Appendix A

GLOBAL PERSPECTIVE.
LOCAL FOCUS.

TECHNICAL MEMORANDUM

Capital Regional District
Mayne Island

Skana Water Service
Tank Replacement Options Analysis

APRIL 2025

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1 ISSUE

The Skana Water System is a small water system located on Mayne Island, operated by the Capital Regional District (CRD). The Skana Water System consists of two groundwater wells (Wells 8 and 13) and two treatment facilities (Skana and Sandy Hook), one for each well to chlorinate the groundwater.

Skana water treatment plant feeds a set of two gravity storage tanks which provide water at pressure, via distribution pipe. The existing horizontal cylindrical welded steel tanks have been identified as having significant corrosion. They are at the end of their 40-year lifetime and are not believed to meet post disaster seismic design requirements. Consideration of options for their replacement is required.

2 BACKGROUND

2.1 Existing System

The Skana Water System is located on Mayne Island, serving homes on Waugh Road, Aya Reach Road, Skana Road, and Sandy Hook Road, near Lighthouse Point, generally on the north of the Island. The system is served by Skana water treatment plant and tanks which are located south of Waugh Road, as well as by Sandy Hook water treatment plant, northwest of Sandy Hook Road, as illustrated in **Figure 2-1**. The system currently serves approximately 53 parcels, with a current capacity of 45.3 m^3 per tank, 91 m^3 in total. The system has the ability to be developed up to a maximum of 73 parcels.

The tanks are located at an approximate elevation of 50 m. By gravity, a series of 100 mm PVC pipes supply water at a residual pressure reported to be up to 350 kPa (50 psi), to parcels along Waugh Road, Aya Reach Road, and Sandy Hook Road, at an approximate elevation of 20 m. The location of the existing Skana water system tanks is suitable for gravity storage tanks, and is accessible from Waugh Road, for ease of maintenance and operation requirements. The tanks were constructed in the 1970s and are constructed as horizontal steel cylinders, each supported on two concrete saddles. Tank 1 is shown in **Figure 2-2** with the second tank out of view behind it.

Figure 2-1 Skana Water Service Area

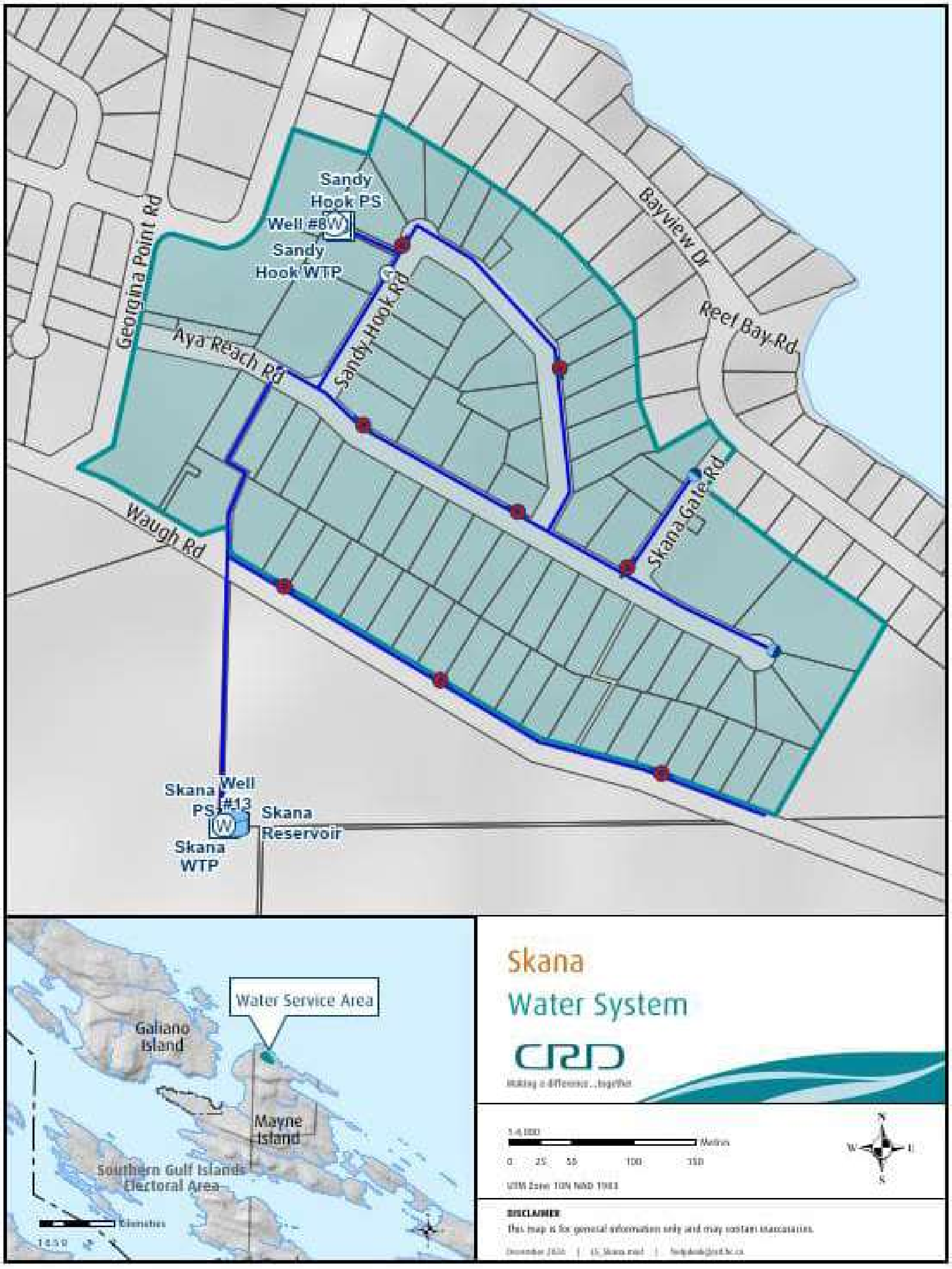

Figure 2-2 Skana Water Storage Tanks

Associated observed the concrete saddles for Tank 1 (closest tank in **Figure 2-2**) to have settled and sitting at an angle 0.4° to 2.7° off of level. The tank walls are understood to be 6 mm thick based on measurements written on the outer tank wall as well as a 2016 assessment report.

The tanks contain low- and high-level float switches, which are used to control the production of water. The level switch wires are routed in the same raceway as the PVC pipe, as illustrated in **Figure 2-2**.

The Water Treatment Plant is located on the same site, adjacent to the tanks. Single phase power is provided to the water treatment plant from a pole mounted transformer adjacent to the treatment plant building.

To understand the operation of the system, relevant background information was collected from the CRD and a site visit was conducted on 7 November 2024. Annotated photographs taken during the site visit are included in **Appendix B**. Background information reviewed included:

- Record Drawings
- Skana water system annual report (2023)
- Assessment of System Tanks, conducted by Stantec (2016)
- SCADA system overview

3 STAKEHOLDERS

The primary stakeholders for the tank replacement are stakeholders are property owners and residents within the service area boundary including customers whose potable water is supplied from the system. Other stakeholders include the Capital Regional District Infrastructure & Water Services (IWS) who own, operate and maintain the system.

4 OBJECTIVE

The objective of this memorandum is to review available information and recommend next steps for the future water storage needs of the Skana water system.

5 TECHNICAL REVIEW OF SYSTEM

5.1 Tank Sizing

Replacement tanks for the Skana Water System should be designed in accordance with the BC Ministry of Health's 2023 Design Guidelines for Drinking Water Systems in British Columbia (Guidelines). Mayne Island Trust Land Use Bylaw No. 146 was also considered, but the provincial guidelines provide the most comprehensive direction for reservoir design. Use of these recently introduced guidelines will be beneficial for obtaining the required Permit to Construct Waterworks, from Island Health Authority, at the completion of the tank design.

Sizing the tanks to include fire storage presents a problem for the Skana system. The demand on the system is typically low relative to the larger volume of water which would be required for fire storage. Fire storage would therefore result in high water age, and present water quality challenges. A comparison of storage volume with and without fire storage is presented in **Table 5-1**.

In lieu of a regulatory requirement, the CRD's July 2009 Engineering Specifications and Standards Drawings summarize requirements which are applied within the Juan de Fuca (JDF) distribution system, and these were used as a basis to develop tank sizing with fire storage. Section 4.12, Reservoirs, of the standards recommends:

- Equalization storage of 25% of maximum day demand (MDD)
- Fire storage of 1,200 m^3
- Emergency storage of 50% of average day demand (ADD)

The fire storage required by the JDF standards would result in extremely long residence time within the Skana tanks and would cause water quality issues. As an alternate, we recommend typical single family home fire flow of 4000 L/min for 1.5 hours, resulting in a volume of 360 m^3, as per the Fire Underwriter's Survey, Water Supply for Public Fire Protection Guidelines. However, the existing infrastructure at Skana water treatment plant and tanks is inadequately sized to deliver flows of 4000 L/min to hydrants within the Skana system. The existing 100mm diameter piping would also present limitations for fire flow, providing higher velocities than required to the hydrants. Fire storage was not further considered at this time.

Table 5-1 Tank Volume Comparison

	With fire storage (m^3)	Without fire storage (m^3)
Equalization storage 25% of maximum day demand (16.6 x 2.5 x 0.25)	11.4	-
Fire storage	360	-
Emergency storage 50% of average day demand (16.6 x 0.25)	8.3	-
Maximum day demand (16.6 x 2.5)	-	46
Total reservoir volume	**380**	**46**

As fire storage is not to be provided, the Guidelines indicate that storage equal to MDD should be provided. Water production records indicate a 2019 – 2023 ADD of 12m³/day (source: Skana Water Production spreadsheet provided by CRD). Scaling this value for maximum likely population growth to 73 parcels at build-out of the service area provides an ADD of 16.6 m³/day. The peaking factor of 2.75 from the Guidelines is then applied to the ADD figure to estimate MDD, providing a recommended 46 m³ of storage. This is approximately 50% of the volume available in the existing tanks.

Build-out capacity can be achieved through construction of a single 46 m³ tank, or through two 23 m³ tanks. A vertical tank solution is recommended for either tank configuration. Vertical tank(s) occupy a smaller site footprint, and design of foundations for seismic and gravity loads is simpler compared to a horizontal tank.

A larger tank could also be considered in order to provide additional emergency storage beyond the amount required by the guidelines. Providing additional storage will improve the resilience of the system, for example by allowing additional time for recovery of source wells or in case repair parts need to be mobilized to the island using scheduled ferries. A significantly larger tank can result in operational challenges due to high water age. Keeping the size of the existing tanks, at 92 m³ (rounded up from 91 m³ to provide double the 46 m³ capacity) total, has been demonstrated to provide a reasonable balance of these considerations and suitable for maintaining an adequate level of service to the water system users. The service area can experience extended power outages and is situated in a remote location, so having storage beyond the Guidelines calculation of 46 m³ will be useful.

5.2 Tank Material

Tanks suitable for potable water service may be manufactured from a wide variety of materials. For field-erected tanks away from large population centres, bolted steel tank construction is common. For small-scale tanks such as those required at Skana, shop fabricated tanks are available in a wider range of materials, including various polymers, coated steel or stainless steel.

Glass-fused (bolted) steel tanks have been used for many years for many applications including reservoir and other liquid storage purposes. This type of tank can provide an economical way to combine shop coating of panels with field erection for a robust tank. Historically, depending on the corrosiveness of the stored liquid, epoxy coated steel tanks have performed satisfactorily with the service life of the epoxy coating lasting at least 30 years. Glass-fused steel tanks have also been used in many similar applications where the estimated maintenance life can extend beyond 50 years. Cathodic protection is often used as an additional measure to protect these tanks and prolong the overall service life. These tanks can be assembled on site using relatively lightweight equipment.

When the required tank size is small enough to facilitate shipping of a complete tank, it is also practical to fabricate a steel tank off site, apply factory coatings to the entire fabrication, and deliver a complete tank to site. As tank sizes exceed 3.5 to 4 metres in diameter, transportation becomes increasingly challenging. Epoxy coated steel would be a likely choice, and coating life of at least 30 years could be expected. Fabrication quality can be better controlled compared to a field-fabricated tank. A large crane is required to lift a shop fabricated tank. Manufacturing for welded steel tank(s) could likely to be completed in BC and this option is therefore less prone to concerns around shipping disruption, Canadian Dollar value fluctuation, and import tariffs.

Cross-linked polyethylene (XLPE) is a polymer with excellent mechanical properties that can be manufactured into tanks within a manufacturing facility.

The material is suitable without protection for storage of potable water or for other materials such as chemical storage and can be procured with NSF 61 certification. A carbon black additive can be added to the polymer during manufacturing to reduce the effects of UV exposure which can cause the material to become brittle over time. These tanks would absorb more solar radiation due to the black additive, resulting in higher water temperatures and requiring operational management to avoid water quality degradation. The mechanical properties of cross-linked polyethylene allow it to provide adequate performance even under seismic loading. An XLPE tank would be expected to last at least 20 years.

Stainless steel is another candidate material which offers many of the benefits of steel while being more resistant to environmental corrosion. Stainless steels are generally still susceptible to corrosion in the presence of chloride (salt), including the sodium hypochlorite which is added to the Skana water for disinfection. When tank size becomes small and the relative cost of applying coatings is more significant, this can be a good option. Stainless steel can be passivated, rapidly forming a thin layer of oxide which prevents more significant corrosion. A stainless-steel tank with proper maintenance would be expected to last more than 50 years if chloride levels are carefully managed. Stainless steel was not considered further due to the additional care required for management of chlorides.

Corrosion within a steel tank often takes place above the water line within the tank where excessive moisture exchanges with oxygen create corrosion when metal is exposed. Therefore, regular maintenance and monitoring programs to inspect for corrosion will help extend the overall service life of any metallic tank. Such programs can be performed through observation at the rooftop hatch of the tank, and a permanent access ladder can be provided to facilitate the required access. For larger tanks, two access manways should be installed at the bottom of the tank at opposite sides. This will improve the safety access from a confined space and improved ventilation.

Tank material options can be considered in more detail as the work progresses, and it is also possible to procure a tank in such a way that a contractor will propose the tank that provides the best value to the Skana system from more than one acceptable solution.

5.3 Tank Replacement

Construction of replacement tanks would result in a water system that operates in the same way as the existing system. This would require the construction of new tanks complete with foundations, piping tie-in to the 100 mm PVC inlet and outlet, and instrumentation. Since these tanks would be hydraulically similar to the existing tanks, it is not anticipated that any modifications to the treatment plant would be required.

Three options were considered for a single 92 m^3, or pair of 46 m^3 vertical tanks to accommodate the required volume: cross-linked polyethylene, glass-fused (bolted) steel and shop fabricated (welded) steel tanks. Using paired tanks will allow the CRD greater flexibility in terms of maintenance and eventual tank replacement. With concrete foundation slabs, ladders and roof hatches, the cost for these tanks is estimated in **Table 5-2**, for each material type.

Table 5-2 Class D Opinion of Probable Cost (+/- 50%)

Option	Likely capital cost	Estimated Life
One 92 m^3 glass-fused steel tank	$1,420,000	30
Twin 46 m^3 welded steel tanks	$940,000	50
Twin 46 m^3 XLPE tanks	$790,000	20

A single glass-fused steel tank of 92 m^3 provides approximately twice the required capacity. The cost of a glass-fused steel tank in this size is relatively high, and consequently glass-fused steel is not commonly used for tanks of this size unless there are significant access constraints for a site that preclude lifting of a shop fabricated tank into place. This site does not have such access constraints. Despite the operational flexibility having two tanks allows for, a single glass-fused steel tank is proposed as the smallest available size of glass-fused steel tank is 73 m^3. Two glass fused steel tanks would provide excessive volume for maintenance of suitable water quality. The cost of two glass-fused steel tanks would also be prohibitive.

Based on a welded steel tank, or tanks, with foundations, piping and instrumentation, the total installed cost is expected to be in the range of $940,000 +/- 50%.

Cross-linked polyethylene tank(s) would provide a lower up-front capital cost; however, they also have the shortest anticipated service life. To allow comparison of the tank options with different service life expectancy, a life cycle analysis was conducted, for which the findings are presented in Appendix D. This analysis indicates that for typical discount rates below about 5%, the welded steel tanks are the more cost-effective option. If a high discount rate (>5%) is used, the XLPE tanks are a better option. The capital cost factored into the life cycle analysis considers manufacture, transport and installation costs for the tank itself. Whereas the Class D Opinion of Probable Cost (Table 5-2) accounts for all direct and indirect costs related to the tank replacement. This cost breakdown is detailed in Appendix A. Therefore, the overall capital costs listed in the class D opinion of probable cost differ from the life cycle analysis.

A geotechnical investigation is recommended to be conducted at the location of the replacement tank(s), due to proximity to the adjacent slope. This is to be considered in conjunction with the design of tank foundation envelope and depth, and with consideration for seismic requirements.

It is anticipated the existing chlorine recirculation pump in Skana water treatment plant, can be re-used for tie-in to the new tank(s), and configured to the new tank(s) volume to achieve the required chlorine residual of the system.

It is recommended that the construction of the new tanks be staged to ensure a tie-in sequence that minimizes service disruptions. Initially, one existing tank will be decommissioned while the other remains in service. During this time, the new tank—or one of the two new tanks—will be constructed. Once completed, the second existing tank will be decommissioned, and service will be fully transitioned to the new tank(s).

Wired level transmitters with backup float switches can be used for the new tank(s), providing comparable information to the existing setup. A more significant upgrade to the existing control system may be appropriate at the same time, given the age of the existing controls.

5.4 Refurbishment of Existing Tanks

A detailed condition assessment was conducted in 2016, concluding that replacement tanks were required. The assessment consisted of visual observations of the inside and outside of the tank supplemented by non-destructive testing to confirm thickness of steel elements. The 2016 observations included major corrosion down the entire length of the tanks as well as severe pitting on the tanks' bottoms. It was noted that the tanks were designed and installed prior to the enactment of modern seismic requirements, and they are unlikely to perform adequately in a significant earthquake. It would be technically feasible to refurbish these tanks and upgrade seismic capacity; however, due to the complexity of such an undertaking this is not anticipated to be less expensive than a replacement. Refurbishment would include upgrading or replacing foundations, welding new steel in areas of corroded tank shell and other components, and field-applying new coatings suitable for potable water. The work would need to be conducted in stages to keep one tank in service throughout. Strict attention to quality management would be required for field welding, surface preparation, and coating application in order to achieve the desired results. Replacement is proposed as a more practical option due to the complexity of refurbishment.

6 RECOMMENDATIONS

Based on this analysis, it is recommended that the CRD proceed with design and procurement of a pair of 46 m^3 shop-fabricated welded steel tanks with an epoxy coating. This option provides good operational flexibility at reasonable cost with the ability to conduct good quality control in a factory setting and minimize site disruption. Using paired tanks will allow the CRD greater flexibility in terms of ongoing operation and maintenance.

CERTIFICATION PAGE

This report presents our findings regarding the Capital Regional District Mayne Island Skana Water Service Tank Replacement Options Analysis

Respectfully submitted,

Associated Engineering (B.C.) Ltd.
Engineers & Geoscientists BC Permit Number 1000163

Prepared by:	Reviewed by:
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Shane Duggan Mechanical Designer	Jonathan Musser, M.A.Sc., P.Eng. Process Engineer

SD/JM/nhd

APPENDIX A - CLASS D OPINION OF PROBABLE COST

Project #: 2021-2386-05
Client: CRD Mayne Island
Project Name: Skana Reservoir
Revision Date: 01-Apr-25
Author: SD

Capital Cost Estimate - Preliminary

Estimate Classification - Class D
Expected accuracy per CEABC/EGBC definition: +/- 50%

			92 m^3 bolted steel tank		twin 46 m^3 welded steel tanks		twin 46 m^3 XLPE tanks	
Item	**qty**		**Cost**	**Total**	**Cost**	**Total**	**Cost**	**Total**
Mob/demob	LS		$ 30,000	$ 30,000	$ 40,000	$ 40,000	$ 40,000	$ 40,000
Demolition	LS		$ 5,000	$ 5,000	$ 5,000	$ 5,000	$ 5,000	$ 5,000
Site piping	LS		$ 10,000	$ 10,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000
Sitework/grading	LS		$ 10,000	$ 10,000	$ 15,000	$ 15,000	$ 15,000	$ 15,000
	LS		$ -	$ -	$ -	$ -	$ -	$ -
	LS		$ -	$ -	$ -	$ -	$ -	$ -
Reservoir	LS		$ 500,000	$ 500,000	$ 250,000	$ 250,000	$ 174,000	$ 174,000
Foundations	LS		$ 85,000	$ 85,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000
Controls	LS		$ 20,000	$ 20,000	$ 40,000	$ 40,000	$ 40,000	$ 40,000
Subtotal				$ 660,000		$ 420,000		$ 344,000
Geotechnical investigation				$ 25,000		$ 25,000		$ 25,000
Engineering allowance				$ 75,000		$ 75,000		$ 75,000
General Costs (contractor)		15%		$ 99,000		$ 63,000		$ 51,600
Inflation		20%		$ 132,000		$ 84,000		$ 68,800
Remoteness		25%		$ 165,000		$ 105,000		$ 86,000
Contingency		40%		$ 264,000		$ 168,000		$ 137,600
Total				**$ 1,420,000**		**$ 940,000**		**$ 790,000**

APPENDIX B - SITE PHOTOS

Figure B-1 Tank

Figure B-2 Exterior Base of Tank 1

Figure B-3 Raceway Between Tanks

Figure B-4 Flange Connection/Corrosion

Figure B-5 Raceway to WTP

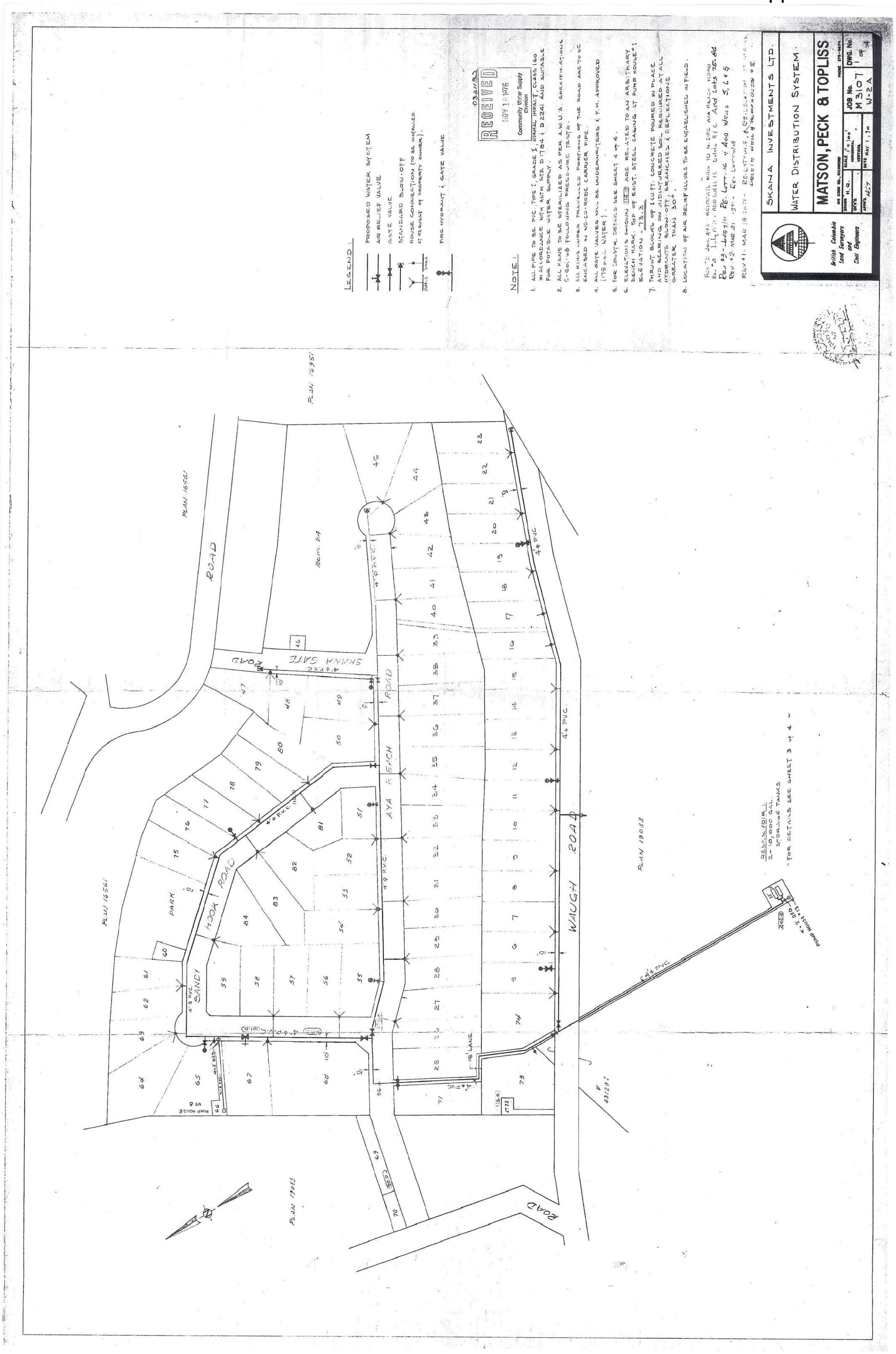
Figure B-6 Exterior Top of Tank

Figure B-7 Front of Tank 2

Figure B-8 Exterior Base of Tank 2

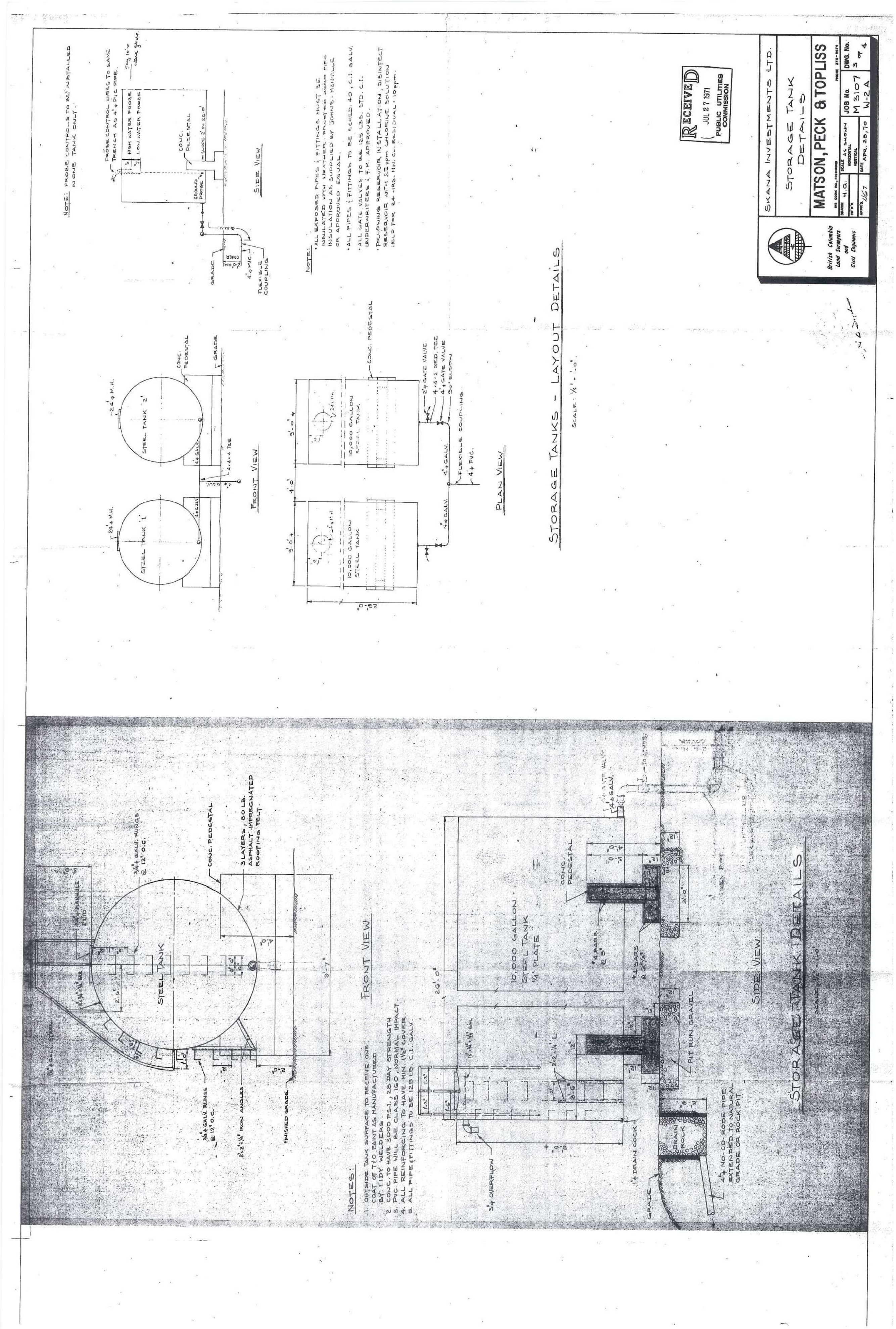
APPENDIX C - EXISTING INSTALLATION DOCUMENTATION

Appendix A



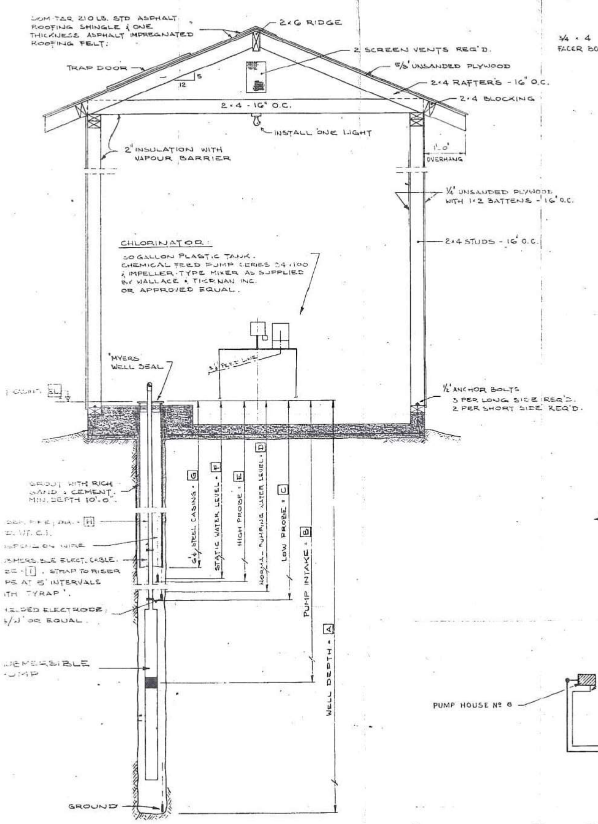
LEGEND:
PROPOSED WATER SYSTEM
AIR RELIEF VALVE
GATE VALVE
STANDARD BLOW-OFF
HOUSE CONNECTION (TO BE INSTALLED AT REQUEST OF PROPERTY OWNER).
FIRE HYDRANT & GATE VALVE
RECEIVED
NOV 10 1976
Community Water Supply Division
NOTE:
1. ALL PIPE TO BE PVC, TYPE I, GRADE I, NORMAL IMPACT, CLASS 160 IN ACCORDANCE WITH ASTM STD. D1784 & D2241 AND SUITABLE FOR POTABLE WATER SUPPLY.
2. ALL MAINS TO BE STERILIZED AS PER A.W.W.A. SPECIFICATIONS C-601-68 FOLLOWING PRESSURE TESTS.
3. ALL MAINS UNDER TRAVELLED PORTIONS OF THE ROAD ARE TO BE ENCASED IN NO-CO-RODE CARRIER PIPE.
4. ALL GATE VALVES WILL BE UNDERWRITERS & F.M. APPROVED (175 p.s.i. WATER).
5. FOR CONSTR. DETAILS SEE SHEET 4 of 4.
6. ELEVATIONS SHOWN ARE RELATED TO AN ARBITRARY BENCH MARK. TOP OF EXIST. STEEL CASING AT PUMP HOUSE #1 ELEVATION = 73.3
7. THRUST BLOCKS OF 1 CU.FT. CONCRETE POURED IN PLACE AND BEARING ON UNDISTURBED SOIL REQUIRED AT ALL HYDRANTS, BLOW-OFF, BRANCHES & DEFLECTIONS GREATER THAN 30°.
8. LOCATION OF AIR RELIEF VALVES TO BE ESTABLISHED IN FIELD.
Rev #3 - Re-lotting & Add Wells 5, 6 & 8
Rev #2 - MAR 31 1971 - Re-lotting
Rev #1 - MAR 18 1971 - Re-lotting
SKANA INVESTMENTS LTD.
WATER DISTRIBUTION SYSTEM
MATSON, PECK & TOPLISS
British Columbia Land Surveyors and Civil Engineers
SCALE 1" = 100'
DATE MAY 1, 70
JOB No. M 3107
DWG. No. 1 of 4
W-2A
RESERVOIR 1:
2 - 10,000 GAL. STORAGE TANKS
- FOR DETAILS SEE SHEET 3 of 4 -
PUMP HOUSE #13
PUMP HOUSE No 8
PLAN 16561
PLAN 16951
PLAN 19083
ROAD
SKANA GATE ROAD
AYA REACH ROAD
SANDY HOOK ROAD
WAUGH ROAD
15' LANE
PARK
4" PVC

Appendix A

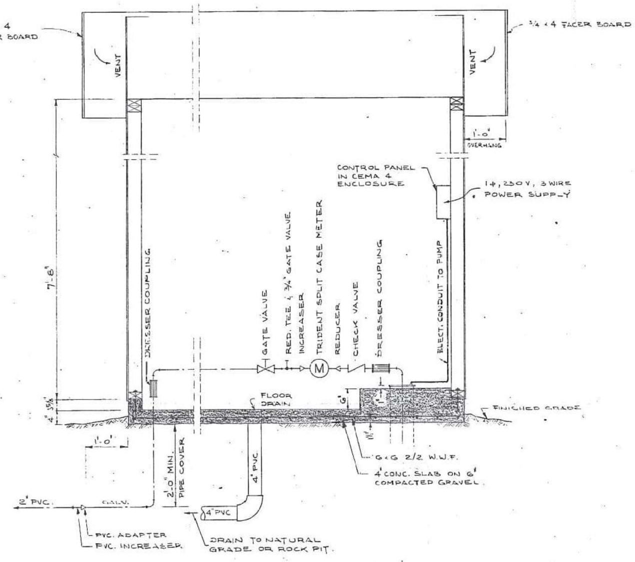


NOTE: PROBE CONTROLS TO BE INSTALLED IN ONE TANK ONLY.
SIDE VIEW
NOTE:
• ALL EXPOSED PIPES & FITTINGS MUST BE INSULATED WITH HEATING CABLE AND INSULATION AS SUPPLIED BY JOHNS-MANVILLE OR APPROVED EQUAL.
• ALL PIPES & FITTINGS TO BE SCHED. 40, C.I. GALV.
• ALL GATE VALVES TO BE 125 LBS. STD. C.I. UNDERWRITERS & F.M. APPROVED.
• FOLLOWING RESERVOIR INSTALLATION, DISINFECT RESERVOIR WITH 25 ppm CHLORINE SOLUTION HELD FOR 24 HRS. MIN. CL. RESIDUAL 10 ppm.
STEEL TANK '1'
STEEL TANK '2'
FRONT VIEW
10,000 GALLON STEEL TANK
CONC. PEDESTAL
PLAN VIEW
STORAGE TANKS - LAYOUT DETAILS
SCALE: 1/4" = 1'-0"
RECEIVED
JUL 27 1971
PUBLIC UTILITIES COMMISSION
SKANA INVESTMENTS LTD.
STORAGE TANK DETAILS
MATSON, PECK & TOPLISS
British Columbia Land Surveyors and Civil Engineers
JOB No. M3107
DWG. No. W-2A
APR. 20, 70
STEEL TANK
FRONT VIEW
3 LAYERS, 90 LB. ASPHALT IMPREGNATED ROOFING FELT.
3/4" GALV. RUNGS @ 12" O.C.
FINISHED GRADE
NOTES:
1. OUTSIDE TANK SURFACE TO RECEIVE ONE COAT OF T/O PAINT AS MANUFACTURED BY TIDY WELDERS.
2. CONC. TO HAVE 3000 P.S.I. 28 DAY STRENGTH
3. PVC PIPE WILL BE CLASS 160, NORMAL IMPACT.
4. ALL REINFORCING TO HAVE MIN. 1 1/2" COVER.
5. ALL PIPE & FITTINGS TO BE 125 LB. C.I. GALV.
10,000 GALLON STEEL TANK 1/4" PLATE
PIT RUN GRAVEL
DRAIN ROCK
1 1/4" DRAIN COCK
3/4" OVERFLOW
GRADE
4" NO-CO-RODE PIPE EXTENDED TO NATURAL GRADE OR ROCK PIT.
SIDE VIEW
STORAGE TANK DETAILS

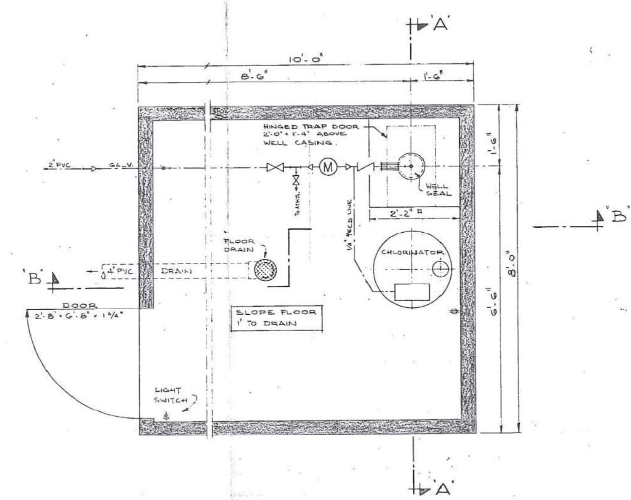
Appendix A



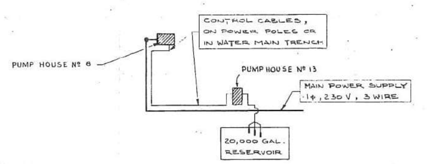
SECTION 'A'-'A'
SCALE: 3/4" = 1'-0".



SECTION 'B'-'B'
SCALE: 3/4" = 1'-0".



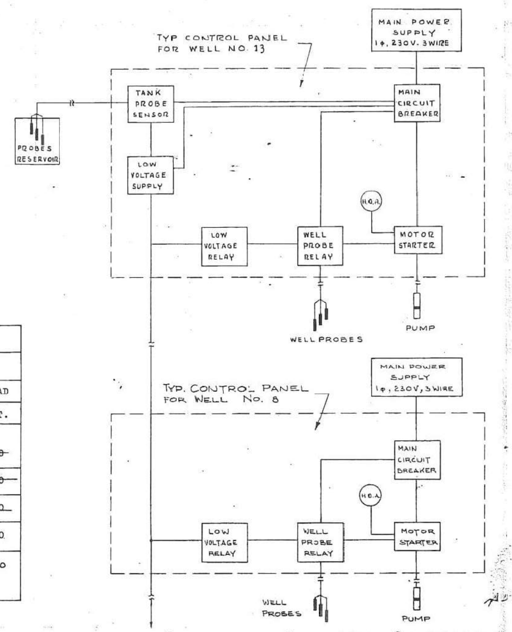
PLAN VIEW
SCALE: 3/4" = 1'-0".



SCHEMATIC OF PUMP HOUSE OPERATION - PLAN VIEW

NOTE:

1. ALL PIPING IN PUMPHOUSES TO BE 1" φ GALV. SCHEDULE 40.
2. SCREWED FITTINGS TO BE 125 LBS. CAST IRON GALV.
3. GATE VALVES TO BE UNDERWRITERS AND F.M. APPROVED WITH RISING STEM (175 p.s.i. WATER).
4. THE ELECTRICAL CONTRACTOR WILL SUPPLY SHOP DRAWINGS OF PUMP & RESERVOIR CONTROL SYSTEM FOR ENGINEERS APPROVAL PRIOR TO INSTALLATION.
5. CONCRETE TO HAVE 3000 p.s.i. 28 DAY STRENGTH.
6. ALL EXPOSED PIPE & FITTINGS TO BE COATED WITH EPOXY ENAMEL SUITABLE FOR POTABLE WATER SUPPLY.
7. ALL EXTERIOR WOODEN SURFACES TO RECEIVE ONE COAT OF C.I.L. # 999 EXTERIOR PRIMER & ONE COAT OF C.I.L. EXTERIOR ACRYLIC LATEX.
8. ALL INTERIOR WOODEN SURFACES TO RECEIVE TWO COATS OF INTERIOR C.I.L. SATIN LATEX, (WHITE).



ELECTRICAL CONTROL SCHEMATIC

WELL DATA														PUMP DATA				
WELL NO.	RATED FLOW AT DRAWDOWN	WELL DEPTH	PUMP INTAKE	LOW PROBE	PUMP LEVEL	HIGH PROBE	STATIC LEVEL	CASING	RISER PIPE	METER	MOTOR CABLE	TOP OF CASING	TANK	T.D.H.	SINGLE φ -- 230 V PUMPS			
		A	B	C	D	E	F	G	H	M	I	EL.	T.W.L.		MAKE / MODEL NO.	H.P.	FLOW	HEAD
	G.P.M.	FT.	FT.	FT.	FT.	FT.	FT.	FT.	INS.	INS.	GAUGE	FT.	FT.	FT.			G.P.M.	FT.
~~1~~	~~4.0~~	~~165~~	~~160~~	~~150~~	~~150~~	~~20~~	~~12~~	~~±20~~	~~1~~	~~5/8~~	~~14~~	~~115~~	~~202~~	~~252~~	Myers ~~SD5C-21~~ 17 Stages	~~1/2~~	~~5~~	~~250~~
~~5~~	~~2.0~~	~~225~~	~~205~~	~~195~~	~~213~~	~~10~~	~~5~~	~~13~~	~~1~~	~~5/8~~	~~14~~	~~92~~	~~202~~	~~321~~	"Myers" ~~SD5C-21~~ 17 Stages	~~1/2~~	~~4~~	~~320~~
~~6~~	~~3.0~~	~~365~~	~~340~~	~~330~~	~~265~~	~~8~~	~~5~~	~~15~~	~~1~~	~~5/8~~	~~14~~	~~93~~	~~202~~	~~454~~	"Myers" ~~SD7C-21~~ 24 Stages	~~3/4~~	~~4~~	~~450~~
8	4.5	215	190	180	205	25	31	4	1	5/8	14	90	202	307	"Myers" SD7C-21 24 Stages	3/4	6+	300
13	13.0	115	87	77	60	20	ARTESIAN	20':	1	5/8	14	195	202	100'	"MYERS" SD7A-21 15-STAGES	3/4	15+	100

RECEIVED
JUL 27 1971
PUBLIC UTILITIES COMMISSION

Rev # 3 July 19, 1971 - ADD WELL 13 - Delete 5 & 6
REV # 2 June 7, 1971 - ADD WELLS 5, 6 & 8
REV. # 1 MAR 18 1971 - DELETE WELL # 2

SKANA INVESTMENTS LTD.

PUMP HOUSE No. 1, 8 & 13
LAYOUT & DETAILS

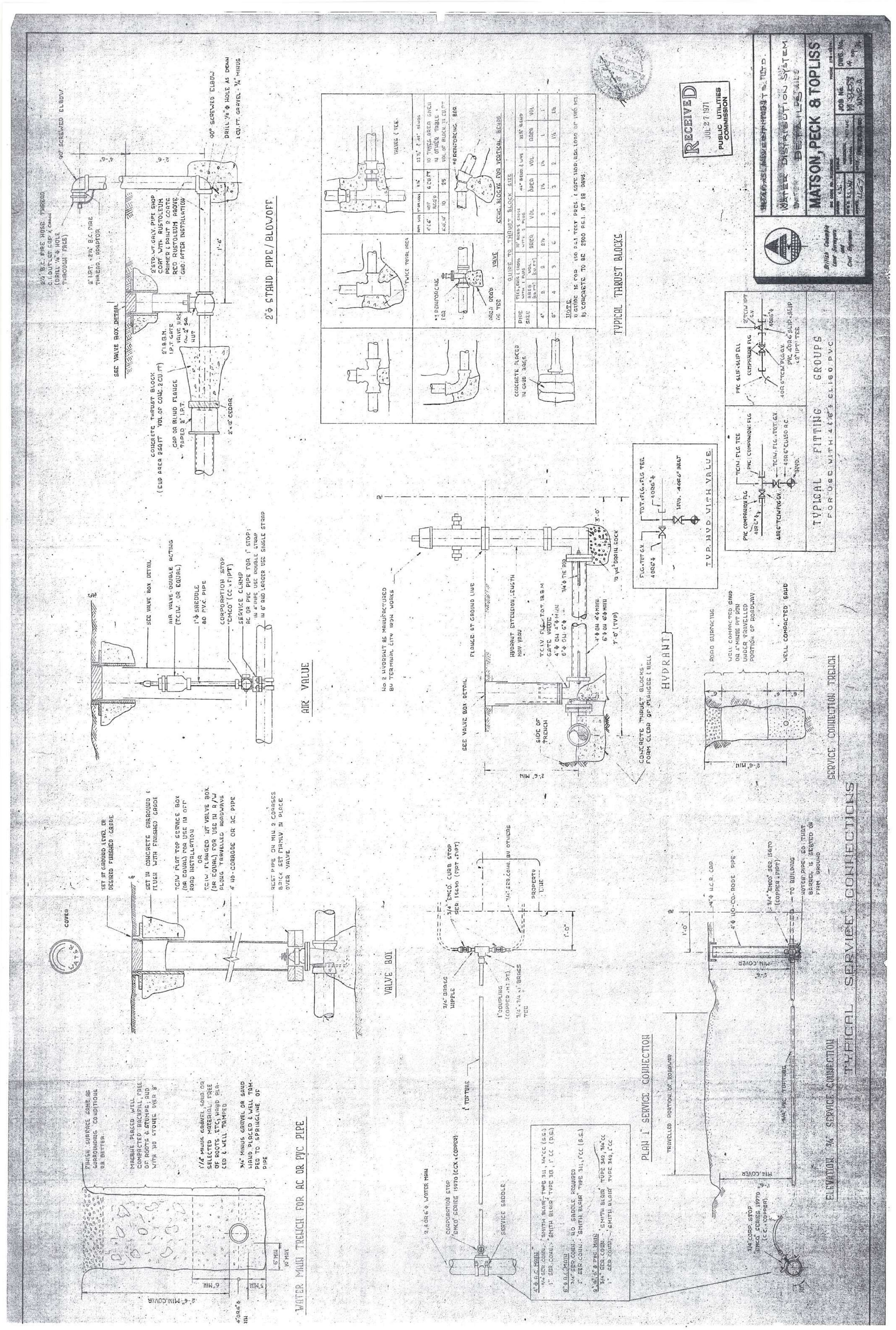
MATSON, PECK & TOPLISS

British Columbia Land Surveyors and Civil Engineers

815 COOK RD., RICHMOND — PHONE 278-9674

DRAWN H.Q.	SCALE AS SHOWN HORIZONTAL VERTICAL	JOB No. M3107 W-2A	DWG. No. 2 OF 4
CH'K'D.			
APPR'D. HGT	DATE APR. 29, 70		

Appendix A



MATSON, PECK & TOPLISS
WATER DISTRIBUTION SYSTEM
RECEIVED
JUL 27 1971
PUBLIC UTILITIES COMMISSION
TYPICAL THRUST BLOCKS
2Ø STAND PIPE/BLOWOFF
AIR VALVE
VALVE BOX
HYDRANT
SERVICE CONNECTION TRENCH
TYPICAL FITTING GROUPS
TYPICAL SERVICE CONNECTIONS
WATER MAIN TRENCH FOR AC OR PVC PIPE
PLAN 1" SERVICE CONNECTION
ELEVATION 3/4" SERVICE CONNECTION

APPENDIX D – LIFE CYCLE ANALYSIS

Project #: 2021-2386-05
Client: CRD Mayne Island
Project Name: Skana Reservoir
Revision Date: 01-Apr-25
Author: SD

Life Cycle Analysis

Option	Estimated capital cost	Estimated life	discount rate	0%	2%	4%	6%	8%	10.0%
				Equivalent Annual Capital Cost					
92 m3 bolted steel tank	$ 500,000	30		$ 17,000	$ 22,000	$ 29,000	$ 36,000	$ 44,000	$ 53,000
twin 46 m3 welded steel tanks	$ 250,000	50		$ 5,000	$ 8,000	$ 12,000	$ 16,000	$ 20,000	$ 25,000
twin 46 m3 XLPE tanks	$ 174,000	20		$ 9,000	$ 11,000	$ 13,000	$ 15,000	$ 18,000	$ 20,000

$$Annual\ cost = \frac{cost \times r}{1 - \frac{1}{(1+r)^t}}$$

r = discount rate
t = number of years
(note r=0 is calculated using lim(r -> 0))

Sample calculation for
cost = 500,000
r = 2%
t = 30

$$Annual\ cost = \frac{cost \times r}{1 - \frac{1}{(1+r)^t}} = \frac{500000 \times 2\%}{1 - \frac{1}{(1+2\%)^{30}}} = \frac{10000}{1 - \frac{1}{1.8114}} = \frac{10000}{0.4479} = 22326$$