading rates			
Soil constraints?	*Table II-5*	*Type 1 VS > soil depth Type 2 VS > soil depth*	Not suitable for gravity distribution
	Table II-6 notes	*No further constraints*	See above for ET, ETA and Lagoon net positive ET constraints.
	Table II-7 notes	*No further constraints*	Some boulders observed, sand media blinding layer recommended.
Soil depth and VS options, distribution and dosing options	*Type 1, gravity dist.*	*Type 1 VS > soil depth*	Not suitable for gravity distribution
	Table II-15. Type 1 pressure dist., demand dose	Native soil 60 cm	Meeting SPM demand dosing HAR standards, for all soil types.
	Table II-15. Type 1 pressure dist., low frequency demand dose	Native soil 70 cm	Meeting SPM low frequency demand dosing HAR standards, for soil with Kfs <1500 mm/day, met by available soil depth plus 10 cm blinding layer
	Table II-15. Type 1 pressure dist., low frequency demand dose	Native soil 75 cm	Meeting SPM low frequency demand dosing HAR standards, for soil with Kfs >1500 mm/day, exceeds available soil depth.
	Selected option	Native soil 60 cm Sand 10 cm Total 70 cm	Sand media blinding layer specified.
Horizontal separation constraints?	*Domestic water supply well, to dispersal area and tanks*	30 m minimum	
	Other setbacks	To meet SPM standards	Tank to house setback to be confirmed based on final building plans and review by structural or geotechnical engineer. Installer to check for water features within 30 m of dispersal bed prior to construction.
HLR for Type 1 (mm/day)	*Table II-22:*	27	
	Table II-23:	35	
	Adjusted:	27	Adjustment for coarse fragment content and or rainfall not required
	Selected HLR:	27	
Minimum system contour length	*VS for LLR (cm)*	60	
	Table II-26	Use LLR tables	
	Table II-27 (L/day/m)	110	
	Table II-28 (L/day/m)	240	
	Tabular LLR (L/daym)	110	
	Selected LLR (L/daym)	110	
	Min. length, m	18.2	
Length constraint?	*Max. contour length available (m)*	*30*	
	Bed length for AIS (m)	*30*	*Including end caps, nominal.*
Dispersal area size options	*Native soil, Type 1 AIS (square metres)*	74.1	
	Type 1 Seepage Bed option, width (m)	2.47	

Dispersal area sizing and system summary (further system selection rationale on file)			
Dispersal area sizing	**Seepage Bed, Type 1**		Site suits seepage bed given low slope crest alignment.
	Bed width (m)	*2.58*	Based on 3 rows of 0.86 m effective width Infiltrator chambers.
	Bed length (m)	*28.8*	Based on 12 chambers per each lateral, not including end caps.
	Number of beds	*1*	
	Resultant HLR (mm/day)	*26.9*	
	Number of laterals	*3*	
	Lateral spacing (m)	0.86	
	Vertical separation & dose		See typical section
	Native soil (cm)	60	Minimum, with at grade placement of chambers in areas with shallower soil depth to rock.
	Sand media (cm)	10	Blinding layer to address risk of macropore flow, and to assist with leveling chambers.
	Total constructed (cm)	70	
	Type of distribution	Uniform	
	Type of dosing	Demand	
	Soil or sand media type for dosing specification	Sandy Loam	Suitable for use with Loamy Fine Sand also.
	Sand media system?	No	
	Effluent type for dose spec.	1	
	Dosing frequency (SPM)	8	
	Dosing frequency (specified)	8	Minimum at DDF
	Pressure distribution		
	Dose volume (L)	250	For single zone
	Number of zones	2	
	Dose volume per zone (L)	125	
	(usgal)	33	Actual dose volume expected 32 usgal per zone based on FLOUT tank swept volume and settings.
	Design HLR (mm/day)	26.9	
	Center or end fed?	End	For each zone, from mid point of overall dispersal bed.
	Lateral length (m)	14.5	From manifold (not including end caps)
	Number of laterals (total for all zones)	6	
	Number of laterals per zone	3	
	Lateral diam. (inches)	1.25	
	Lateral type	Sch 40 PVC	
	Manifold diam. (inches)	2	
	Manifold type	Sch 40 PVC	
	At Grade Bed?	No	
	Min. orifice number for all zones	133	
	Chosen orifice number	144	
	Orifices per zone	72.0	
	Orifices per lateral	24.0	
	Nominal spacing (cm)	63	
	Orifice size (inches)	1/8"	Small orifice specified to reduce risk of root intrusion and to minimize necessary FLOUT drawdown. Fine effluent filter specified.
	Design method	FLOUT dosing, main calculations	Including Premier Plastics FLOUT main spreadhseet and float setting sheet. On file.
	FLOUT min. average discharge required, usgpm	46	14" drawdown dual FLOUT specified.
	Distal pressure (ft.)	10	Target maximum, for improved clearing.
	Laterals drain?	No	Pipe stands to be used. Pipe stands also address potential for future root management. Non draining laterals necessary to achieve lower HAR. Forcemain piping to be taken through depressional area, expected to remain full in depression, with head for dispersal system pressurization provided by backup in pipelines on steep slope leading down to the depressiona area.
Other considerations	*Tree cover*	To be improved	Cedar tree (sapling) to be removed, Douglas fir and arbutus to be preserved. For improved ET. Higher distal pressure (max.) specified with small orifices to reduce risk of root intrusion, pipe stands allow for future maintenance.
	Dip in topography upslope of dispersal bed, after steep slope.	FLOUT mains will not drain in this portion	Considered preferable to poor distal pressure which would be the case if the mains were led along a low slope area to the bed. Ongoing system use expected. Cleanouts to be provided at end of each main.
	Chosen septic tank size (L)	9092	Chosen tank size: Two tanks each at 1000 IG, one per suite (per client preference)
	Minimum septic tank size (L)	*6000*	For Type 1 system
System summary	*Treatment*	*Type 1 with effluent filter*	Fine effluent filter specified to protect small orifices.
	Flow equalization	*In chambers only, demand dose*	
	Dispersal	Pressure distribution to seepage bed	*With sand media blinding and leveling layer.*
	Summary of site use and capability constraints addressed by specified system	*Simplest system to meet site capability, with FLOUT dosing utilized to take advantage of elevation available. Separate septic tanks specified to meet client objective for separation of suite flows, larger tanks specified for improved performance and increased time between pump outs.*	

Specifications

Primary treatment	For each suite, with separate sewer outlets from building, dedicated 1000 IG Dans Precast concrete tank, two compartment with letterbox opening. Effluent filter for each tank Polylok A300 12 x 18 with base support and alarm switch. Alarm from each tank to one input of SJE Rhombus Tank Alert Duo panel (red lamp and amber lamp labeled to identify relevant tank). At outlet of each effluent filter install Valterra 4" PVC sliding gate valve (with stainless steel knife), with handle below riser for access.
Tank installation.	All tanks with risers to grade, slope ground away from risers. Fully compact under or otherwise support all pipe connections. Place tank on min. 10 cm thickness of pea gravel or round 19 mm drain rock. Compact permeable structural fill around tank. If tanks are to be placed on blasted rock fill, base to be pre approved by project geotechnical engineer. Base of tanks to be at minimum outside of line at 1:1 from outer edge of house footings or as pre approved by the project geotechnical or structural engineer. Drain tank area to maintain water table at or below base of tanks, drain specification and or shop drawing to be pre-approved by the design engineer prior to installation. Septic tanks and FLOUT dosing tank to be installed to allow surcharge of septic tanks if FLOUT outlet blocked.
Piping and fittings	Install all piping to meet Plastic Pipe and Fittings Association and SPM standards and guidelines, with pipe bedding and backfill to meet appropriate MMCD standards for the location. Pipeline minimum cover 45 cm, 60 cm in travelled areas. Bed pipes with pre-approved bedding sand and compact, min. 15 cm bedding around pipes. Where piping is below traffic areas, sleeve piping and consult project civil engineers for backfill and compaction requirements. Ensure groundwater flow concentration will not occur in pipeline trenches, including dose forcemain trenches, using trench dams as necessary (confirm dam and any associated drainage details with project civil engineer). All pipeline trenches to be marked for detection. Install tape at 4" below grade above forcemain lines. For lines not installed in same trench as cables optionally install with tracer wire (recommended, not required). Provide a 12 AWG PE jacketed copper clad steel tracer wire (example PRO-TRACE HF-CCS PE30). Install tracer wire at 15cm above pipelines. Bring tracer wire into terminal valve boxes and connection boxes with a 1.5 m slack loop (without breaking cable) to provide access for tracing, ground both ends of tracer cable in accessible location with disconnect at distal end, provide minimum 1.5 m long leads for connection. If splices are necessary, use manufacturer recommended water resistant splices, insulated with electrical tape (minimize splices). Tank interconnection piping PVC Sewer CSA, solvent weld. Fully support interconnection piping. Ensure all components are separated by min. 3 m from water supply piping, or relocate or sleeve water supply piping as necessary. All valve boxes with "sewer" lids and pea gravel bases. Mark key points along forcemain alignment and mark each valve box location with 5 ft upright length of 1/2" EMT conduit or pre approved equal.
Valve boxes	Install all valve boxes in landscaped areas, or contact design engineer for revised specifications. Plastic valve boxes, sized as needed for adequate access or as per the drawings. All valve boxes to be bedded on and around with 10 mm washed pea gravel, with the base of the box supported on a minimum of 10 cm depth of pea gravel. All valve boxes with tamper resistant lids marked "sewer" or with purple lids. Boxes over electrical splice boxes marked "electrical". Mark boxes for detection with 60 cm section of 16 mm rebar installed vertically in the valve box. Where necessary utilize concrete blocks to support valve box bases per MMCD standards to ensure piping or dripline is not impacted by valve box settling, even where direct foot pressure is applied to the valve box. Valve boxes may be cast iron or concrete if plastic not used, all with pea gravel bases and fully supported with bricks or other equivalent method.
Sewers	Sewers to be constructed under the BC Building and Plumbing Code and do not form part of the sewerage system.
Tank access	Tank to be provided with sealed risers to min. 5 cm above finished grade. Risers with sealed lids. Tanks to be poured with cast in place 24" UltraRib pipe adapters (no inner concrete lip). Riser pipe to be 24" BOSS 2000 HDPE piping (with smooth inner wall), attached to adapters with 8 of stanless steel #10 x 1.5" screws from inside of adapter and sealed with pre approved adhesive sealant. Riser lids to be Simtech HD STF-APC24 polycarbonate, secured with 8 of stainless screws per lid. For additional safety during maintenance, each 24" riser to be provided with Simtech STF-N24-QL4 safety net with 4 quick links per riser.
Tank watertight testing.	Tanks to be tested for water tightness of tank and of tank/riser connections and the connection before or after installation but before tank interconnection and backfill. Follow the procedure described in the SPM V2 Appendix O. Vacuum testing may be used. Inlet and outlet of tanks should be capped or caps inserted in the rubber boots. Do not fill with water more than 2.5 cm above top of tank lid. For water testing, maximum leakage in 24 hours after 24 hour presoak 0.1% of volume. Measure fall in riser adapter by marking riser adapter at water level. Do not attempt to measure fall in tank itself. For vacuum testing, draw a vacuum of 4 inches of mercury on the sealed tank, allow tank to settle, restore vacuum to 4 inches mercury, turn off valve to vacuum pump and test that vacuum is held to min. 90% of initial value after 5 mins., no loss preferred. **Report results to design engineer and do not backfill tanks until design engineer has confirmed that leakage rate meets standard.**
Dosing system	FLOUT dosing system. Provide shop drawings and specifications to design engineer for pre-approval prior to construction. Double 3" FLOUT assembly with 14" drawdown and 3" PVC Sch40 pipe outlets at base of tank wall. In 300 IG Galcon Precast tank with 24" riser over outlet/FLLOUT. FLOUT dosing counter, Rissy Plastics High level alarm, externally weighted SJE Rhombus Sensor Float suspended in tank to specified level, to input of separate SJE Rhombus Tank Alert panel, alarm prior to overflow. Transition to 2" Sch40 PVC pipe outside of tank using assymetrical reducing coupling or pre approved Fernco reducing coupling from the 3" outlet pipe.

Forcemain and manifold systems	Forcemain, one per zone, 2" IPS SDR11 HDPE, taken to mid point of the dispersal system (end of each zone), forcemain to manifold on native soil bedded in blinding sand media layer, at or below base of chamber elevation. HDPE piping full length or socket fusion welded, with transitions to PVC at each end using socket fusion flange fitting on the HDPE pipeline, with cast iron backup rink, stainless steel bolts (3" NC) and plain stainless steel nuts to 2" Sch40 PVC solid flange x slip or as pre approved. EPDM gaskets. Place bentonite or other low permeability plugs in forcemain trench to prevent flow concentration in trench (see note above). Manifold (2" Sch 40 PVC) feeds bed system from end point of bed. Cleanout to grade (using 2" long radius sweep and male adapter with threaded PVC cap) in 10" round valve box at end of manifold. Valve box with min. 2 cuft pea gravel base. For each lateral (3 in each zone), 2" x 1.25" Sch 40 PVC slip tee with 1.25" Sch40 PVC pipe riser to 1.25" Slip 90 Sch80 PVC, to slip PVC sch 40 ball valve to 1.25" Sch40 PVC lateral. Valves in 10" round valve boxes. All valves in valve boxes marked "sewer" and with pea gravel base.
Bed layout	Bed layout is to be approved on site by the design engineer. Do not construct without layout approval, see drawing notes. Layout is to minimize impact on existing trees except for removal of western red cedar sapling or saplings.
Dosing and distribution system	2 zone system with 3 laterals per zone, each zone end fed. Bed with distribution system laid out 3 laterals wide, see typical section drawing. Laterals in Infiltrator Quick4+ Standard (wide) chambers (12 per lateral, 72 total for both zones), with Infiltrator standard multiport end caps (12 total). Lateral lines 1.25" Sch 40 PVC, install lateral pipes level to ± .5 cm over length of bed, using Simtech pipe stands (STF-BTPS-1.25), one per chamber (total 72). Level from lateral to lateral as well as along length of each lateral. Orifices 1/8" at approx. 63 cm on center, min. 30 cm from all orifices to end of bed, all orifices face up. Exactly 144 orifices overall, with 24 per lateral. Target distal pressure at peak dosing rate 7 ft. min.. Each lateral with cleanout at distal end formed using 1 of 45 deg PVC Sch 40 slip elbows and PVC MIP x slip adapter with PVC threaded cap, cover cleanouts with 10" diameter valve boxes at angle. Valve boxes with 2 cuft pea gravel bases supporting cleanouts to native soil below. Each lateral feed line with ball valve (for isolation during flushing) at manifold, as noted above. 6 bed observation ports installed in chambers to SPM standards and per manufacturer guidelines, one per lateral near lateral centerline of bed, 3 per zone, terminated with 4" PVC cleanout below 10" round valve box or led up to 60 cm above final grade. Ensure observation port sealed to chamber with Sikkaflex 1a sealant or PL Premium. Flush laterals at commissioning, minimum 12 gallons flush per.
Sand media (blinding and leveling layer)	Base of sand media to be placed on native soil per sand mound standards, prepare soil per SPM sand mound standards. Install bed on level alignment (on contour), in low slope area. Sand media blinding layer must be minimum 10 cm thick, but may be deepended to level chambers, fill shallow depressional areas. TRAX to be retained to inspect and pre-approve soil moisture content prior to bed excavation and sand placement and to inspect exposed soils. Sand media is to meet SPM Coarse Filter Sand specifications or as pre approved, and is to be pre-approved by TRAX. The sand must be kept clean during installation. Install sand media following SPM sand mound specifications after scarification, establish minimum settled sand depth of 10 cm above scarified basal area and level top of sand media (resulting in greater depth at downslope edge if and where necessary). Material testing: Sand delivered to the site is to be checked by the installer using a jar test for each load delivered to confirm sand is clean, with <4% silt and clay. In addition the installer is to retain sand samples from each truckload delivered.
Cover soil	Lateral chambers are to be covered with min. 15 cm depth (settled) pre approved cover soil meeting SPM standards. This may be pre approved select native soil. Mulch media may also be utilized for cover, if mulch media is to be used the media is to meet MCTGP "Favorable" specifications and cover depth over chambers is to be min. 20 cm settled.
Basal observation standpipe	4" PVC Sewer pipe installed as shown on the plan section (sheet 2). One at approximately mid point of the bed. Side slot pipe from base to approx. 10 cm above base using a hand saw. Backfill around the pipe with pea gravel to 10 cm above the uppermost side slot. Ensure sand media is packed around pipe during backfil and media placement. Extend pipe to 10 cm below final grade, terminate with threaded cleanout and plug. Drill 1/8" diameter hole in base of cleanout fitting to vent pipe. Cover with 10" diameter valve box, with pea gravel base in valve box and support box with concrete pavers or blocks. Mark box for location with vertical rebar per above and with EMT conduit per above.
Primary monitoring provisions	Monitor water table observation standpipe to measure water table level below dispersal bed lower edge during system operation, to provide assurance of maintenance of VS in excess of 30 cm below the infiltrative surface during normal conditions to meet SPM standards rationale. Note that transient reduction of VS below this value may be expected during or after heavy rainfall events.

References

The following documents were the principal sources of reference for standard practice in this design.

The BC SEWERAGE SYSTEM STANDARD PRACTICE MANUAL Version 3, September 2014, Ian Ralston, Michael Payne for Ministy of Health. And supporting rationale documentation and calculations (on file).

The BC SEWERAGE SYSTEM STANDARD PRACTICE MANUAL Version 2, 21st September 2007, Issued By: Ministry of Health, Population Health and Wellness Health Protection.

EGBC Professional Practice Guidelines - Onsite Sewerage Systems. V1.2 January 2013

Laak, R.H. 1986. Wastewater engineering design for unsewered areas, Technomic

Design Guidance for Large Subsurface Wastewater Treatment Systems (LSTS), Minnesota Pollution Control Agency, Version: 03-08-2005

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 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 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 (site evaluation). 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 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 and recommendations.

Declaration of interest

Ian Ralston, in a personal capacity, is a manufacturer's representative for Geoflow Inc. in BC. TRAX undertakes to ensure that no bias toward this equipment manufacturer will be shown during design and specification.

Risks and Liability

TRAX and Ian Ralston carry 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 that they understand the insurance carried by TRAX and Ian Ralston and accepts that TRAX and Ian Ralston's liability are limited in this way.

TRAX Developments Ltd. EGBC Permit to Practice

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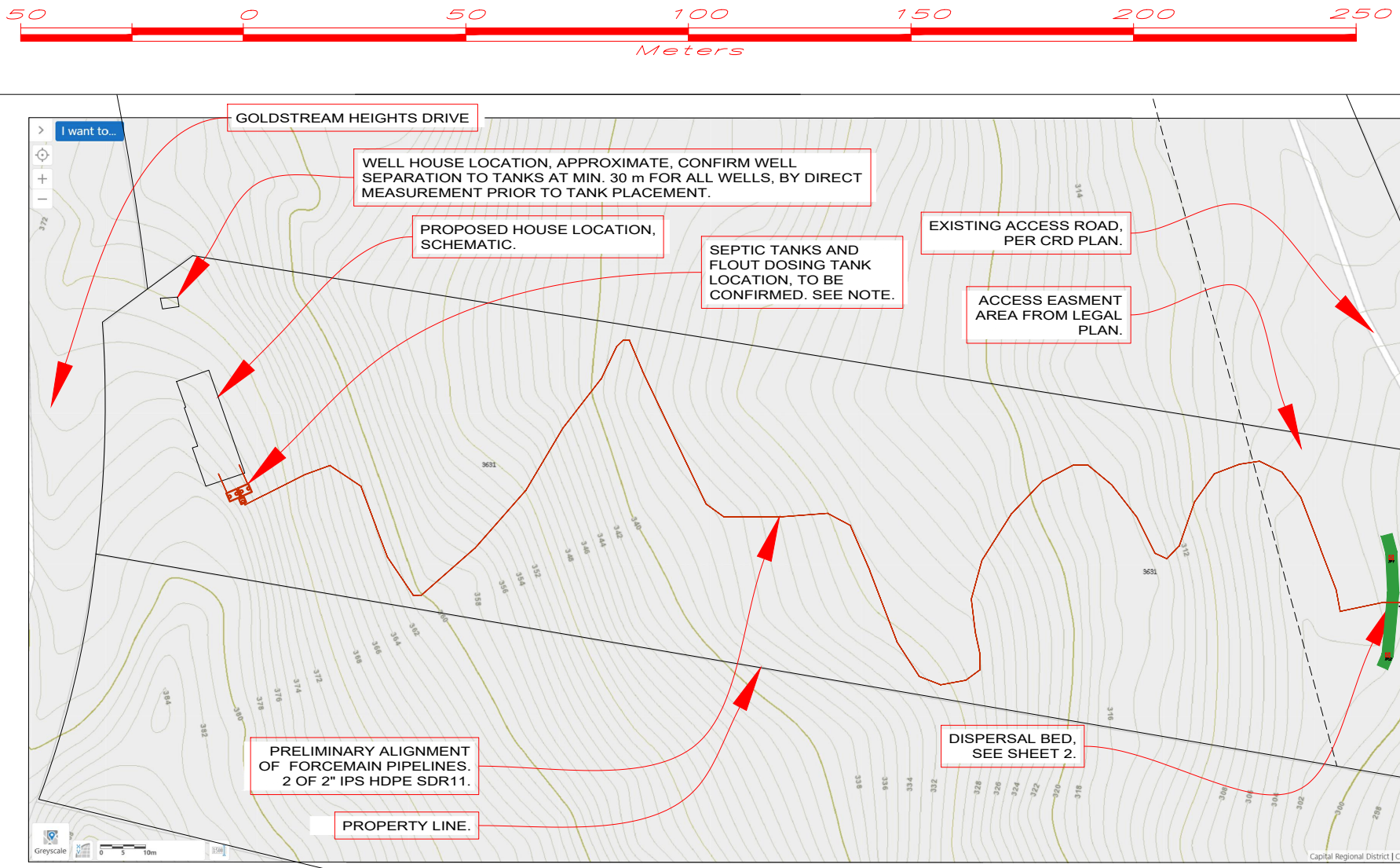
Engineering Limited License scope



3631 Goldstream Heights Drive, Malahat
(PID 030-838-878)
Sewerage system, keyplan and overview of system.

Drawn by IPR Trax Developments Ltd. Based on survey plan, CRD mapping and contours (1m), owner drine photographs and markup and approximate field measurements,

11 August 2023 R0

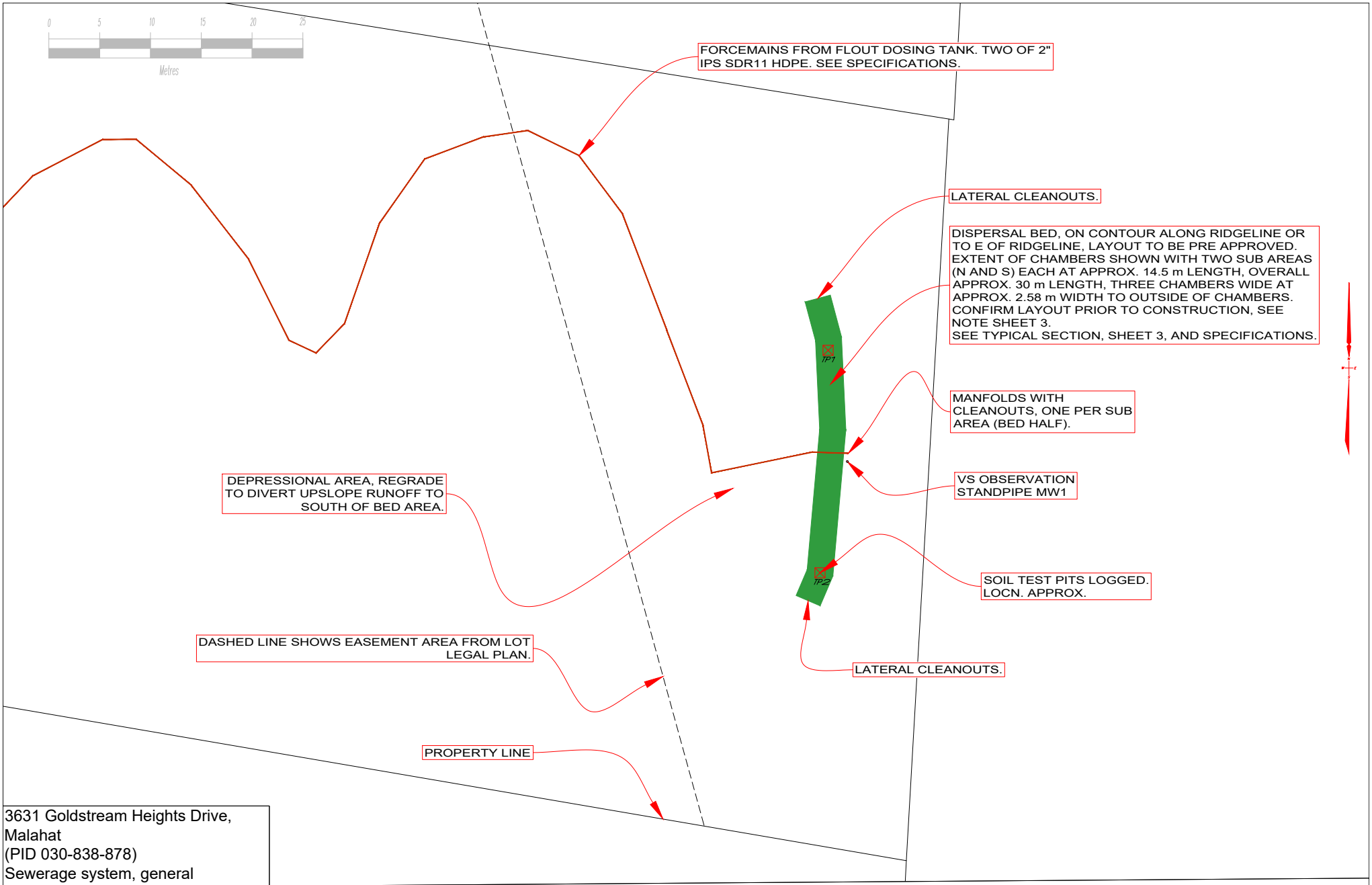
NOTES:

This is a preliminary design. During initial construction the designer is to be retained to approve layout, make further evaluation of exposed conditions after preparation of bed At that time details of construction will be finalized. See design notes and specifications, R0. Layout shown is schematic and does not show all details of existing and proposed site use. Installation to follow SPM standards except as directed or pre approved by the design engineer. Coordinate utilities, including water piping and stormwater system layout with sewerage system. Divert storrmwater away from sewerage system components.Separate water lines minimum 3 m to sewerage system components.

TANKS

Tank location is illustrative only. Tank layout to be approved on site as field fit at construction. Septic Tanks (1000 IG Galcon Precast, 1000 IG, 77" w x 102" L, inlet elevation 49" from outside base., two of, and FLOUT tank (1300IG Galcon Precast), see sheet 4,. Protect tanks and riser lids from traffic. Ensure tank area is drained to lower water table to below lowest tank base. Septic tanks with Polylok A300 12x20 effluent filters with alarm. Alarm panels to be installed on wall of garage within view of tank, below eaves.

Each suite to discharge to a dedicated septic tank by separate sewers. Sewers do not form part of the sewerage system and are to be constructed under the plumbing permit.



3631 Goldstream Heights Drive, Malahat
(PID 030-838-878)
Sewerage system, general arrangement, showing W part of lot.

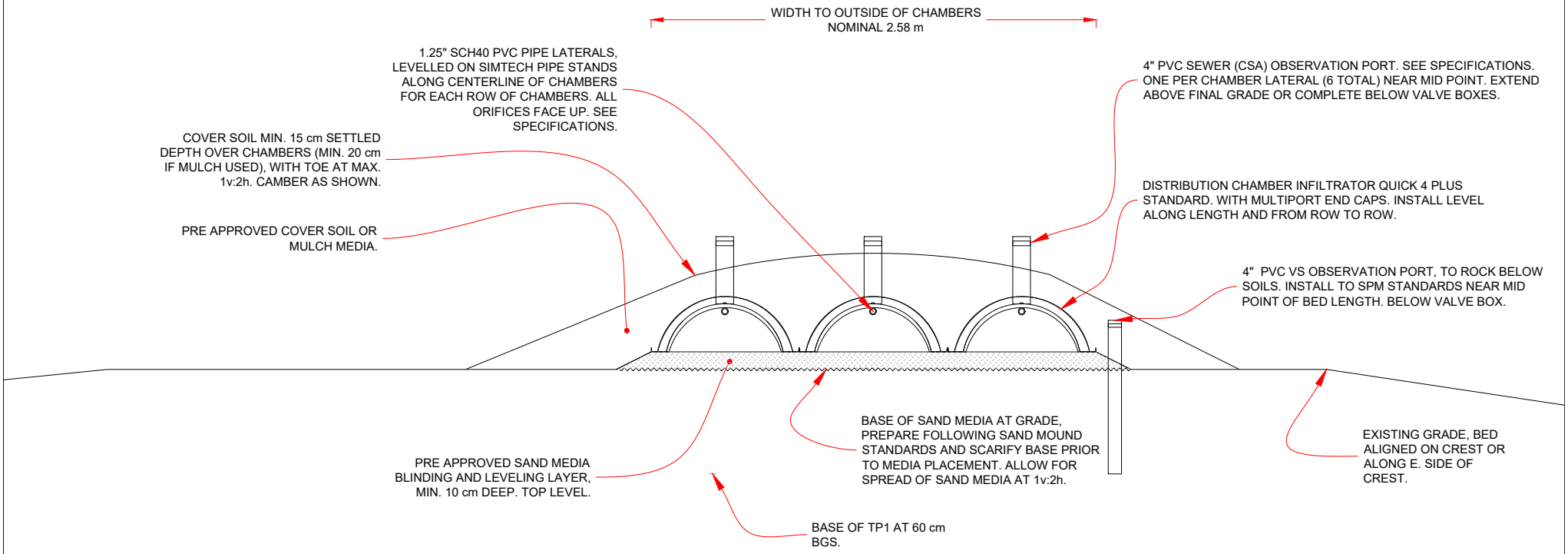
Drawn by IPR Trax Developments Ltd. Based on survey plan, CRD mapping and contours, owner drine photographs and markup and approximate field measurements,

11 August 2023 R0

See notes, sheet 1.

BED SUMMARY:

- Bed laid out three laterals wide, in two sub areas. Laterals in Infiltrator chambers
- Each sub area with 12 chambers per lateral, total 72 chambers
- Manifolds feed sub areas from mid point of the bed, end of each sub area, 2" Sch40 PVC pipe bedded in sand media, feed up to ball valves to laterals
- 1.25" Sch40 PVC pipe lateral lines, supported on Simtech pipe stands
- Orifices all face up, 24 per lateral, $\frac{1}{8}$"
- All laterals and manifolds with cleanouts.



NOTES:

See specifications, R0. All sand media, amendments, aggregate and cover materials to be pre-approved by the designer. Bed sand media to meet SPM Coarse Sand Filter Sand specifications.

Designer to be retained to confirm layout on site, inspect bed area and toe area exposed soils conditions during initial surface preparation, at that time the design engineer may specify changes to this section and the design. The installer is to probe soil depth to rock along the bed alignment at an interval of 3 m and is to report measured depth at each location on a sketch plan of the bed. At that time the design engineer will confirm depth of sand media installation, based on observation of exposed conditions over the entire bed area and on results of soil depth probing reported by the installer. During installation the installer may increase sand media depth where needed, e.g. to level bed,

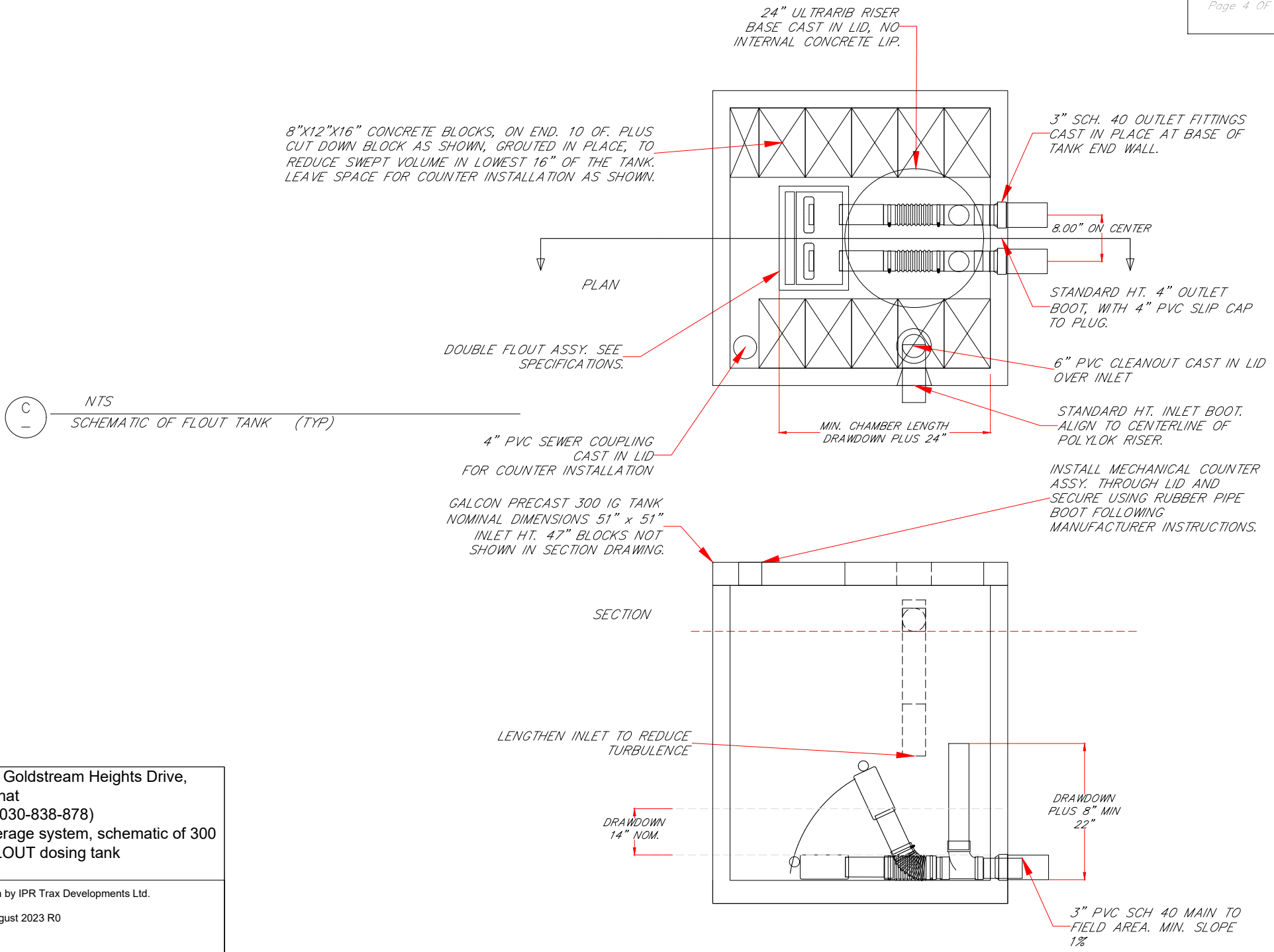
See specifications for details of distribution system in bed. Confirm run and lateral layout and manifold locations with design engineer after final bed layout. Note that bed is expected to step at mid point, between sub areas, at that point a pre approved membrane is to be installed vertically from the top of the lateral chamber elevation of the higher part of the bed to 15 cm below the base of the sand media across the width of the distribution bed.

Completed bed is to be protected from traffic.

3631 Goldstream Heights Drive, Malahat
(PID 030-838-878)
Sewerage system, typical section of dispersal bed from south

Drawn by IPR Trax Developments Ltd. Based on approximate field measurements.

11 August 2023 R0



3631 Goldstream Heights Drive, Malahat
(PID 030-838-878)
Sewerage system, schematic of 300 IG FLOUT dosing tank

Drawn by IPR Trax Developments Ltd.

11 August 2023 R0

TRAX DEVELOPMENTS LTD.
SEWERAGE SYSTEM SITE AND SOIL NOTES, RATIONALE NOTES

Design	Lot 31 Goldstream Heights	August 11, 2023
Revision	Rev. 0	Client: Owner
Notes	Test pits were excavated by the client and logged by Ian Ralston. Permeability tests were made by Henry VanHell ROWP. Photographs on file.	

Permeability	4 tests have been made using a constant head borehole permeameter, with auger hole to 40 cm depth, by Henry VanHell, August 2023. Calculations on file.Kfs Median 2500 mm/day. Note risk of macropore flow, sand media blinding layer recommended.
Summary of soils	TP1: L1- 0 to 30 cm Brown, Loamy Fine Sand, SG/0, Soft. Coarse fragments Gravel and Cobbles 10-15%, Roots Fine to Medium, Many. L2- 30 to 60 cm Brown, Loamy Fine Sand and Loamy Sand, SG/0, Loose. Coarse fragments Gravel 15% and Cobbles 10%, Roots Fine to Medium, Common. Base of pit on weathered fractured rock. No moisture or seepage observed. Interpreted usable soil depth 60 cm. TP2: L1- 0 to 20 cm Dark Brown, Sandy Loam, GR/3, Soft. Coarse fragments Gravel 15% and Cobbles 10%, Roots Medium, Many. L2- 20 to 75 cm Light Brown, Loamy Fine Sand, SG/0, Soft. Coarse fragments Gravel 15-20% and Cobbles 10-15%, Roots Fine, Common. Base of pit on weathered fractured rock. Large boulder observed. No moisture or seepage observed. Interpreted usable soil depth 75 cm. Soil type for HLR and HLLR selection for sand media basal area Sandy Loam, Favorable structure and consistence category. No evidence of SHWT observed, interpretation that run on is diverted by the upslope depressional area and rainfall flows to fractured rock in the ridge area.
Summary of site information	Site slopes steeply from the road to lower easement, with a lower slope bench at the road and small benches along the slope. From the upper to lowermost benches the slope is generally 40 to 60% (see contour plan). Soils appear shallow to rock over much of the site, with some rock outcrops. Access to the mid part of the site is challenging. A potential dispersal area has been identified in the lower bench area near the lower easement, with the dispersal alignment on a small ridge line running perpendicular to the slope, forming the lower edge of the bench area. The upper edge of this bench area is a depression (with slope back from the dispersal alignment at approximately 10%) and may see some saturation in soils due to water flowing from upslope, this depression is expected to at least partially divert flows away from the dispersal area. Downslope of the potential dispersal area the slope steepens to 15% and 20%. Soils in the potential dispersal alignment and immediate receiving area appear relatively undisturbed, soils in the depressional area appear to have been impacted by use of the area as an access trail. The site has been logged, and is in young second growth with some larger trees. In the dispersal area vegeation includes Douglas fir, western red cedar, arbutus. Understorey in less disturbed locations shows Oregon grape, otherwise grasses and Scotch broom.
Summary of existing system	Existing system is a Type 1 (septic tank) with gravity trench dispersal system. This system is malfunctioning by saturation during wet weather in the dispersal area. An inspection by Mike Hyde ROWP of Save on Septic found the tank (750 IG concrete) to be in usable condition (needing risers) but the distribution box had degraded and water was flowing from the field to the tank, the water reportedly appeared to be clean groundwater. Inspection was carried out in very wet weather, and field reportedly accepts effluent at other times. Save on Septic did not identify an immediate health hazard. The owners report that the area near the apple tree (see plan) has been seasonally wet. The original filing shows the trench system as having been dug into underlying shale rock. Based on these observations the dispersal area is not considered reusable, due to limited vertical separation. The existing tank may be reused with addition of risers.
Horizontal setback triggers	No wells are reported within 30 m of the proposed dispersal area, the on site well constrains tank placement in the upper bench area. Downslope of dispersal area to E an existing access road is in place on the neighboring lot, below a steep bank. Risk of breakout expected to be over 7.5 m from dispersal bed. During dry season evaluation, no surface water features observed within 30 m of dispersal area (note that neighboring property was not evaluated due to access constraints, but no water features shown in mapping, to be confirmed at construction, see design notes). Setbacks are expected to meet SPM standards.

Summary of site use and soil capability	Site is constrained by rock outcrops, shallow and disturbed soils and steep slope. The elevation from the planned house site to the potential dispersal area provides an opportunity for gravity powered pressure distribution system dosing. Location of a dispersal system at the lower bend area is chosen to: - Use area of relatively undisturbed native soils in lower slope alignment - Take advantage of available elevation from upper bench area - Allow installation approximately on contour and maximize length on contour. - Allow natural drainage of surface water away from dispersal area - Provide for easier access to allow construction (from the existing easement access road) The preferred dispersal system location is within an easement area. See design notes.