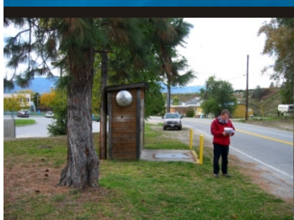
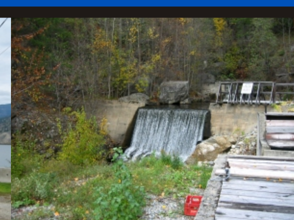
PRE-DESIGN REPORT

REGIONAL DISTRICT OF OKANAGAN-SIMILKAMEEN

Naramata Water Supply Improvements

May 2005




Associated Engineering

May 13, 2005
File: 042629

Andrew Reeder, P.Eng.
Director of Works and Utilities
Regional District of Okanagan-Similkameen
101 Martin Street
Penticton, BC
V2A 5J9

Re: NARAMATA WATER SUPPLY IMPROVEMENTS
PRE-DESIGN REPORT

Dear Mr. Reeder:

We are pleased to submit our report entitled *Naramata Water Supply Improvements, Pre-Design Report*, *May 2005.*

The report includes a Summary Report and seven (7) technical memoranda, which confirm the pre-design of the project. It provides information on the design criteria, siting, general arrangements, cost estimates and implementation schedule for the proposed facilities.

We would like to thank you and other RDOS staff for your input in developing the project design approach. We look forward to working with you to complete the design and construction of the facilities.

Respectfully submitted,

ASSOCIATED ENGINEERING (B.C.) LTD.

W.J. (Bill) Harvey, P.Eng.
Project Manager

WJH/cb

Enclosure

cc: Ron Johnston, P.Eng. - Interior Health

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Summary Report

Regional District of Okanagan-Similkameen

Naramata Water Supply Improvements

May 2005

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1 Introduction

1.1 BACKGROUND

The Naramata water system provides water which services 782 domestic connections and 450 hectares of irrigation. The community of Naramata is approximately 15 km North of Penticton and is supplied by two creek water sources, Robinson and Naramata Creeks, and Okanagan Lake. Currently, water must be supplied from all three water sources in order to meet the maximum daily demand and the yearly supply needs.

The Naramata water supply does not meet the Federal Guidelines for Canadian Drinking Water Quality (GCDWQ), nor does the system deliver water which meets the objectives of the Interior Health Authority (IHA). High levels of turbidity, colour and the presence of Giardia and Cryptosporidium in the creek sources are the primary concerns for the District and IHA. The existing water system is on a Boil Water Advisory for much of the year. Further, the District does not currently treat, or filter the water supply from Okanagan Lake for protozoa.

In order to determine the best method and means of improving the water quality, the District commissioned several strategic reviews. Further, the RDOS formed a public advisory committee in order to vet possible solutions with the community. He RDOS applied for, and was awarded, a Federal Provincial infrastructure grant for $3M in order to improve the Naramata water system supply, and has received an 88% approval at a recent referendum to proceed with a $6.2M project. The conceptual improvements consist of changing the existing water system to supply and treat the entire water system from Okanagan Lake. Treatment with Ultra Violet (U.V.) light has been selected as the most cost effective means of meeting IHA and GCDWQ health objectives. It is the District's intent to gradually split the water system into a domestic water supply system from Okanagan Lake, and an irrigation supply system from the two creek sources. A forty-year reserve on water rights has been placed on Robinson and Naramata Creeks by provincial Cabinet in order to facilitate this objective.

In December 2004, the RDOS retained Associated Engineering to provide engineering services for the design and construction of the new facilities. This document confirms the predesign and cost estimates for the various components of the project.

1.2 DESIGN TEAM

The design team includes staff from the RDOS, Associated Engineering, and various sub-consultants. Associated Engineering acknowledges the input of the RDOS design team including:

- Andrew Reeder – Engineering Services
- Stephen Juch, AScT – Engineering Superintendent
- David Carlson – Operations Manager
- Dave Gold - Operator

- Judy Burton – Engineering Services Clerk

Associated Engineering's team includes individuals from across the company, as well as various specialist sub-consultants. The team members and their individual responsibilities are listed in Associated Engineering's proposal. During design meetings, the Associated Engineering team was generally represented by:

- Bill Harvey, P.Eng. – Project Manager
- Sean Bolongaro, P.Eng. – Design Lead

1.3 PRELIMINARY DESIGN TECHNICAL MEMORANDA

The Naramata Water Supply Improvements includes many different elements.

For the preliminary design, it was therefore necessary to breakdown the design tasks into more manageable assignments. These assignments were then addressed by individual technical memoranda. The following list summarizes the technical memoranda which were prepared as part of the preliminary design.

Technical Memorandum No. 1 – Water Distribution System Analysis and Planning

This technical memorandum covers the hydraulic modelling of the existing and proposed water systems. It also includes a plan for future system separation.

Technical Memorandum No. 2 – Water Quality and Treatment

This technical memorandum confirms exiting raw water quality, water quality objectives, treatment implementation strategy, preliminary design criteria for the UV disinfection equipment, and preliminary design of the chlorination upgrades.

Technical Memorandum No. 3 – Intake Pump Stations and UV Facilities Predesign

This technical memorandum confirms the predesign for the intake pump stations and water treatment facilities.

Technical Memorandum No. 4 – SCADA System Predesign

This technical memorandum covers the predesign of SCADA System including interim improvements deemed necessary to keep existing facilities operating until the project is completed.

Technical Memorandum No. 5 – Treated Water Storage

This technical memorandum covers the predesign of the treated water storage improvements which involves construction of a new North Reservoir.

Technical Memorandum No. 6 – Watermains and System Deficiency Upgrades

This technical memorandum covers the predesign of the new supply pipelines, upgrading of existing distribution mains, and other system improvements.

Technical Memorandum No. 7 – Cost Estimates and Schedule

This technical memorandum confirms the predesign cost estimates and project implementation schedule for the proposal improvements.

1.4 PREDESIGN WORKSHOP

On March 1, 2005 a predesign workshop was held to define design criteria and discuss the overall direction of the project. The intent of the workshop was to review the design criteria, design concepts, facility costing, and to ensure that all logical alternatives have been considered in the predesign.

The attendees at the workshop included representatives from the RDOS and Associated Engineering. The workshop lasted a whole day and many issues were discussed and resolved. Key areas of discussion included:

- Water Demand Projections
- Future System Separation
- System Upgrading Options
- Water Supply and Treatment Concepts
- SCADA Upgrading
- Treated Water Storage Requirements
- Deficiency Upgrades
- Predesign costs Estimates
- Project Schedule

For a detailed account of the workshop proceedings, please refer to the meeting notes. As a result of the workshop, a new system option was developed which forms the basis of this report.

2 Water Distribution Analysis And Planning

2.1 APPROACH

Associated Engineering prepared a computer hydraulic model of the existing Naramata water distribution system using WaterCad software. The model included all pipes, pump stations, reservoirs, and PRV's in the system.

As a first step, runs were done to confirm existing system performance under varying demand conditions. The output data was compared to field pressure readings by RDOS operations staff to confirm that it replicates existing system performance.

System physical input data was then revised to simulate the improvements proposed under the 2005 Water Supply Improvements Project. This involved analyzing system performance to determine the most cost effective improvement plan.

As a final step, a plan was developed based on the findings of the above analysis, toward separating the majority of the distribution system.

2.2 WATER DEMAND PLANNING

2.2.1 Historical Water Demands

The RDOS operating records as well as previous consultant reports were reviewed to confirm historical water demands. The summarized water demand data is presented in Table 1-1.

Table 1-1
Summarized Water Demands

Year	Irrigation Land Area (ha)	Domestic Connections	Ave. Day Demand L/s	Max. Day Demand L/s
1994	365 (1)	750 (1)	N.A.	344 (July 20) (1)
1996	285 (2)	N.A.	57	252 (July 13)
1997	285 (2)	N.A.	35 (3)	158 (July 21) (3)
1998	285 (2)	N.A.	43 (3)	174 (July 28) (3)
1999	285 (2)	N.A.	49 (3)	171 (July 29) (3)
2000	285 (2)	N.A.	73	265 (July 19)

Year	Irrigation Land Area (ha)	Domestic Connections	Ave. Day Demand L/s	Max. Day Demand L/s
2001	285 (2)	N.A.	68	282 (Aug. 16)
2002	285 (2)	N.A.	78	282 (July 26)
2003	285 (2)	N.A.	77	281 (July 30)
2004	285 (2)	794 (2)	59	265 (Aug. 2)

(1) Naramata Irrigation District Upper Zone Water Study February 1995.

(2) Based on RDOS billing information and aerial photo assessment

(3) Data for South Creek Intake not available therefore does not cover full system demand

The RDOS staff collected and compiled consumption data for the period from 1996 to 2004. This data which was compiled in a series of Excel spreadsheets was then analyzed and synthesized by the Associated Engineering review team to extract the above summarized system water demands. As can be seen above there was remarkable consistency in maximum day demands during the years 2001, 2002, and 2003. As a result of this review the evaluation team determined that an existing maximum day demand of 295 L/s should be used as a starting point for existing system evaluation and system upgrading evaluation. This analysis assumes that the existing agricultural irrigation land area is approximately 285 Ha at a per hectare demand of 0.78 L/s-Ha (5 usgpm) and that there are 794 domestic service connections at a max day demand of 8,200 l/unit.

New irrigation techniques are being implemented throughout the Okanagan, which are significantly reducing agricultural irrigation water demands. This is a result of changes to crops, as well as changes to irrigation practices and technology. There are some discrepancies between RDOS taxation records, data obtained from previous reports, and aerial photo analysis. The design team concluded that taking all of the above factors into account (the most important of which is recent historical demand records), the above existing demand criteria are reasonably conservative for system planning purposes.

2.3 MEETING FUTURE GROWTH

Future growth in Naramata is planned to be in the order of 1.3% per annum according to the current OCP which is currently under review. This growth rate would probably be significantly exceeded if a major development such as the Blackwell property were to proceed. Planning of the system should therefore be done in such a way that facilitates system expansion to serve future development areas without creating a significant financial burden for the existing ratepayers. Potential developments identified during the system planning phase include the following:

1) Blackwell Development Phase 1 – 75 lots
2) Blackwell Development Future Phases – 350 lots plus 100 resort units

3) Workman Development – 40 lots
4) Wheeler Development – 30 lots

Some allowance should be included in the system design for increased demands generated due to densification in the Townsite as well as future development. The other factor to be considered in planning for future growth is the fact that system separation will result in significant reduction of demands at the supply system. It therefore would not be prudent to significantly oversize system components when all of the oversizing may never be required. Funds would be better spent on initiating the system separation. For the purpose of this report we have assumed an allowance of 15% for increased demand beyond the existing demands on the assumption that system separation will proceed within the next 5 to 10 years. Thereafter, as separation proceeds demands will gradually decline as separation is phased in place.

2.4 DESIGN CRITERIA

.1 Water Demand Criteria

The following water demand criteria was utilized:

Domestic Winter Demand – 1,640 L/d conn.
Domestic Max. Day Demand – 8,200 L/d conn.
Domestic Peak Hour Demand – 13,600 L/d conn.

Irrigation Winter Demand – 0 L/s ha
Irrigation Max. Day Demand – 0.78 L/s ha
Irrigation Peak Hour Demand – 0.78 L/s ha

.2 Fire Flow

Interim	30 L/s
Residential	60 L/s
Town Centre	90 L/s

.3 Water Pressure

Max. Day Demand – 275 kPa to 795 kPa
Max. Day Plus Fire – 140 kPa at fire location

.4 Pipe Criteria

Maximum Velocity – 1.8 m/sec

C Factors = 120 for pipes > 150 mm
100 for pipe < 100 mm

.5 Treated Water Storage

Storage = $S_Q + S_F$

Where S_Q = 25% of Max. Day Domestic Demand
S_F = Fire Flow Storage

S_{FF} Town Centre = 90 L/s for 1.75 hours
Residential = 60 L/s for 1.5 hours
Interim = 30 L/s for 2 hours

2.5 EXISTING SYSTEM

The existing system was modelled under maximum day combined domestic and irrigation demands utilizing both creek sources and both lake intake pump stations. Refer to Plan 1-1, which shows the existing system.

Under these conditions, the system is able to deliver water throughout the system while meeting the minimum pressure requirements. Under maximum day demand conditions several sections of pipe (generally 102mm diameter) exhibit high velocities. Some areas on the south system show higher pressures than the criteria set out in Section 3 herein. Generally, however system performance is satisfactory. This is probably largely a result of decreasing irrigation demands as discussed in Section 3.

High pressures were noted on Robinson and Ellis Ave. north of Bartlett Road. There were also isolated low areas in the system where high pressures were observed.

2.6 ANALYSIS OF UPGRADED SYSTEM OPTION 1

The upgraded system option 1, incorporates the following improvements:

- Upgraded Townsite Pump Station including 3 operating pumps rated @ 76 L/s each.
- Upgraded South Lake Intake Pump Station including 3 operating (and 1 redundant) pumps rated @ 78 L/s each.
- Dedicated 350mm high pressure supply main from Townsite Pump Station to downstream side of existing Robinson Booster Station.
- Replacement 305mm high-pressure supply main on Salting Road from Robinson to 250mm main connection.
- New North System Treated Water Reservoir east of Hook Place with TWL of 515m.

Refer to Plan 1-2 showing the Option 1 layout. An alternative involving aligning the 350mm high pressure supply main from Townsite Pump Station along Booth Road to the 250mm connection west of Partridge Road was also analyzed and found to have similar performance characteristics as the above.

2.6.1 Maximum Day Demand

The Upgraded System - Option 1 was modelled under maximum day combined domestic and irrigation demands utilizing the two improved lake intake pump stations. Under these demand conditions the system is able to deliver water throughout the system while meeting the minimum pressure requirements. Pipes exhibiting high velocities are shown in blue on Plan 1-2. The balancing reservoirs were all observed to be in “filling mode” under this scenario. Problem areas under this operating condition include:

- Similar problems as existing system on Robinson and Ellis Ave. north of Bartlett Road.

2.6.2 Peak Hour Demand

The Upgraded System - Option 1 was modelled under combined peak hour domestic and irrigation demands. Due to the fact that peak hour irrigation demands are the same as maximum day irrigation demands, this analysis revealed similar results with only minor pressure variations compared to the maximum day demand conditions. Problem areas were therefore no different than indicated in 7.1 above. Juniper and Arawana reservoirs were draining under this condition as expected.

2.6.3 Maximum Day Plus Fire Demands

The Upgraded System - Option 1 was modelled under the fire demand conditions defined in Section 3.2.

Under these demand conditions the following was observed:

- The system can provide 30 L/s fire demand in all areas except at extreme south end.
- The system is not capable of providing 60 L/s fire demand except in residential areas and areas in close proximity to balancing reservoirs and the Town Centre area.
- The system can provide 90 L/s fire demand in the Town Centre commercial area.

2.6.4 Analysis of Upgraded System Option 2

The upgraded System Option 2 was developed subsequent to the March 1 Preliminary Design Workshop. This option involves relocating the treatment facilities for the entire system to the McKay Avenue Reservoir site, replacing the Townsite Pump Station with a new raw water pumping station and converting the South Lake Pump Station to a backup facility. This option incorporates the following improvements:

- New Townsite Raw Water Supply Pump Station including 2 operating (and 1 redundant) pumps rated @ 170 L/s each.

- Dedicated 610mm raw water supply main from Townsite Raw Water Pump Station through Townsite to McKay Reservoir site.
- New McKay Avenue Water Treatment Plant and Treated Water Pump Station including 2 operating pumps serving the North System rated at 55 L/s each and 2 operating (and 1 redundant) pumps serving the South System rated @ 100 L/s each.
- Dedicated 305/254mm North System treated water supply main from McKay Avenue Treated Water Pump Station to existing 250mm main on Salting Road.
- Dedicated 406mm South System treated water supply main from McKay Avenue Treated Water Pump Station to existing 305mm main at intersection of Arawana Road and Gammon Road.
- New North System Treated Water Reservoir adjacent to existing North Creek Intake with TWL of 515m.

Refer to Plan 1-3, which shows this upgrading option.

2.6.5 Maximum Day Demand

The Upgraded System - Option 2 was modelled under maximum day combined domestic and irrigation demands. Under these demand conditions the system performance was better than Option 1 in that it eliminated some existing constraints in the South System thereby resulting in improved hydraulic performance.

2.6.6 Peak Hour Demand

The Upgraded System - Option 2 was modelled under combined peak hour domestic and irrigation demands. Again, performance was very somewhat better than Option 1.

2.6.7 Maximum Day Plus Fire Demands

The Upgraded System - Option 2 was modelled under the fire demand conditions defined in Section 3.2.

Under these demand conditions the following was observed:

- The system can provide 30 L/s fire demand in all areas except at the extreme south end.
- The system is not capable of providing 60 L/s fire demand except in residential areas and areas in close proximity to balancing reservoirs and the Town Centre area.
- The system can provide 90 L/s fire demand in the Town Centre commercial area.

2.7 OPTION EVALUATION

Cost estimates for both options were prepared in order to undertake a financial and technical evaluation and comparison. Details of the cost estimates are provided in technical memorandum No. 7. The costs for the two options are presented below:

- Option 1 - $7,586,000
- Option 2 - $7,658,000

In comparing the two options, Option 2 has numerous advantages compared to Option 1 and these are summarized below:

- Eliminates South Lake Pump Station from the system thereby eliminating potential risks due to slope failure above station, which could potentially severely damage the pump station and supply line.
- Eliminates risks associated with continued operation of existing gas chlorination system at South Lake pump station.
- Eliminates costs associated with travelling and transporting chlorine tonners to and from South Lake pump station.
- Eliminates water supply risks associated with shallow intake and pump well at South Lake Pump Station, which are above Lake Okanagan drought level.
- Eliminate water supply risks associated with 400 South Lake supply line on silt bluff.
- Minimizes facility site space requirements at Townsite pump station thereby eliminating need for costly land acquisition at this site.
- Minimizes visual impact of facilities at the prominent Townsite Pump station site.
- Consolidates all water treatment and treated water pumping facilities at one location thereby reducing life cycle operation and maintenance costs.
- Allows improved redundancy provisions for both treatment and pumping systems through consolidation of facilities at one site.
- Allows option for future addition of filtration with minimal impact on facilities installed under Phase 1.

We therefore recommend that the RDOS proceed on the basis of Option 2.

2.8 SYSTEM SEPARATION

2.8.1 Separation Concept and Staging

As a result of findings from the analysis of the existing system as well as the two upgrading options the following phased separation concept was developed.

When separation is implemented the plan is to supply the irrigation demands from the two existing high elevation creek intakes. This will significantly reduce energy consumption in comparison to serving the combined systems from the lake intake pump station(s). The South Creek Intake is somewhat remote from the majority of the irrigation system that it serves. As an interim step, therefore, retaining the South lake Pump Station would allow earlier phasing of the South system separation thus reducing the demands on the domestic system and possibly allowing the domestic system treated water supply mains to be downsized. The most financially practical option for separating the systems therefore is to install parallel mains from the North Creek Intake and South Lake Pump Station supply line terminus to allow maximum cost benefit for initial phases and thereby progressively implementing the separation.

The maximum cost benefit is achieved by starting at the North Intake on Naramata Creek and placing parallel mains first on North Naramata Road and Langedoc Road (upper bench) and then progressively to the south.

2.8.2 Fire Protection

Two alternatives were considered for fire protection in the separated system as follows:

Alternative 1 -utilize the separated irrigation system with its larger mains. The Townsite area and the residential area near the Arawana and Juniper reservoirs would continue to utilize the domestic system for fire protection as there will be no system separation in these areas. This would mean that the irrigation system would have to remain operational during the winter months when it would otherwise be shut down. It would also mean that the treated water reservoirs would have to be cross-connected to the irrigation system due to the fact that the creek intakes can freeze during winter months. A solution to this issue may be to utilize the South Lake Pump Station to keep the irrigation system pressurized when the creek intakes freeze up.

Alternative 2 - utilize the domestic system. This would necessitate provision of minimum 150mm mains for looped mains, 200mm for unlooped mains in the domestic system and larger for the main trunks between the treated water pump station and the balancing reservoirs. This would add a significant cost to separation of the systems.

As a result of our evaluation we recommend that Alternative 1 be selected for fire protection. Cross-connections employing PRV’s and possibly double check valve assemblies will be provided at critical locations to ensure that water can be delivered from treated water systems to the irrigation system during winter months when the creek intakes may not be operational. The South Lake Pump Station could also be kept operational in order to provide additional assurance that the irrigation system remains pressurized during winter months.

2.8.3 System Separation Phasing

The details and phasing for the system separation are covered in Technical Memorandum No. 1.

3 Water Quality And Treatment

3.1 RAW WATER QUALITY

The RDOS just recently began collecting water quality data, therefore the data available is somewhat limited. This data was compared by the design team to data from other major centres on Okanagan Lake, most significantly the City of Kelowna. In recent years, the City of Kelowna has tailored the data collection to parameters that are particularly relevant to UV disinfection. This section outlines the lake water quality parameters in regard to UV disinfection for the Naramata Water Supply Improvements.

3.1.1 Transmittance

The most relevant parameter to the suitability of ultraviolet (UV) disinfection is transmittance of UV light through the water or UVT. The amount of organic carbon in the water greatly affects the UVT. The cost of the UV system will be quite sensitive to the selected UVT design value. For example, the difference in treatment capacity between 92% UVT and 85% UVT is approximately double. Generally, below 70% UVT, UV disinfection is considered not to be viable.

Table 2-1 shows a summary of UVT values collected at the two intake sites.

Table 2-1
UV Transmittance Values

Site	Minimum UVT %	Maximum UVT %
South Lake	86.5	90.8
Townsite	85.0	90.3

The above values are considerably lower than those experienced by the City of Kelowna. Part of the reason is thought to be the shallow intakes in Naramata thereby exposing raw water to greater variations in raw water quality and temperature. However, a minimum of 85% UVT is consistent with Kelowna values.

When selecting a UVT design value it is common practice to use the 95th percentile value. The 95th percentile UVT value is the UVT value or greater that the site experiences more than 95% of the time. The 95th percentile approach is outlined in the AWWARF/NWRI Guidelines and the USEPA UV design guidelines. However, these documents are primarily based on UV being applied to an existing particulate removal plant. Where UV is to be used for primary disinfection, it is necessary to be more conservative. For the two Naramata sites, it is proposed to use the minimum recorded

UVT of 85%. The UVT value selected for the UV disinfection equipment selection document will be 85%.

3.1.2 Turbidity

Turbidity levels do not have a direct bearing on UVT. However, there is a potential relationship. Generally, waters with high NTU (>5) are not suitable for treatment with UV. Some studies using "artificial" turbidity have demonstrated an ability to treat water at 12 NTU. However, the effects of shielding by natural particles was not considered. The general practise is to keep turbidity to less than 4 NTU. Table 2-2 shows a summary of turbidity values for the two lake intakes:

Table 2-2
Turbidity Values

Site	Minimum Turb. NTU	Maximum Turb. NTU
South Lake	0.40	4.50
Townsite	0.50	13.0

The maximum turbidities are a concern. Continued monitoring is required to determine if these readings are possibly due to sampling error or related to lake turnover or some other phenomenon.

3.1.3 Other Parameters

The other parameters that effect the application of UV disinfection are water hardness and iron content. Although these parameters do not typically impact on the viability of a UV disinfection scheme, they do effect equipment selection. Hard waters and waters with a high iron content typically lead to greater scaling of the UV quartz sleeves. Scaling on the sleeves absorbs UV light and therefore, impacts the efficiency of the equipment. Scaling leads to the need for more regular cleaning of the equipment and, therefore increased operational costs. Table 2-3 shows a summary of water quality parameters measured in Kelowna including hardness and iron content. At this time, we have not received physical and chemical analyses for Okanagan Lake at Naramata; however, we would not expect significant differences to the data presented in Table 2-3.

Table 2-3
Water Quality Parameters

Parameter	Units	Mean	Min	Max	Period
pH	pH	7.97	5.21	9.12	2003
Alkalinity	mg/L	109	101	114	1997-2003
Calcium	mg/L	33.5	29.7	37.6	1991-2002
Hardness	mg/L	119	107	130	1999-2003
Iron	mg/L	0.0164	<0.001	0.04	1991-2003

The values given in Table 2-3 are relatively low. Scaling of the UV equipment is, therefore, unlikely to be a concern for the UV disinfection systems. The parameter values in Table 2-3 will be used in the evaluation of the various UV equipment suppliers.

3.2 TREATMENT GOALS

The RDOS in Naramata is intending on using UV disinfection as a second water treatment barrier. The UV disinfection system and chlorination system will work together to inactivate bacteria, protozoa and viruses. Various studies have shown that UV disinfection is well suited to the inactivation of bacteria and protozoa at low UV doses. However, UV disinfection is not as effective at inactivating viruses at low dosages. Chlorination on the other hand is effective at inactivating viruses, but is ineffective at inactivating some protozoa.

However, the dual disinfection strategy will not address the turbidity requirements stated in the Guidelines for Canadian Drinking Water Quality (GCDWQ). The data presented in Section 2.2 suggests that the raw water turbidity may not meet the GCDWQ; however, the RDOS does not have adequate funds to meet this. Refer to Section 3.4 for the proposed approach to this issue.

The design of the UV system is to be based on the inactivation of protozoa, such as *Giardia* and *Cryptosporidia*. From the USEPA UV Disinfection Guidance Manual, the dose required for a 2 log inactivation of *Giardia* is 23 mJ/cm^2 . For a 2 log inactivation of *Cryptosporidia* the required dose is 24 mJ/cm^2. UV disinfection equipment manufacturers have generally validated their equipment at 40 mJ/cm^2 and presently, this has become an industry standard. The dose value of 40 mJ/cm^2 is sufficient for a 3 log inactivation of *Giardia*.

Based on what is available from the UV disinfection equipment manufacturers, the required dose for the UV disinfection system has been set at a minimum of 40 mJ/cm^2 ,

3.2.1 Staged Implementation

As noted in Section 3.3, the RDOS does not have adequate funding to address the turbidity requirements under the GCDWQ, therefore a phased approach to water treatment is proposed as follows:

Phase 1 – Two Stage Disinfection

Phase 1 will involve a dual treatment approach involving UV primary disinfection and chlorine secondary disinfection. The combined disinfection strategy will be designed to achieve the following treatment objectives:

- 2 log inactivation of *Giardia*
- 3 log inactivation of *Cryptosporidium*
- 4 log inactivation of viruses

Phase 2 – Turbidity Removal

Phase 2 will involve treatment to remove turbidity to meet the GCDWQ. The current GCDWQ turbidity limit is 1 NTU. It is expected that in the near future, this limit will be reduced to 0.3 NTU.

To build a filtration plant to meet these criteria under current combined water demand conditions would cost several million dollars. The proposed approach, therefore, is to defer this stage until at least partial system separation has been achieved, thereby significantly reducing the associated costs and allowing an opportunity to collect additional water quality data to be used for the ultimate filtration system design.

3.3 ULTRAVIOLET DISINFECTION EQUIPMENT

3.3.1 Equipment Pre-Qualification

There are many UV disinfection equipment manufacturers, but not all of them have equipment which is suited to water disinfection. For the purposes of equipment pre-selection it was necessary to set criteria for determining manufacturer suitability. The two criteria used were:

- Does the manufacturer produce medium capacity (greater than 10 ML/d) UV reactors?
- Are the reactors validated for inactivation of the target pathogens?

Based on the two above criteria, five UV disinfection equipment manufacturers were identified and contacted. The five manufacturers were:

- Hanovia

- Calgon Carbon
- Infilco-Degremont
- Trojan Technologies
- Wedeco Technologies

The manufacturers responded with data on their UV disinfection equipment. Data collected included equipment dimensions, reactor capacities, lamp type and reactor head losses. Based on the data and responses submitted by the manufacturers, all manufacturers were deemed to be qualified. Table 2-4 summarizes the typical number of reactors required at each site for each manufacturer.

The data presented in Table 2-4 is only preliminary information and based only on Option 1. The actual number and size of reactors will be left to the manufacturers to select based on the equipment supply RFP technical requirements.

3.3.2 Equipment Procurement

A UV disinfection equipment pre-selection document will be prepared and distributed to the five identified manufacturers based on the capacities and redundancy provisions summarized in Section 5.1. The pre-selection document will be prepared in the form of a request for proposals (RFP). This approach will give the RDOS greater flexibility in selecting the most favourable manufacturer. The RFP will require the manufacturers to provide technical details for their proposed UV disinfection equipment, as well as pricing information and operating costs. All of the above named suppliers have been shortlisted due to the fact that they have proven that they are capable of meeting the technical requirements. The evaluation of the UV equipment and recommendation for the award of the supply contract will therefore be based on a financial evaluation including both capital and life cycle costs.

The supply contract will include a Novation Agreement which will facilitate assigning the supply contract to the installation contractor after the installation contract has been awarded. This will ensure a single line of responsibility for equipment supply and installation during construction.

3.4 CHLORINATION UPGRADES

3.4.1 CT Design Criteria

The chlorination system will be designed to provide 4-log virus inactivation. Based on a worst case scenario of a maximum pH of 9.1 and a minimum temperature of 4*C the required CT is 15.8 mg/L.min. Based on a residual of 1.85 mg/L at the end of the contact period the required contact time is 8.5 min.

3.4.2 System Description and Location

The new chlorination facility under Option 2 will be located at the McKay Avenue Water Treatment and Pump Station. With this facility being located near the downtown area we recommend that it be designed as a packaged sodium hypochlorite generation system.

Based on a maximum day demand of 345 l/s serving the entire system at a dosage of 2.0 mg/l the system should be designed for a capacity of 59.6 kg/day.

Chlorine contact will be achieved through each of the treated water supply lines. The following confirms the treated water supply line lengths to the first connection point and calculated contact times under future peak demand conditions:

Townsite 305mm Treated Water Gravity Supply Main - 800 lin.m. – 12 min.
North System 305mm Treated Water Supply Main - 800 lin. m. – 8.9 min.
South System 406mm Treated Water Supply Main - 780 lin.m. – 8.5 min.

In addition to the above pipeline contact time the existing McKay Reservoir cell no. 1 will provide some contact time even without any baffling.

3.4.3 Sodium Hypochlorite Preliminary Design

The typical sodium hypochlorite generation system will include the following components:

- NaOCl generation equipment; water softener, heater, rectifier, controller, electrolytic cells, and brine proportioning pump.
- Brine tank.
- Solution storage tanks.
- Solution metering pumps.

Refer to Technical memorandum No. 3 for the proposed layout.

4 Facilities Preliminary Design

4.1 EXISTING INTAKE PUMP STATIONS

4.1.1 South Lake Intake Pump Station

The existing South Lake Intake Pump Station (built in the early 1970's) consists of three 200 hp pumps each with a capacity of 57 L/s (900 USgpm) at a TDH of 220 m (310 psi). There is also a fourth inactive smaller pump that has been abandoned. The power supply to this facility is provided at 480 volt. Pump operation is controlled by level at the Juniper Reservoir. A level transmitter at the reservoir transmits the level signal to the pump station PLC. The pump station has one surge anticipator/pressure relief control valve installed downstream of the pumps. The system delivers water into the distribution system via a 400 mm diameter ductile iron supply main.

The chlorination system at the South Lake Pump Station is a gas system fed by liquid chlorine tonners. A tonner-based system is typically capable of delivering 200 kg/day. However, there is likely to be restriction at the chlorinator. The capacity of the chlorinator should be confirmed. Operation of the system is activated via a solenoid valve, which is energized on pump start-up.

4.1.2 Townsite Intake Pump Station

The existing Townsite Intake Pump Station is a wood frame superstructure partially founded on a small reinforced concrete intake well substructure. The intake well was apparently designed to accommodate four vertical turbine pumps, however, the existing arrangement includes only two pumping units and it would appear hydraulically impractical to provide two additional units of the same capacity.

The two existing pumps are 75 hp units, each having a capacity of 44 L/s (700 USgpm) at a TDH of 90 m (125 psi). The power supply to this facility is 600 V. Pump operation is controlled by level at the McKay Reservoir. A level transmitter at the reservoir transmits the level signal to the pump station PLC. The pump system delivers water into the distribution system via a 300 mm diameter supply main. A 200 mm diameter pressure-reducing valve on a manhole outside the pump station reduces pressure from 968 kPa to 830 kPa.

To deliver water at adequate pressure into the higher elevation pressure zones, two booster stations located on Booth Road and Robinson Road can be used. Each station includes a 65 hp in-line unit having a capacity of 32 L/s (500 USgpm) at a TDH of 107 m (150 psi). These pumps can be run automatically from the Townsite Pump Station or manually from a local control.

The chlorination system at the Townsite Pump Station is a gas system fed by 75 kg (150 lb) cylinders. This type of system is typically capable of delivering 60 kg/day of chlorine. Operation of the chlorination system is activated by a solenoid valve, which is energized when the pump starts.

4.2 PROPOSED PUMPING AND TREATMENT FACILITIES

4.2.1 Townsite Raw Water Intake and Pump Station

4.2.1.1 Site Layout

At the Townsite facility, it is proposed to demolish the existing superstructure and construct a new building. The existing 750 mm intake pipe has the capacity to handle the entire combined water demands, however, the intake screen capacity will have to be increased. The existing clearwell substructure will be retained and the new superstructure will be used to house all pumping and water treatment equipment. The footprint shown on Dwg. No. TSRWPS-1 occupies the one lot occupied by the existing facility. The RDOS has the right under the current right of way agreement to occupy the portion of this lot required for the pump station.

Grading of the site will be left basically unchanged from the existing site grades. We are assuming that the Contractor will utilize the area to the east of the station for laydown purposes during the construction period.

Yard piping will consist of the new treated water supply main to the existing distribution system. The only sanitary waste stream originating within this facility will be grey water generated from washdown of floors etc. It is proposed that this water be discharged to a soakaway pit.

Access to the site will continue to be provided from First Street to a gravelled parking area on the east side of the new structure.

4.2.1.2 Intake

The existing ___ m long 750 mm intake is installed at a depth of __ m below normal lake level. The intake pipe has adequate capacity to convey the full maximum day demand for the entire system. However, the intake screen assembly will have to be upgraded due to screen capacity limitations. The simplest way to accomplish this would be through the provision of a second screen assembly. For this project a new screen assembly could be manufactured and installed adjacent to the existing screen. The other option would be to purchase an existing screen from the City of Kelowna. The City has two recently abandoned relatively new screens of suitable capacity that could be purchased and reused by the RDOS for the Naramata Water Supply Improvements project.

4.2.1.3 General Arrangement

The general arrangement of the new facility is shown on Dwgs. TSRWPS-3 and TSRWPS-4. The existing superstructure will be demolished and replaced with a new 8.4 m long by 5.8 m wide by 4.0 m high building set over the existing clearwell and a new adjacent slab on grade.

The raw water supply pumps will be vertical turbine units set into the inlet clearwell on the north side of the structure. It should be noted that the existing clearwell is smaller than what would normally be designed for this capacity of station. The entrance bay is shorter than recommended by the Hydraulic Institute Standards. Also, the pump bays are small. While we believe that the proposed design is workable, this should be checked upon completion of construction. If problems occur, it should be extended toward the lake. From the clearwell, water will be pumped via one or more high lift pumps into the 400 mm diameter discharge header and into supply. The discharge header will incorporate a full bore magnetic flow element.

4.2.1.4 Raw Water Pump System

The raw water pump system will consist of three vertical turbine pumps set in the existing wet well. The pumps will have a duty point of approximately 170 L/s at 92 m TDH. The exact capacity will be confirmed once hydraulic modelling is complete.

The pumps will be typically 300 hp units and will be provided as constant speed units. The raw water pumps will be provided with new piping and valving. New pump start-up bypass valves will also be provided.

4.2.1.5 Structural

The structure has been designed to utilize the existing clearwell modified to accommodate the new higher capacity pumps. The existing slab on grade will be demolished and replaced with a new 8.4 m by 5.8 m slab on grade. Although geotechnical investigation remains to be completed, it is assumed that it will be designed as a raft slab.

The superstructure will house all above grade piping, valving and equipment. A double door on the east side of the building will provide maintenance access. A personnel access door will be located on the west side of the structure.

To satisfy the open floor space for process requirements, we propose a galvanized steel frame structure to form the main load carrying system. Concrete block masonry walls will enclose the steel frames and provide a waterproof and thermal envelope for the building. The roof structure will incorporate purlins and metal decking to support gravity loads and provide resistance for lateral loads. Perimeter gutters will provide drainage for the roof.

At the Townsite location we propose to provide an architectural design concept that complements the neighbourhood due to the high visibility of this structure. Further details of the architectural treatment will be provided in a later technical memorandum.

4.2.1.6 Electrical

The existing 200 A, 600 V service will be replaced with a new 800 A 600 V service. A new pad-mount transformer would be provided by Fortis B.C. south of the new building.

The electrical service entry and all distribution panels and control panels will be located within the new structure. Electrical distribution will be done utilizing Teck cable supported on an aluminium cable tray.

The requirements for standby power are being reviewed with the RDOS. As a minimum standby power will be provided to allow operation of one raw water pump thereby allowing operation at 60% of existing max day demand and 50% of design max day demand.

4.2.1.7 Mechanical

An electrically fired supply air ventilation unit will distribute filtered heated air to the new building. The supply air unit will incorporate motorized outdoor/return and dampers that are modulated to maintain the humidity and temperature conditions within the building. A roof-mounted exhaust fan with two-speed control will be run to provide sufficient exhaust air to maintain a balance of outdoor air being introduced into the building at any given time. The controls will include programmable controller and night setback features.

4.2.2 McKay Road WTP and Pump Station

4.2.2.1 Site Layout

At the McKay Road Reservoir site it is proposed that a new structure housing the UV treatment process and high lift pumps will be provided on the north side of the reservoir structure. Refer to Dwg. MAWTPS-2.

By locating it on the north side, the east portion of the site can be utilized by the contractor as a laydown area during construction. The existing reservoir can also remain operational while the new structure is being constructed.

The standby generator will be installed on the south side of the existing reservoir when access to the laydown area is no longer required. A parking area will be developed in the southwest corner of the site.

The new structure will be partially buried in order to make the most efficient use of the existing site grading, however the roof will be left uncovered in order to allow roof hatches etc to allow removal of pumps and other equipment, if necessary.

4.2.2.2 General Arrangement

The general arrangement of the new facility is shown on Dwgs. MAWTPS-3 and MAWTPS-4. A portion of the existing reservoir will be utilized for chlorine contact to supplement contact time in the treated water supply lines. Located in the area previously planned for Cell no. 2 of the McKay Reservoir. The new building will be approximately 18 m long by 16 m wide and 6 m high. The new building will house the UV equipment, chlorination equipment, high lift pumps and associated piping and valving.

Water from the Townsite Raw Water Pump Station will be directed into one of two UV treatment inlet headers. These headers will incorporate isolating valves, control valves, UV reactors and a chlorine feed connection each having the capacity to serve the full system demands. Treated water will then be directed into the existing reservoir. From the treated water reservoir, water will be pumped via one or more of the treated water high lift pumps into the 305 mm diameter North System Treated Water Supply Main and the 406 mm diameter South System Treated Water Supply Main. The existing 305mm reservoir inlet/outlet will be utilized to supply the Townsite area by gravity. Each discharge header will also incorporate a full bore magnetic flow element. The gravity Townsite supply header will also include a flow control valve to ensure that the supply rate doesn't exceed the maximum flow to meet CT requirements.

Consideration was given to providing lower capacity jockey pumps to meet the far lower winter flow conditions, however it was determined that due to the fact that the pumps would be supplying water to balancing reservoirs, jockey pumps would be unnecessary.

The chlorination system will be provided as an on-site hypochlorite generation system and this will be installed in a separate room on the north side of the facility.

4.2.2.3 North High Lift Pump System

The North high lift pump system will consist of two split case centrifugal pumps with a duty point of approximately 55 L/s at 100 m TDH. The exact capacity will be reconfirmed once hydraulic modelling is complete.

The high lift pumps will typically be 100 hp units and they will be provided as fixed speed units. It is intended that the high lift pump motors be water cooled and provided with soft-start drives. Providing water-cooled motors will greatly simplify the station ventilation requirements.

The high lift pumps will be provided with check valves, isolation valves and start-up bypass valves. The start-up bypass valves will assist in minimizing hydraulic transients on pump start-up and stop. Starting and stopping of the pumps will be controlled by level in the North Treated Water Reservoir.

4.2.2.4 South High Lift Pump System

The South high lift pump system will consist of two operating and one redundant split case centrifugal pumps with a duty point of approximately 100 L/s at 130 m TDH. The redundant pump will have the capability of feeding either the North or South Systems by providing a pressure reducing valve on the discharge header between the two supply systems. The exact capacity will be reconfirmed once hydraulic modelling is complete.

The high lift pumps will typically be 250 hp units and they will be provided as fixed speed units. It is intended that the high lift pump motors be water cooled and provided with soft-start drives. Providing water-cooled motors will greatly simplify the station ventilation requirements.

The high lift pumps will be provided with check valves, isolation valves and start-up bypass valves. The start-up bypass valves will assist in minimizing hydraulic transients on pump start-up and stop. Starting and stopping of the pumps will be controlled by level in the Juniper Reservoir.

4.2.2.5 Structural

The structure has been designed to have the base slab set at the same elevation as the existing reservoir. Although geotechnical investigation remains to be completed, it is assumed that it will be designed as a raft slab. The west and north exterior walls will be cast monolithically with the base slab and designed to resist both hydrostatic and backfill pressures while supporting the superstructure. The existing reservoir west wall will become the east wall of the new building. The south wall facing the road will be an architecturally treated masonry wall and will incorporate entry and maintenance doors.

The superstructure will house all piping, valving and equipment. A double door on the south side of the building will provide maintenance access. A personnel access door will also be located on the south side of the structure.

The roof structure will incorporate purlins and metal decking to support gravity loads and provide resistance for lateral loads. Perimeter gutters will provide drainage for the roof.

4.2.2.6 Electrical

A new 600 volt service will be required to provide electrical service to the site. It is assumed that a new pad mount transformer will be supplied by and remain the property of Fortis B.C. It will be sited in the northeast corner of the site as shown on Dwg. SLPS-1.

The electrical service entry and all distribution panels and control panels will be located within the existing structure. Electrical distribution will be done utilizing Teck cable supported on an aluminium cable tray.

The requirements for standby power are being reviewed with the RDOS. As a minimum, standby power will be provided to meet control and instrumentation needs and emergency building lighting.

4.2.2.7 Mechanical

An electrically fired supply air ventilation unit will distribute filtered heated air to the new building. The supply air unit will incorporate motorized outdoor/return and dampers that are modulated to maintain the humidity and temperature conditions within the building. A roof-mounted exhaust fan with two-speed control will be run to provide sufficient exhaust air to maintain a balance of outdoor air being introduced into the building at any given time. The controls will include programmable controller and night setback features.

To meet WCB requirements, the sodium hypochlorite room will be continuously ventilated at a minimum rate of three air changes per hour and 20 air changes per hour when occupied. To achieve this, the supply air ventilation system will include a two position motorized damper, filter section, supply fan and electric duct heater controlled by a room thermostat. An exhaust fan will remove air from the room at a higher rate to maintain a slight negative pressure within the room. An outdoor air inlet louvre complete with motorized damper and interlocked exhaust air fan will provide additional ventilation at the rate of 17 air changes per hour when the room is occupied.

The ventilation for occupancy will be controlled by an on/off switch outside the room adjacent to the door.

4.3 SUPPLY PIPELINES

In Technical Memorandum No. 1, under Option 2, the need for a new 610mm raw water supply main as well as treated water supply mains supplying water to the North and South Distribution Systems was identified.

The proposed alignment for the 610mm raw water supply main is shown on drawing WM-1. This pipe will be specified as AWWA C905 Class 200 PVC pipe. The proposed supply main alignment has been selected with a view to minimizing disruption of existing roads while utilizing existing road rights of way to the extent practical. It's alignment follows First Street, Robinson Avenue, Second Street, the lane west of Robinson Avenue, Fourth Street, Ritchie Avenue, Eighth Street, Sherwood Place, Robinson Avenue, the unused McKay Avenue right of way and McKay Avenue to the proposed water treatment plant site. There is an existing lane which parallels Robinson Avenue from Second Street to Eighth Street however from Fourth Street to Eighth Street the backyards of several residences encroach it, therefore for this portion of the pipe alignment we have shown it following Ritchie Avenue. The least expensive option would be to follow the undeveloped lane where asphalt resurfacing would not be required. We also note that a portion of the alignment on the undeveloped McKay Road right of way follows a trail up a steep bank which will require geotechnical review. Should the geotechnical investigation reveal potential problems an alternate alignment has been shown on drawing WM-1 following Eighth Street, Patterson Road, Bartlett Road, Lower DeBeck Road and McKay Road. This alignment is longer than the proposed alignment and would therefore be more costly if geotechnical issues don't exist on the preferred alignment.

The North System Treated Water Supply Main is proposed to be a 305mm Class 51 ductile iron main aligned in a common trench with the Raw Water Supply Main along McKay Road and Robinson Avenue to Salting Road. The portion along Salting Road to the 254mm tie-in is proposed to be a 254mm Class 51 ductile iron main. An additional tie-in will be provided at Bartlett Road to allow this system to backfeed the Townsite system through the Bartlett PRV under a fire demand condition. No tie-ins will be allowed upstream of this location to ensure that the CT criteria are met.

The South System Treated Water Supply Main is proposed to be a 406mm AWWA C905 Class 200 PVC main. It will be aligned along McKay Road, Lower DeBeck Road, Naramata Road, and Arawana Road to a tie-in to the existing 305mm main at Gammon Road. An additional tie-in will be made to the existing 152mm main on Naramata Road. No tie-ins will be allowed upstream of this location to ensure the CT criteria are met.

Refer to Appendix A which includes photographs along the proposed alignments of the above noted mains.

4.4 NORTH RESERVOIR

4.4.1 Description

The North Reservoir is required to provide balancing storage for the north portion of the water system, which operates at a HGL of 515m. Beyond providing balancing storage for the North System, the North Reservoir water level will be used to control the treated water pumps supplying the North System. It will also be used to augment fire flows to the Townsite area.

4.4.2 Capacity

Technical Memorandum No. 1 confirms the capacity requirements for the reservoir. During the initial draft of this Technical Memorandum it was assumed that a capacity of 900,000 Litres was required. During the Preliminary Design Workshop it was determined that the design flows would be significantly reduced. The revised capacity as confirmed in the April 2005 issue of Technical Memorandum No. 1 is still 900,000 Litres because of a significant storage shortfall on the North and Townsite systems.

4.4.3 Design Criteria

The North Reservoir is to be designed to meet the following design criteria:

- Top Water Level – 515 m
- Seismic Design – NBCC
- Seismic Zone – Za & Zv = 1, v = .05
- Wind Load q100 – 0.68 kPa
- Roof Snow Load – Ss = 1.9 kPa, Sr = 0.3 kPa
- Freeboard – 0.5 m
- Maximum Outflow – 90 L/s

4.4.4 Siting

Two alternatives have been considered for the reservoir siting. One alternative involves siting the reservoir on the slope east of Naramata Road and Hook Place. The final site selection would be dependant on land acquisition, however; for the purpose of the evaluation it has been assumed that the structure will be constructed on a side slope at an elevation of approximately 505 to 510 metres. During the Preliminary Design Workshop, RDOS staff expressed concern about this siting due to land acquisition issues and requested that an alternative be developed based on a site adjacent to the North Intake.

4.4.5 Tank Materials and General Arrangement

Tanks in this size range can either be constructed of reinforced concrete (1or 2 cells) or bolted or welded steel. The most economical of these alternatives in this size range is bolted steel. AWWA Standard D-103 covers bolted steel tank design. Steel tanks are made of plates with factory-applied coatings and bolted construction. The tanks are assembled on site and placed on a reinforced concrete base.

Two options exist for tank coatings glass fused or epoxy. Both systems have their merits, however; we have had good success with epoxy coatings and recommend this approach. Bolts for the tanks are galvanized with the heads nylon copped for erosion protection on the interior of the tank. Repairs to the lining are done with epoxy touch-up paint. Exterior touch-up paints would match the shop applied exterior coating. For the exterior coating we would recommend the optional zinc-rich primer/epoxy/urethane, four-coat system if the tank is un-insulated. Due to the fact that it will be an above ground structure we are proposing that it be provided with RSI 3.5 Styrofoam insulation overlay by a prefinished metal cladding. The proposed general arrangement of the structure (based on 900,000 litres capacity) is shown in Drawing No. NRES-1.

During the Preliminary Design Workshop, the RDOS staff expressed a concern about the use of bolted steel tankage. They indicated that the RDOS was prepared to pay a cost premium for using reinforced concrete. A proposed general arrangement for the reinforced concrete option (based on 900,000 litres capacity) is shown on Drawing No. NRES-2.

4.4.6 Tank Access

For the bolted steel option, we are proposing that an external ladder with a lockable cage be provided. The ladder will begin 2.5 m above grade and will provide access to the roof hatch. A 610mm diameter roof manhole with hinged cover would be provided on the roof. A perimeter railing is proposed on the roof of the tank for safety purposes. In addition to the roof access a 610mm diameter wall manhole with bolt-on hinged cover is proposed for the base of the tank to provide access for cleaning purposes.

For the reinforced concrete option, we are proposing that the structure be buried on the side slope of the access road to the North Intake. An access hatch will be provided for access from the roof and an internal ladder provided for access.

4.4.7 Piping and Controls

Separate 250mm diameter inlet and outlet pipes are proposed in addition to a 250mm diameter overflow and 100mm diameter drain. The inlet pipe will rise to the tank top water level while the outlet pipe will be provided at the base of the tank and equipped with a check valve to ensure single direction flow. These separate inlet/outlet pipes will ensure better water circulation within the tanks and minimize the potential for water stagnation. An ultrasonic level transmitter will be provided for level control purposes. The local RTU will be provided in an enclosed part near the base of the tank to provide level signals to the Master Control Station.

4.5 SCADA

4.5.1 SCADA System Communication

The options for system communications include leased land lines, spread spectrum radio, and licensed radio communication. We recommend the SCADA system use licensed radio communication between the sites similar to neighbouring communities. Previous radio path studies have been done between some of the sites by Omega Communications. We have reviewed these studies and recommend that Omega Communications complete the studies required for the entire SCADA system once the SCADA sites have been confirmed.

4.5.2 Potential SCADA Sites

The following is a preliminary list of the potential SCADA sites:

1. South Lake Pump Station
2. Townsite Pump Station
3. Juniper Reservoir
4. Arawana Reservoir
5. Mackay Road Reservoir
6. South Creek Intake
7. North Creek Intake
8. Robinson Road Booster Pump Station
9. Booth Road Booster Pump Station
10. Juniper Pump Station
11. Public Works Building
12. North Reservoir (proposed)

The Robinson and Booth booster pump stations will no longer be required as part of the upgrading project, however, the PRV's will be retained. SCADA communication will therefore not be required at the sites. The South Creek Intake and North Creek Intake will be retained as backup facilities and the need for SCADA communication will be driven by budget availability. The above list does not include any allowance for future facilities required to serve future developments as these will be funded from future development cost charges. The most significant of these would be future Arawana Booster Station and higher elevation treated water reservoir.

4.5.3 SCADA System Implementation

4.5.3.1 Current Requirements

The communication between the South Lake Pump Station and Juniper Reservoir is no longer functioning. Before the upgrade of the two intake pump stations for the UV project, a SCADA/Communication system must be implemented to enable operation of the South Lake Pump Station with the Juniper Reservoir.

4.5.3.2 Interim SCADA System

An interim SCADA system is required that will fit into the overall Naramata future SCADA system. Direct radio communication between South Lake and Juniper is not possible due to the silt bluff near the pump station. Previous radio path surveys, by Omega Communications, indicated that it would be possible to communicate from South Lake to the Townsite Pump Station or the Public Works building and then to Juniper Reservoir. The Townsite Pump Station or the Public Works Building could be a repeater station for the communication between South Lake and Juniper.

Again, as outlined in the attached summarized pump station project notes, the existing Townsite Pump Station superstructure will be demolished for the upgrade project. This location therefore would not be a good location for the repeater before the upgrade work. We recommend that a repeater station be located at the Public Works Building for the interim communication between the South Lake Pump Station and Juniper Reservoir.

4.5.3.3 South Lake Pump Station

A SCADA PLC is required for the interim communication with Juniper Reservoir and a SCADA master PLC is eventually required for the pump station and UV project. We propose that the station master PLC be installed in the existing station to serve, in the interim, as a communications means to Juniper Reservoir, and in the future as the station master PLC. In this manner the SCADA and master PLC of the upgrade project will be ready for use.

The exact location of the master PLC control panel for the station needs further consideration along with the upgrade project requirements. If the project proceeds on the basis of Upgrade Option 2, this PLC may be relocated to the McKay Road site and replaced with a small PLC.

Minimum requirements for the master PLC are:

- One PLC CPU P/N 140CPU-434-12
- Modbus Plus communication with other control PLCs.
- Ethernet communication to an 8 port Ethernet switch (included in control panel)
- Two 32 pt 120 VAC Digital Input Modules
- Two 16 pt Isolated Digital Output Modules
- One 16 pt 4-20 mA Analog Input Module
- One 8 pt 4-20 mA Analog Output Module
- One Ethernet Licensed Frequency Radio and Antenna

In the future the facility will contain an Operator Interface; however, that is not proposed as part of this interim upgrade.

4.5.3.4 Public Works Building

Repeater radios and antenna will be installed at the Public Works Building. In the future this installation may remain or be used at the Townsite Pump Station. In any event the Public Works Building, in the future, will contain a PC for monitoring the whole SCADA system.

4.5.3.5 Juniper Reservoir

A radio will be added at the Juniper Reservoir to communicate the Reservoir Level from the existing PLC to the South Lake Pump Station through the Public Works radio repeater. It the existing PLC is not compatible it will be replaced.

4.5.4 Overall SCADA System Upgrading Implementation

4.5.4.1 System Requirements

The overall SCADA System upgrading will follow from the standards established for the interim upgrade as described in preceding sections. As part of the overall Water Supply Improvements Project the remainder of the system will be developed to include the following additional sites:

<u>Upgrade Option 1</u>

- Townsite Pump Station – Master PLC
- McKay Reservoir – Small PLC
- Juniper Reservoir – Small PLC
- Arawana Reservoir – Small PLC
- North Reservoir – Small PLC

The proposed system for Upgrade Option 1 is shown on Dwg. No. SCA –1.

<u>Upgrade Option 2</u>

- Townsite Raw Water Pump Station – Small PLC
- McKay Road Water Treatment Plant – Master PLC
- Juniper Reservoir – Small PLC
- Arawana Reservoir – Small PLC
- North Reservoir – Small PLC

The proposed system for Upgrade Option 2 is shown on Dwg. No. SCA-2.

4.5.4.2 System Implementation

Numerous options exist for implementation of the system, however; the simplest from a risk perspective is to include the work as part of the overall water supply system construction contract. The contractor will therefore be responsible for installation and energization of hardware. PLC programming responsibility should be assigned to either the design consultant or a programming specialist selected by the RDOS. This decision will be made during detail design.

4.6 SYSTEM DEFICIENCY UPGRADES

4.6.1 High Maintenance Watermain Upgrading

In previous reports two existing distribution mains have been identified as high priority for replacement due to their poor condition. The following summarizes these mains:

4.6.1.1 Naramata Road Watermain – Lot 20A to Lot 1

Based on information included in previous reports it is our understanding that the existing 102mm main on Naramata Road between Lot 20A and Lot 1 as well as mains on Little John Road and Hyde Road are in poor condition with high pipe failure incidence. It is therefore proposed to replace this pipe with a new 204mm AWWA C900 PVC main on Naramata Road and 150mm diameter laterals on Little John and Hyde Roads. In conjunction with this main replacement, consideration should be given to installing a small diameter domestic main in a common trench (100mm on Naramata Road and 50mm on Little John and Hyde Road). Upgrading of the Naramata Road watermain will also eliminate a bottleneck in the distribution system in this area as the hydraulic model showed this pipe having high velocities.

4.6.1.2 Intersection of Naramata Road and Arawana Road

The operations staff advise that several repairs have been required to the existing 152mm main in this area. In previous reports it has been recommended that the existing 152 main on Naramata Road between Gammon Road and Aikens Loop be replaced with a 305mm main to improve pump capacity, fire flow and enhance system looping. Our modelling does not indicate any major capacity issues in this pipe therefore we would recommend prioritizing replacement of the section in poor condition between Gammon Road and Old Main Road. We would recommend installation of a 254mm AWWA C900 PVC main for the replacement section.

4.6.1.3 Watermain Replacement to Address Fire Flows

In previous reports it has been recommended that high priority be given to watermain upgrades in the following areas to address fire flow constraints.

4.6.1.4 Eighth Street Between Robinson Avenue and Ellis Avenue

The existing main on Eighth Street has been identified as a constraint for providing fire flows to the school and downtown area. Our modelling supports this conclusion. We would recommend installation of a 254mm main in this area.

4.6.1.5 Naramata Road Between Old Main Road and Aikens Loops

The existing 152mm main on Naramata Road between Old Main Road and Aikens Loop has been previously recommended for upgrading to improve fire flows and enhance system looping. Our modelling indicates that replacement of this pipe should be the lowest priority of the improvements recommended herein. If funds are available for its replacement we would recommend installation of a 254mm main with the primary objective of improving system looping.

4.6.2 Confined Space Entry Improvements

Previous reports have identified the need for improvements at the Juniper Pump Station, Bartlett PRV Station, DeBeck PRV Station, and Smethurst PRV Station. These recommendations are addressed toward improving worker safety and reducing operational costs. Specifically the proposed improvements are summarized as follows:

.1 <u>Juniper Pump Station</u> – installing side door entry into the Pump Station substructure from Juniper Drive

.2 <u>Bartlett PRV Station</u> – provisions of above ground structure and relocation of piping into new structure

.3 <u>DeBeck PRV Station</u> – widening of existing stairwell, access door and HVAC improvements

.4 Smethurst PRV Station – installing side door entry into the chamber association with other structural improvements, installation of lighting and heating, and replacement of valving, controls, and pipe work. (Note: land ownership for this structure site needs to be confirmed).

5 Cost Estimates and Schedule

5.1 COST ESTIMATING BASIS

The following confirms the basis of the costs:

- Accuracy – The cost estimate is based on the costs of construction as of February 2005 in Canadian dollars. The total estimated cost is considered accurate to approximately +10%/-15%. It should be noted that the construction work has been quite volatile over the past year and we have attempted to make provisions to address recent cost escalation.

- Equipment – Costs for major equipment have been based on quotations or recent tenders from similar projects.

- Escalation – Escalation is not included.

- Engineering – Engineering costs have been carried at 10% of the estimated construction costs.

- Contingencies – The contingency allowance is provided to cover those costs that are unforeseen at the time the estimate is produced and may become apparent as detailed design and construction proceed. Contingencies have been carried at 15% of the estimated construction costs.

- Exclusions – This estimate covers the capital costs for the design and construction of the Naramata Water Supply Improvements but does not include certain indirect project costs including:
  - Interest during construction
  - RDOS project administration costs
  - Foreign currency variations (equipment)
  - Escalation
  - GST

5.2 PROJECT CAPITAL COST ESTIMATES

A detailed breakdown of the cost estimates is provided in Enclosure A. The following is a summary of the estimates for each of the project components based on the recommended Upgrade Option 2:

• Townsite Raw Water Pump Station & Intake Screen	$ 710,000
• Raw Water Supply Main	$1,183,000
• McKay Road Water Treatment Plant	$2,492,000
• Treated Water Supply Mains	$ 835,000
• North Treated Water Reservoir	$ 358,000
• Disconnection of Existing Creek Intakes	
• SCADA Upgrades	$ 39,000
• System Deficiency Upgrades	$ 399,000
Total Construction	$6,097,000
25% Allowance for Engineering & Contingencies	$1,525,000
Grand Total Project Costs	$7,622,000

5.3 PROJECT IMPLEMENTATION

The project implementation schedule is provided in Enclosure B. Based on a construction start of September 1, 2005 construction should be substantially complete in March 2006. We are proposing that construction be scheduled to avoid disrupting water supply and minimize disruption of streets during the July/August tourist season. Construction scheduling has therefore been based on a September start date.

The proposed sequencing will necessitate shutting down the Townsite intake pump station and McKay Reservoir beginning September 1. The South Lake pump station will remain operational throughout the entire construction period and thereby supply the entire system.

Refer to the attached schedule for more information.

Technical Memorandum No. 1

Regional District of Okanagan-Similkameen

Naramata Water Supply Improvements

Water Distribution System Analysis and Planning

April 2005

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TECHNICAL MEMORANDUM NO. 1

Naramata Water Supply Improvements
Water Distribution System Analysis and Planning

Issued: April 1, 2005
Previous: February 24, 2005

1 Objective

The objective of this technical memorandum is to confirm findings from the hydraulic model study and present a plan for water distribution system upgrading and system separation.

2 Approach

Associated Engineering prepared a computer hydraulic model of the existing Naramata water distribution system using WaterCad software. The model included all pipes, pump stations, reservoirs, and PRV's in the system.

As a first step, runs were done to confirm existing system performance under varying demand conditions. The output data was compared to field pressure readings by RDOS operations staff to confirm that it replicates existing system performance.

System physical input data was then revised to simulate the improvements proposed under the 2005 Water Supply Improvements Project. This involved analyzing system performance to determine the most cost effective improvement plan.

As a final step, a plan was developed based on the findings of the above analysis, toward separating the majority of the distribution system.

3 Water Demand Planning

3.1 Historical Water Demands

The RDOS operating records as well as previous consultant reports were reviewed to confirm historical water demands. The summarized water demand data is presented in Table 1-1.

Table 1-1
Summarized Water Demands

Year	Irrigation Land Area (ha)	Domestic Connections	Ave. Day Demand L/s	Max. Day Demand L/s
1994	365 (1)	750 (1)	N.A.	344 (July 20) (1)
1996	285 (2)	N.A.	57	252 (July 13)
1997	285 (2)	N.A.	35 (3)	158 (July 21) (3)
1998	285 (2)	N.A.	43 (3)	174 (July 28) (3)
1999	285 (2)	N.A.	49 (3)	171 (July 29) (3)
2000	285 (2)	N.A.	73	265 (July 19)
2001	285 (2)	N.A.	68	282 (Aug. 16)
2002	285 (2)	N.A.	78	282 (July 26)
2003	285 (2)	N.A.	77	281 (July 30)
2004	285 (2)	794 (2)	59	265 (Aug. 2)

(1) Naramata Irrigation District Upper Zone Water Study February 1995.

(2) Based on RDOS billing information and aerial photo assessment

(3) Data for South Creek Intake not available therefore does not cover full system demand

The RDOS staff collected and compiled consumption data for the period from 1996 to 2004. This data which was compiled in a series of Excel spreadsheets was then analyzed and synthesized by the Associated Engineering review team to extract the above summarized system water demands. As can be seen above there was remarkable consistency in maximum day demands during the years 2001, 2002, and 2003. As a result of this review the evaluation team determined that an existing maximum day demand of 295 L/s should be used as a starting point for existing system evaluation and system upgrading evaluation. This analysis assumes that the existing agricultural irrigation land area is approximately 285 Ha at a per hectare demand of 0.78 L/s-Ha (5 usgpm) and that there are 794 domestic service connections at a max day demand of 8,200 l/unit.

New irrigation techniques are being implemented throughout the Okanagan, which are significantly reducing agricultural irrigation water demands. This is a result of changes to crops, as well as changes to irrigation practices and technology. There are some discrepancies between RDOS taxation records, data obtained from previous reports, and aerial photo analysis. The design team concluded that taking all of the above factors into account (the most important of which is recent historical demand records), the above existing demand criteria are reasonably conservative for system planning purposes.

3.2 Meeting Future Growth

Future growth in Naramata is planned to be in the order of 1.3% per annum according to the current OCP which is currently under review. This growth rate would probably be significantly exceeded if a major development such as the Blackwell property were to proceed. Planning of the system should therefore be done in such a way that facilitates system expansion to serve future development areas without creating a significant financial burden for the existing ratepayers. Potential developments identified during the system planning phase include the following:

1) Blackwell Development Phase 1 – 75 lots
2) Blackwell Development Future Phases – 350 lots plus 100 resort units
3) Workman Development – 40 lots
4) Wheeler Development – 30 lots

Some allowance should be included in the system design for increased demands generated due to densification in the Townsite as well as future development. The other factor to be considered in planning for future growth is the fact that system separation will result in significant reduction of demands at the supply system. It therefore would not be prudent to significantly oversize system components when all of the oversizing may never be required. Funds would be better spent on initiating the system separation. For the purpose of this report we have assumed an allowance of 15% for increased demand beyond the existing demands on the assumption that system separation will proceed within the next 5 to 10 years. Thereafter, as separation proceeds demands will gradually decline as separation is phased in place.

4 Design Criteria

.1 Water Demand Criteria

The following water demand criteria was utilized:

Domestic Winter Demand – 1,640 L/d conn.
Domestic Max. Day Demand – 8,200 L/d conn.
Domestic Peak Hour Demand – 13,600 L/d conn.

Irrigation Winter Demand – 0 L/s ha
Irrigation Max. Day Demand – 0.78 L/s ha
Irrigation Peak Hour Demand – 0.78 L/s ha

.2 Fire Flow

Interim	30 L/s
Residential	60 L/s
Town Centre	90 L/s

.3 Water Pressure

Max. Day Demand – 275 kPa to 795 kPa
Max. Day Plus Fire – 140 kPa at fire location

.4 Pipe Criteria

Maximum Velocity – 1.8 m/sec

C Factors = 120 for pipes > 150 mm
100 for pipe < 100 mm

.5 Treated Water Storage

Storage = $S_Q + S_F$

Where S_Q = 25% of Max. Day Domestic Demand
S_F = Fire Flow Storage

S_{FF} Town Centre = 90 L/s for 1.75 hours
Residential = 60 L/s for 1.5 hours
Interim = 30 L/s for 2 hours

5 System Performance Evaluation Criteria

In assessing performance of the supply and distribution system, it is important to understand the ultimate objective which is to minimize cost of service while meeting the quality of service objectives. The quality of service objectives include:

- reliability of supply
- adequate pressures
- emergency supplies

In planning a water supply and distribution system, in order to obtain the most effective utilization of infrastructure, the following general principles apply.

.1 System Analysis

The system should be hydraulically analyzed under the following conditions:

Maximum Day Demand – Minimum residual pressure – 280 kPa
- Distribution reservoirs in filling mode

Maximum Day Plus Fire Demand – Minimum residual pressure – 140 kPa
- Distribution reservoirs in draining mode

Peak Hour Demand – Minimum residual pressure – 280 kPa
- Distribution reservoirs in draining mode

The maximum day demand conditions are required to check system performance during the early morning, twilight, and evening hours when reservoirs have to be replenished after mid-day peak hour demand periods. The analysis should include an assessment of the time requirements to refill the reservoirs. The peak hour demand condition is required to check system performance with reservoirs in the draining mode. The minimum required residual pressure is 280 kPa.

The maximum day plus fire demand condition is required to check system performance under a fire demand condition without any electrically driven pumping equipment in operation. The minimum residual pressure for this demand condition is 140 kPa.

.2 Water Demand Allocation

Generally, the most cost effective approach in system planning is to size water supply and treatment components to supply maximum day demands, and then to provide fire fighting and peak hour demand from the treated water storage facilities. To size the water supply and treatment facilities for less than maximum day demand conditions, would require inordinately high storage requirements, thereby resulting in high capital costs and possibly water quality problems due to extended travel times. To size the water supply and treatment facilities for more than maximum demand conditions would require larger supply mains and treatment facilities, thereby resulting in high capital costs and high treatment operating costs.

Because of the high quality source water in Lake Okanagan, the unit treatment costs are relatively low. However, the upgraded system will be a pumped system and the long term plan is to gradually separate the irrigation and domestic systems therefore component sizing should not include significant oversizing for future developments. If possible DCC's collected from future developments should be directed toward system separation thereby offsetting increased demands created by the new developments.

.3 Treated Water Storage Facilities

Criteria for sizing of treated water storage facilities was confirmed in Section 3. There are three components included when sizing storage facilities:

- equalization storage
- fire storage
- emergency storage

Equalization storage is the component that is used for supplying short term peak hourly demand requirements. These are drawn and replenished on a daily basis. Peak hour irrigation demands are considered to be equal to the maximum day irrigation demands therefore the equalization storage applies only to the domestic demand component.

Fire storage should be designed to meet the maximum fire demand condition. At Naramata's current population, conventional design practice is to provide adequate storage for one fire at any given time. The possibility of two simultaneous fires is very low except in a wild fire event such as the 2003 Okanagan Mountain fire – a scenario for which the Naramata water system would not be capable of providing full fire protection.

Emergency storage is provided to offset interruption of the source of supply. This would typically involve pumping system failure or a rupture of the supply pipelines. The most likely cause of source supply interruption is a power failure event causing shutdown of the pumping system. Because the proposed upgrading includes the provision of standby generators at the supply pumping facilities, the need for emergency storage is largely eliminated. In the event of an extreme emergency such as a major pipeline failure, the RDOS could supply water via the creek intakes albeit not UV treated.

Storage provided in higher elevation pressure zones can be backfed into lower pressure zones. On this basis it can be assumed that storage in the Juniper and Arawana Reservoir is available to both the South System PZ 544 and PZ 589 and North System PZ 515 and PZ 424 (Townsite) although conveyance capacity between pressure zones is limited by the capacity of the DeBeck PRV. Future developments should not be included in the assessment of storage capacity as they should provide and pay for additional storage as part of their developments.

Based on the foregoing, the following system storage (excluding provisions for future development) is required for the Naramata system:

Required Storage = $S_Q + S_F$

= .25 x 800 connections x 8200 l/d + 1.75hr x 90 l/s x 3600 s/hr

= 1,640,000 + 567,000

= 2,207,000 litres

Existing Storage = 450,000 + 450,000 + 900,000
= 1,800,000 litres

Additional Required Storage = 2,207,000 – 1,800,000
= 407,000 litres

This additional storage should be provided on the North System which currently does not have any treated water storage which can feed the 515 pressure zone by gravity. We recommend provision of a minimum of 450,000 litres which combined with the existing McKay Avenue Reservoir (450,000 litres) falls short of the required storage capacity of 1,600,000. To address this shortfall, the ability to backfeed from the South System should be improved and the storage on the North System increased to 900,000 depending on budget availability.

6 Analysis of Existing System

6.1 Maximum Day Demand

The existing system was modelled under maximum day combined domestic and irrigation demands utilizing both creek sources and both lake intake pump stations. Refer to Plan 1-1, which shows the existing system.

Under these conditions, the system is able to deliver water throughout the system while meeting the minimum pressure requirements. Under maximum day demand conditions several sections of pipe (generally 102mm diameter) exhibit high velocities. Pipes shown on Plan 1-1 in blue are the ones with high velocities. Some areas on the south system show higher pressures than the criteria set out in Section 3 herein. Generally, however system performance is satisfactory. This is probably largely a result of decreasing irrigation demands as discussed in Section 3.

High pressures were noted on Robinson and Ellis Ave. north of Bartlett Road. There were also isolated low areas in the system where high pressures were observed.

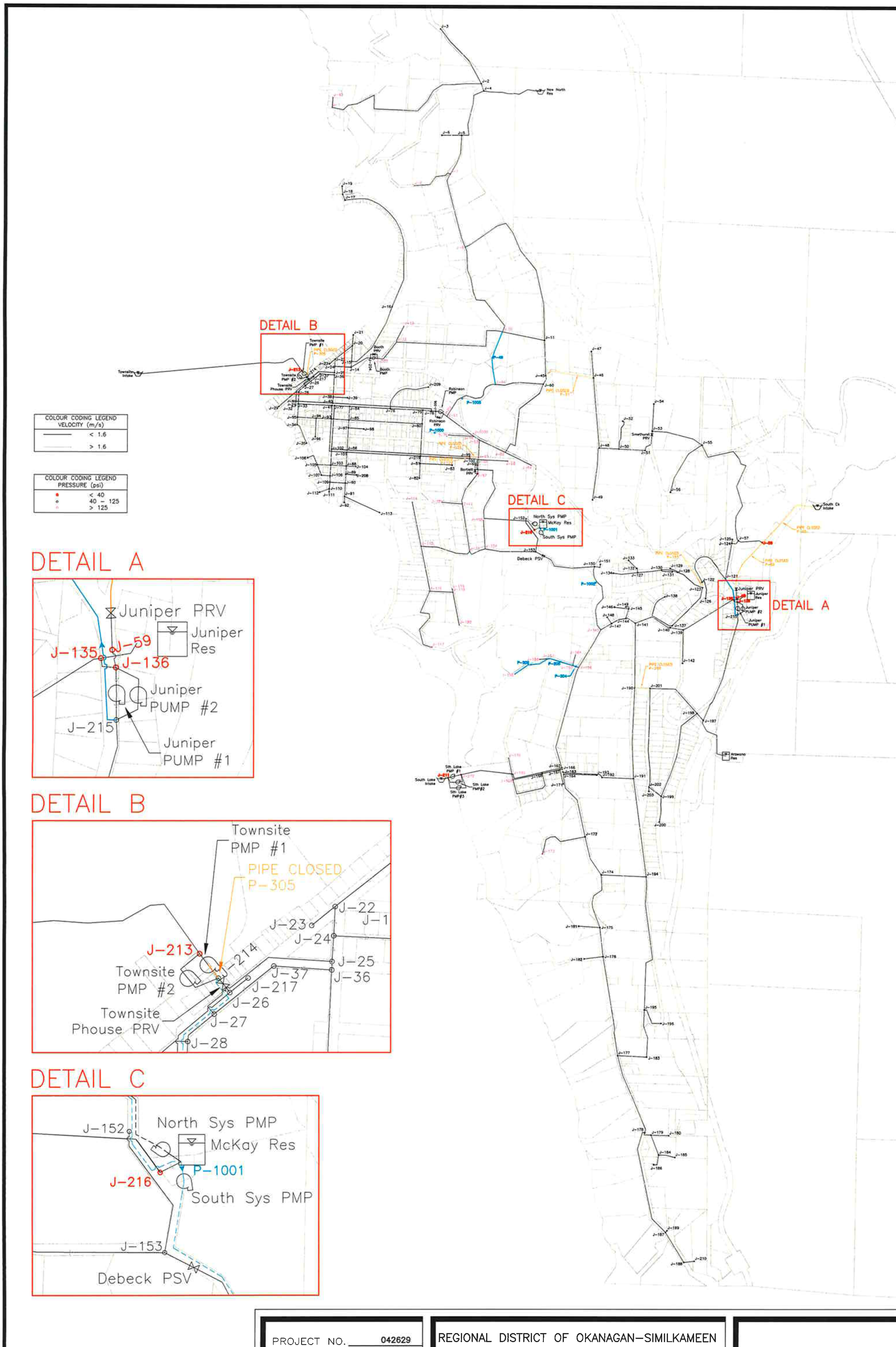
6.2 Maximum Day Demand Plus Fire

The existing system was not run under this demand condition.

7 Analysis of Upgraded System – Option 1

The upgraded system option 1, incorporates the following improvements:

- Upgraded Townsite Pump Station including 3 operating pumps rated @ 76 L/s each.
- Upgraded South Lake Intake Pump Station including 3 operating (and 1 redundant) pumps rated @ 78 L/s each.



PROJECT NO.	042629
DATE	05/04/05
APPROVED	B. HARVEY
SCALE	N.T.S.
DWG. No.	042629-1-001

REGIONAL DISTRICT OF OKANAGAN-SIMILKAMEEN
NARAMATA WATER SUPPLY IMPROVEMENTS

PLAN NO. 1-1
Existing Water Distribution System

Associated Engineering

- Dedicated 350mm high pressure supply main from Townsite Pump Station to downstream side of existing Robinson Booster Station.
- Replacement 305mm high-pressure supply main on Salting Road from Robinson to 250mm main connection.
- New North System Treated Water Reservoir east of Hook Place with TWL of 515m.

Refer to Plan 1-2 showing the Option 1 layout. An alternative involving aligning the 350mm high pressure supply main from Townsite Pump Station along Booth Road to the 250mm connection west of Partridge Road was also analyzed and found to have similar performance characteristics as the above.

7.1 Maximum Day Demand

The Upgraded System - Option 1 was modelled under maximum day combined domestic and irrigation demands utilizing the two improved lake intake pump stations. Under these demand conditions the system is able to deliver water throughout the system while meeting the minimum pressure requirements. Pipes exhibiting high velocities are shown in blue on Plan 1-2. The balancing reservoirs were all observed to be in "filling mode" under this scenario. Problem areas under this operating condition include:

- Similar problems as existing system on Robinson and Ellis Ave. north of Bartlett Road.

7.2 Peak Hour Demand

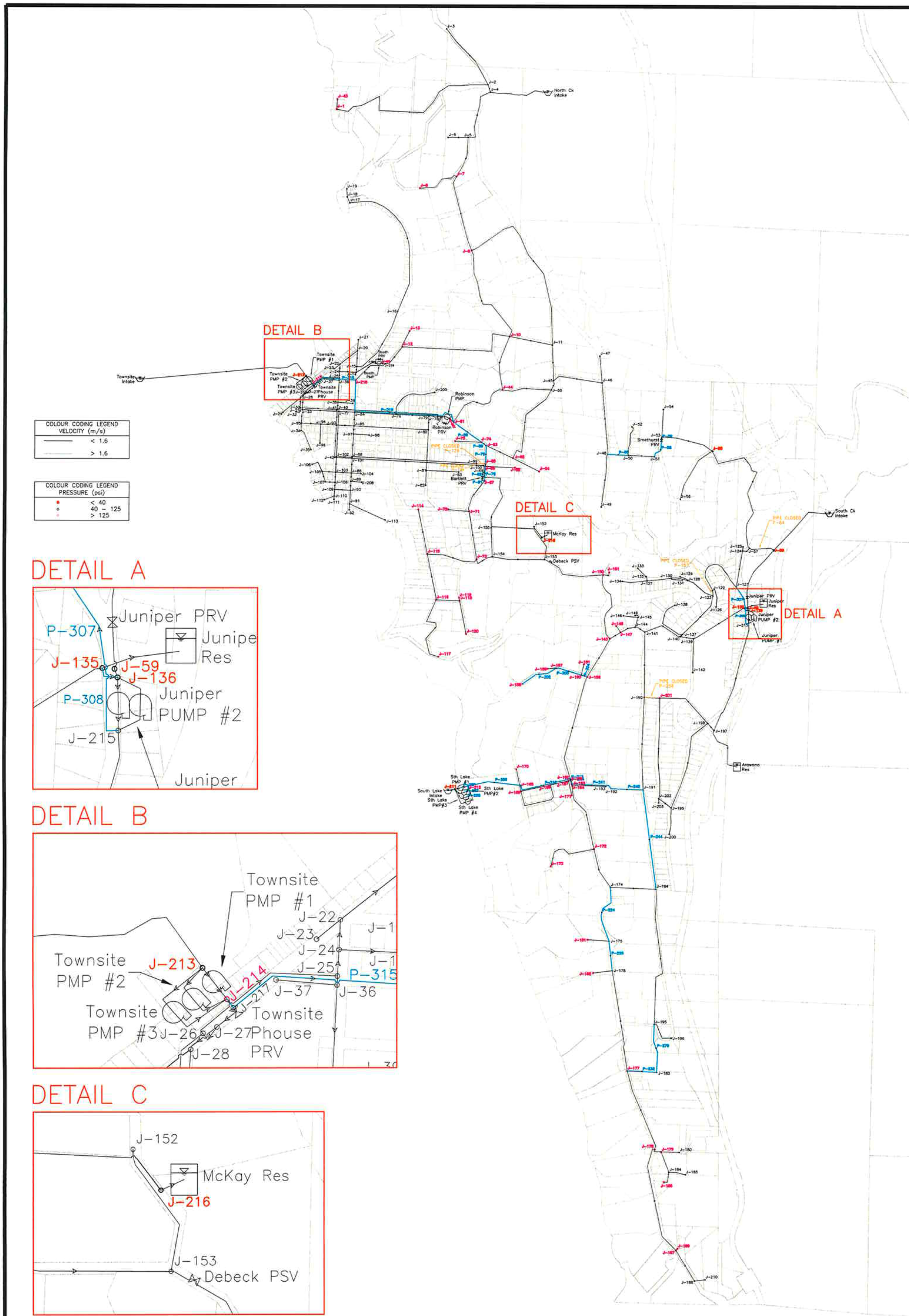
The Upgraded System - Option 1 was modelled under combined peak hour domestic and irrigation demands. Due to the fact that peak hour irrigation demands are the same as maximum day irrigation demands, this analysis revealed similar results with only minor pressure variations compared to the maximum day demand conditions. Problem areas were therefore no different than indicated in 7.1 above. Juniper and Arawana reservoirs were draining under this condition as expected.

7.3 Maximum Day Plus Fire Demands

The Upgraded System - Option 1 was modelled under the fire demand conditions defined in Section 3.2.

Under these demand conditions the following was observed:

- The system can provide 30 L/s fire demand in all areas except at extreme south end.
- The system is not capable of providing 60 L/s fire demand except in residential areas and areas in close proximity to balancing reservoirs and the Town Centre area.
- The system can provide 90 L/s fire demand in the Town Centre commercial area.



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REGIONAL DISTRICT OF OKANAGAN-SIMILKAMEEN
NARAMATA WATER SUPPLY IMPROVEMENTS

PLAN NO. 1-2
Upgraded Water Distribution System – Option 1

Associated Engineering

8 Analysis of Upgraded System – Option 2

The upgraded System Option 2 was developed subsequent to the March 1 Preliminary Design Workshop. This option involves relocating the treatment facilities for the entire system to the McKay Avenue Reservoir site, replacing the Townsite Pump Station with a new raw water pumping station and converting the South Lake Pump Station to a backup facility. This option incorporates the following improvements:

- New Townsite Raw Water Supply Pump Station including 2 operating (and 1 redundant) pumps rated @ 170 L/s each.
- Dedicated 610mm raw water supply main from Townsite Raw Water Pump Station through Townsite to McKay Reservoir site.
- New McKay Avenue Water Treatment Plant and Treated Water Pump Station including 2 operating pumps serving the North System rated at 55 L/s each and 2 operating (and 1 redundant) pumps serving the South System rated @ 100 L/s each.
- Dedicated 305/254mm North System treated water supply main from McKay Avenue Treated Water Pump Station to existing 250mm main on Salting Road.
- Dedicated 406mm South System treated water supply main from McKay Avenue Treated Water Pump Station to existing 305mm main at intersection of Arawana Road and Gammon Road.
- New North System Treated Water Reservoir adjacent to existing North Creek Intake with TWL of 515m.

Refer to Plan 1-3, which shows this upgrading option.

8.1 Maximum Day Demand

The Upgraded System - Option 2 was modelled under maximum day combined domestic and irrigation demands. Under these demand conditions the system performance was better than Option 1 in that it eliminated some existing constraints in the South System thereby resulting in improved hydraulic performance.

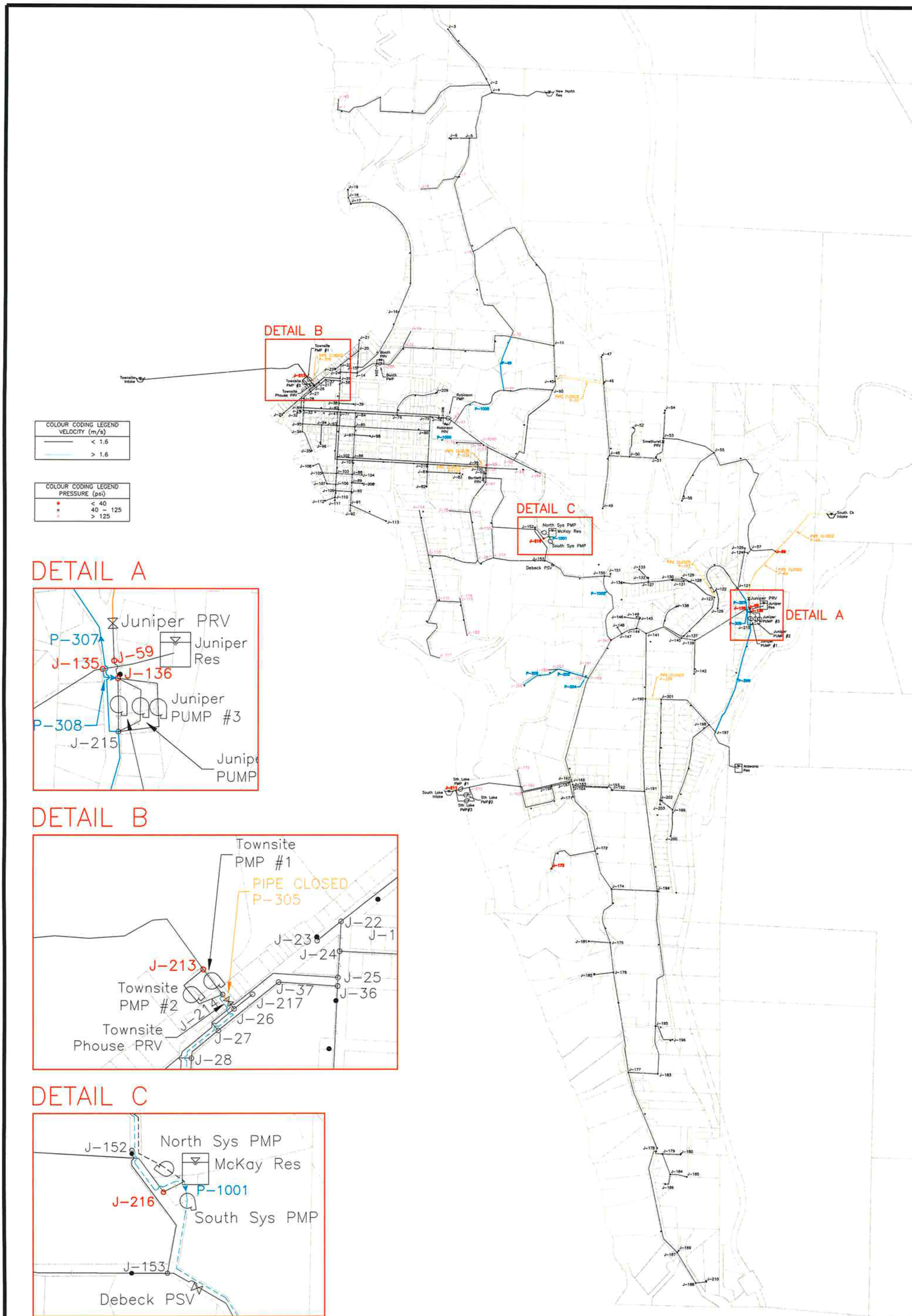
8.2 Peak Hour Demand

The Upgraded System - Option 2 was modelled under combined peak hour domestic and irrigation demands. Again, performance was very somewhat better than Option 1.

8.3 Maximum Day Plus Fire Demands

The Upgraded System - Option 2 was modelled under the fire demand conditions defined in Section 3.2.

Under these demand conditions the following was observed:



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REGIONAL DISTRICT OF OKANAGAN-SIMILKAMEEN
NARAMATA WATER SUPPLY IMPROVEMENTS

PLAN NO. 1-3
Upgraded Water Distribution System – Option 3

Associated Engineering

- The system can provide 30 L/s fire demand in all areas except at the extreme south end.
- The system is not capable of providing 60 L/s fire demand except in residential areas and areas in close proximity to balancing reservoirs and the Town Centre area.
- The system can provide 90 L/s fire demand in the Town Centre commercial area.

9 Option Evaluation

Cost estimates for both options were prepared in order to undertake a financial and technical evaluation and comparison. Details of the cost estimates are provided in technical memorandum No. 7. The costs for the two options are presented below:

- Option 1 - $7,586,000
- Option 2 - $7,658,000

In comparing the two options, Option 2 has numerous advantages compared to Option 1 and these are summarized below:

- Eliminates South Lake Pump Station from the system thereby eliminating potential risks due to slope failure above station, which could potentially severely damage the pump station and supply line.
- Eliminates risks associated with continued operation of existing gas chlorination system at South Lake pump station.
- Eliminates risks associated with travelling and transporting chlorine tonners to and from South Lake pump station.
- Eliminates water supply risks associated with shallow intake and pump well at South Lake Pump Station which are above Lake Okanagan drought level.
- Eliminate water supply risks associated with 400 South Lake supply line on silt bluff.
- Minimizes facility site space requirements at Townsite pump station thereby eliminating need for costly land acquisition at this site.
- Minimizes visual impact of facilities at the prominent Townsite Pump station site.
- Consolidates all water treatment and treated water pumping facilities at one location thereby reducing life cycle operation and maintenance costs.
- Allows improved redundancy provisions for both treatment and pumping systems through consolidation of facilities at one site.
- Allows option for future addition of filtration with minimal impact on facilities installed under Phase 1.

We therefore recommend that the RDOS proceed on the basis of Option 2.

10 System Separation Concept

10.1 Separation Concept and Staging

As a result of findings from the analysis of the existing system as well as the two upgrading options the following phased separation concept was developed.

When separation is implemented the plan is to supply the irrigation demands from the two existing high elevation creek intakes. This will significantly reduce energy consumption in comparison to serving the combined systems from the lake intake pump station(s). The South Creek Intake is somewhat remote from the majority of the irrigation system that it serves. As an interim step, therefore, retaining the South lake Pump Station would allow earlier phasing of the South system separation thus reducing the demands on the domestic system and possibly allowing the domestic system treated water supply mains to be downsized. The most financially practical option for separating the systems therefore is to install parallel mains from the North Creek Intake and South Lake Pump Station supply line terminus to allow maximum cost benefit for initial phases and thereby progressively implementing the separation.

The maximum cost benefit is achieved by starting at the North Intake on Naramata Creek and placing parallel mains first on North Naramata Road and Langedoc Road (upper bench) and then progressively to the south.

10.2 Fire Protection

Two alternatives were considered for fire protection in the separated system as follows:

Alternative 1 -utilize the separated irrigation system with its larger mains. The Townsite area and the residential area near the Arawana and Juniper reservoirs would continue to utilize the domestic system for fire protection as there will be no system separation in these areas. This would mean that the irrigation system would have to remain operational during the winter months when it would otherwise be shut down. It would also mean that the treated water reservoirs would have to be cross-connected to the irrigation system due to the fact that the creek intakes can freeze during winter months. A solution to this issue may be to utilize the South Lake Pump Station to keep the irrigation system pressurized when the creek intakes freeze up.

Alternative 2 - utilize the domestic system. This would necessitate provision of minimum 150mm mains for looped mains, 200mm for unlooped mains in the domestic system and larger for the main trunks between the treated water pump station and the balancing reservoirs. This would add a significant cost to separation of the systems.

As a result of our evaluation we recommend that Alternative 1 be selected for fire protection. Cross-connections employing PRV's and possibly double check valve assemblies will be provided at critical locations to ensure that water can be delivered from treated water systems to the irrigation system during winter months when the creek intakes may not be operational. The South Lake Pump Station could also be kept operational in order to provide additional assurance that the irrigation system remains pressurized during winter months.

10.3 Stage 1

Based on this approach the first phase of the system could be developed to cover all areas north of Boothe Road. This would reduce demands on the North Supply System by approximately 70 L/s or 50% of the total maximum day demand. This would require the installation of approximately 4 km of 100mm and 150mm diameter pipe at an estimated cost of $600,000. The implementation of this phase of system separation would effectively eliminate operation of one of the North System treated water pumps and allow the North System supply main diameter to be reduced from 350mm to 250mm.

10.4 Stage 2

Stage 2 would cover the area bounded by Boothe Road on the north Lyons Road on the east, Robinson Ave on the south, and Mill Road to the west. By providing approximately 4 km of new pipe this portion of the system could be separated at an estimated cost of $600,000.

10.5 Stage 3

Stage 3 would involve providing a new irrigation supply main from the south intake down Juniper Drive, DeBeck Road and Arawana Road to Naramata Road then north on Naramata Road to Lower DeBeck Road in order to serve the agricultural lands south and east of the Townsite area. A second leg would be directed south on Naramata Road to Old Main Road. This would involve installation of 4.3 km of new pipe of an estimated cost of $800,000.

10.6 Stage 4

Stage 4 would involve installing 3.4 km of new pipe along Naramata Road plus 0.8 km of laterals to serve properties bounding Naramata Road at an estimated cost of $700,000. As part of this, the South Lake Pump Station would become a backup facility to the irrigation system, thereby allowing the option of supplying lake water into the irrigation system in the event of a failure of one of the creek intakes.

10.7 Stage 5

Stage 5 would involve installing a new main on Gammon Road from Arawana Road to the intersection with Naramata Road and laterals connecting to Naramata Road. This would involve installation of 3.1 km of new pipe at an estimated cost of $450,000.

In conjunction with the separation program, consideration should be given to downsizing the treated water supply pumps to meet the significantly reduced domestic demands. While this may not be absolutely necessary (depending on treated water distribution main sizing), it would result in significant reduction in energy demand charges.

11 System Improvements Proposed for Water Supply Improvement Project

As a result of our findings out of the hydraulic modelling program we recommend that the following improvements be implemented in 2005/2006.

.1) Townsite Raw Water Intake Pump Station and Intake Screen Upgrading.
.2) Townsite Raw Water Supply Main to McKay Avenue Water Treatment Facility – 610mm diameter.
.3) McKay Avenue Water Treatment Plant and Treated Water Pump Station.
.4) North System Treated Water Supply Main – 305/254mm diameter.
.5) South System Treated Water Supply Main – 406mm diameter.
.6) North Treated Water Reservoir - 900,000 litre capacity.
.7) Temporary disconnection of North and South Creek Intakes from distribution system through valve isolation.
.8) Close PRV from the South Creek Intake at Juniper Pump Station.

The above improvements will allow the distribution of a maximum day demand of 30 ML/d, and filling the balancing reservoirs, while providing a minimum pressure of 280 kPa throughout the system. It will also allow the distribution of a peak hour demand of 34 ML/d while providing a minimum pressure of 280 kPa. It will also allow provision of a fire flow of 30 L/s to the agricultural areas, 60 L/s to the residential areas and 90 L/s to the Townsite commercial area.

12 Future System Expansion

The next priority for system expansion should be to initiate the system separation program. A 6-stage program has been proposed above, which involves starting at the north end of the system and progressively expanding to the south. If monies were available to implement Stage 1 it would reduce the required capacity of the supply system components by approximately 15%.

Prepared by

Reviewed by

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Project Manager

WJB/cb

Technical Memorandum No. 2

Regional District of Okanagan-Similkameen

Naramata Water Supply Improvements

Water Quality and Treatment

April 2005

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Naramata Water Supply Improvements
Water Quality and Treatment

Issued: April 22, 2005
Previous: February 7, 2005

1 Objectives

The objective of this technical memorandum is to confirm existing raw water quality, water quality objectives, and treatment implementation.

2 Raw Water Quality

The RDOS just recently began collecting water quality data, therefore the data available is somewhat limited. This data was compared by the design team to data from other major centres on Okanagan Lake, most significantly the City of Kelowna. In recent years, the City of Kelowna has tailored the data collection to parameters that are particularly relevant to UV disinfection. This section outlines the lake water quality parameters in regard to UV disinfection for the Naramata Water Supply Improvements.

2.1 Transmittance

The most relevant parameter to the suitability of ultraviolet (UV) disinfection is transmittance of UV light through the water or UVT. The amount of organic carbon in the water greatly affects the UVT. The cost of the UV system will be quite sensitive to the selected UVT design value. For example, the difference in treatment capacity between 92% UVT and 85% UVT is approximately double. Generally, below 70% UVT, UV disinfection is considered not to be viable.

Table 2-1 shows a summary of UVT values collected at the two intake sites.

Table 2-1
UV Transmittance Values

Site	Minimum UVT %	Maximum UVT %
South Lake	86.5	90.8
Townsite	85.0	90.3

The above values are considerably lower than those experienced by the City of Kelowna. Part of the reason is thought to be the shallow intakes in Naramata thereby exposing raw water to greater variations in raw water quality and temperature. However, a minimum of 85% UVT is consistent with Kelowna values.

When selecting a UVT design value it is common practice to use the 95th percentile value. The 95th percentile UVT value is the UVT value or greater that the site experiences more than 95% of the time. The 95th percentile approach is outlined in the AWWARF/NWRI Guidelines and the USEPA UV design guidelines. However, these documents are primarily based on UV being applied to an existing particulate removal plant. Where UV is to be used for primary disinfection, it is necessary to be more conservative. For the two Naramata sites, it is proposed to use the minimum recorded UVT of 85%. The UVT value selected for the UV disinfection equipment selection document will be 85%.

2.2 Turbidity

Turbidity levels do not have a direct bearing on UVT. However, there is a potential relationship. Generally, waters with high NTU (>5) are not suitable for treatment with UV. Some studies using "artificial" turbidity have demonstrated an ability to treat water at 12 NTU. However, the effects of shielding by natural particles was not considered. The general practise is to keep turbidity to less than 4 NTU. Table 2-2 shows a summary of turbidity values for the two lake intakes:

**Table 2-2
Turbidity Values**

Site	Minimum Turb. NTU	Maximum Turb. NTU
South Lake	0.40	4.50
Townsite	0.50	13.0

The maximum turbidities are a concern. Continued monitoring is required to determine if these readings are possibly due to sampling error or related to lake turnover or some other phenomenon.

2.3 Other Parameters

The other parameters that effect the application of UV disinfection are water hardness and iron content. Although these parameters do not typically impact on the viability of a UV disinfection scheme, they do effect equipment selection. Hard waters and waters with a high iron content typically lead to greater scaling of the UV quartz sleeves. Scaling on the sleeves absorbs UV light and therefore, impacts the efficiency of the equipment. Scaling leads to the need for more regular cleaning of the equipment and, therefore increased operational costs. Table 2-3 shows a summary of water quality parameters measured in Kelowna including hardness and iron content. At this time, we have not received physical and chemical analyses for Okanagan Lake at Naramata; however, we would not expect significant differences to the data presented in Table 2-3.

Table 2-3
Water Quality Parameters

Parameter	Units	Mean	Min	Max	Period
pH	pH	7.97	5.21	9.12	2003
Alkalinity	mg/L	109	101	114	1997-2003
Calcium	mg/L	33.5	29.7	37.6	1991-2002
Hardness	mg/L	119	107	130	1999-2003
Iron	mg/L	0.0164	<0.001	0.04	1991-2003

The values given in Table 2-3 are relatively low. Scaling of the UV equipment is, therefore, unlikely to be a concern for the UV disinfection systems. The parameter values in Table 2-3 will be used in the evaluation of the various UV equipment suppliers.

3 Water Quality Objectives

3.1 Interior Health

Under letter dated March 3, 2004, Interior Health confirmed its requirements for water quality. The basic requirements in this letter were stated as follows:

- 2 log reduction of *Cryptosporidium* and 3 log reduction of *Giardia*
- Two-stage treatment
- Turbidity level contained in Guidelines for Canadian Drinking Water Quality

3.2 Infrastructure Funding Agreement

The project is covered under a Canada/British Columbia Infrastructure Program Funding Agreement dated August 9, 2002. Appendix 2 of that agreement has the following conditions:

“Demonstration that the project will meet the drinking water quality objectives set within the following:

- Guidelines for Canadian Drinking Water Quality
- British Columbia Safe Drinking Water Regulations”

3.3 Treatment Goals

The RDOS in Naramata is intending on using UV disinfection as a second water treatment barrier. The UV disinfection system and chlorination system will work together to inactivate bacteria, protozoa and viruses. Various studies have shown that UV disinfection is well suited to the inactivation of bacteria and protozoa at low UV doses. However, UV disinfection is not as effective at inactivating viruses at low dosages. Chlorination on the other hand is effective at inactivating viruses, but is ineffective at inactivating some protozoa.

However, the dual disinfection strategy will not address the turbidity requirements stated in the Guidelines for Canadian Drinking Water Quality (GCDWQ). The data presented in Section 2.2 suggests that the raw water turbidity may not meet the GCDWQ; however, the RDOS does not have adequate funds to meet this. Refer to Section 3.4 for the proposed approach to this issue.

The design of the UV system is to be based on the inactivation of protozoa, such as *Giardia* and *Cryptosporidia*. From the USEPA UV Disinfection Guidance Manual, the dose required for a 2 log inactivation of *Giardia* is 23 mJ/cm^2 . For a 2 log inactivation of *Cryptosporidia* the required dose is 24 mJ/cm^2. UV disinfection equipment manufacturers have generally validated their equipment at 40 mJ/cm^2 and presently, this has become an industry standard. The dose value of 40 mJ/cm^2 is sufficient for a 3 log inactivation of *Giardia*.

Based on what is available from the UV disinfection equipment manufacturers, the required dose for the UV disinfection system has been set at a minimum of 40 mJ/cm^2 ,

3.4 Staged Implementation

As noted in Section 3.3, the RDOS does not have adequate funding to address the turbidity requirements under the GCDWQ, therefore a phased approach to water treatment is proposed as follows:

<u>Phase 1 – Two Stage Disinfection</u>

Phase 1 will involve a dual treatment approach involving UV primary disinfection and chlorine secondary disinfection. The combined disinfection strategy will be designed to achieve the following treatment objectives:

- 2 log inactivation of *Giardia*
- 3 log inactivation of *Cryptosporidium*
- 4 log inactivation of viruses

<u>Phase 2 – Turbidity Removal</u>

Phase 2 will involve treatment to remove turbidity to meet the GCDWQ. The current GCDWQ turbidity limit is 1 NTU. It is expected that in the near future, this limit will be reduced to 0.3 NTU. To build a filtration plant to meet these criteria under current combined water demand conditions would cost several million dollars. The proposed approach, therefore, is to defer this stage until at least partial system separation has been achieved, thereby significantly reducing the associated costs and allowing an opportunity to collect additional water quality data to be used for the ultimate filtration system design.

4 Phase 1 – Treatment Implementation

4.1 Primary Disinfection

Primary disinfection will be achieved utilizing ultraviolet radiation to achieve the *Giardia* and *Cryptosporidium* inactivation goals.

4.2 Secondary Disinfection

Secondary disinfection will be achieved utilizing chlorine. The chlorine will be used to achieve virus inactivation and maintain a minimum chlorine residual throughout the distribution system. The initial dosage will be set to achieve a residual of 2.0 mg/l at the point of entry into the distribution system.

4.3 Location of UV Treatment Process

Two basic alternatives were originally considered for locating the UV treatment process. One alternative involved retaining the current high lift pumping system and implementing UV downstream of the pumps. The other alternative involved adding a set of low lift pumps to deliver water via a head tank through the UV reactors at low pressures into high lift treated water pumps.

The first alternative has several technical issues as follows:

- High operating pressures creating higher potential for lamp breakage.
- High pressure transients creating potential for lamp breakage on either upsurges or downsurges.
- Potential CT issues due to the fact that chlorination has to occur downstream of UV treatment.
- Reduced availability of equipment to meet required design conditions.

The most critical of the above issues are the pressure constraints. We are only aware of one manufacturer who supplies equipment rate for pressure higher than 1050 kPa. The pressures at the existing South Lake Intake Pump Station site are in the order of 2200 kPa, which is well beyond the rating of any reactor that we are aware of. The one possible way to overcome this problem utilizing the high pressure approach would be to locate the reactors at a location above 450 m elevation. This would necessitate locating the UV treatment equipment in the vicinity of Naramata Road. We recommend not chlorinating upstream of UV treatment due to concerns about the impact of UV on chlorine. This would therefore mean that the existing chlorination system would have to be replaced with a new system downstream of the UV system and that some means of providing contact time for virus removal would also have to be provided.

The second alternative using low pressure eliminates all of the above issues and also provides more flexibility in the design of the high lift treated water pumping system by creating the option of having high pressure discharge at both intake pump station sites, thereby eliminating the need for booster pumps. This alternative was adopted for development of Option 1. Refer to the Process Flow Diagrams shown on Dwg. No.'s. SLPS-2 and TSPS-2.

During the Preliminary Design Workshop a new overall upgrading option identified as Option 2 was developed involving providing the treatment facilities and treated water high lift pumps at a common facility located at the McKay Reservoir site. Under this option the UV treatment facilities would be provided immediately upstream of the McKay Reservoir inlet and thereby operating at a constant head of 3 metres. Having the treatment equipment at a common location upstream of a balancing reservoir has numerous advantages compared to Option 1. Refer to the Process Flow Diagram shown on Dwg. No.'s RWPSTS-2 and MAWTPS-5.

4.4 Equipment Redundancy

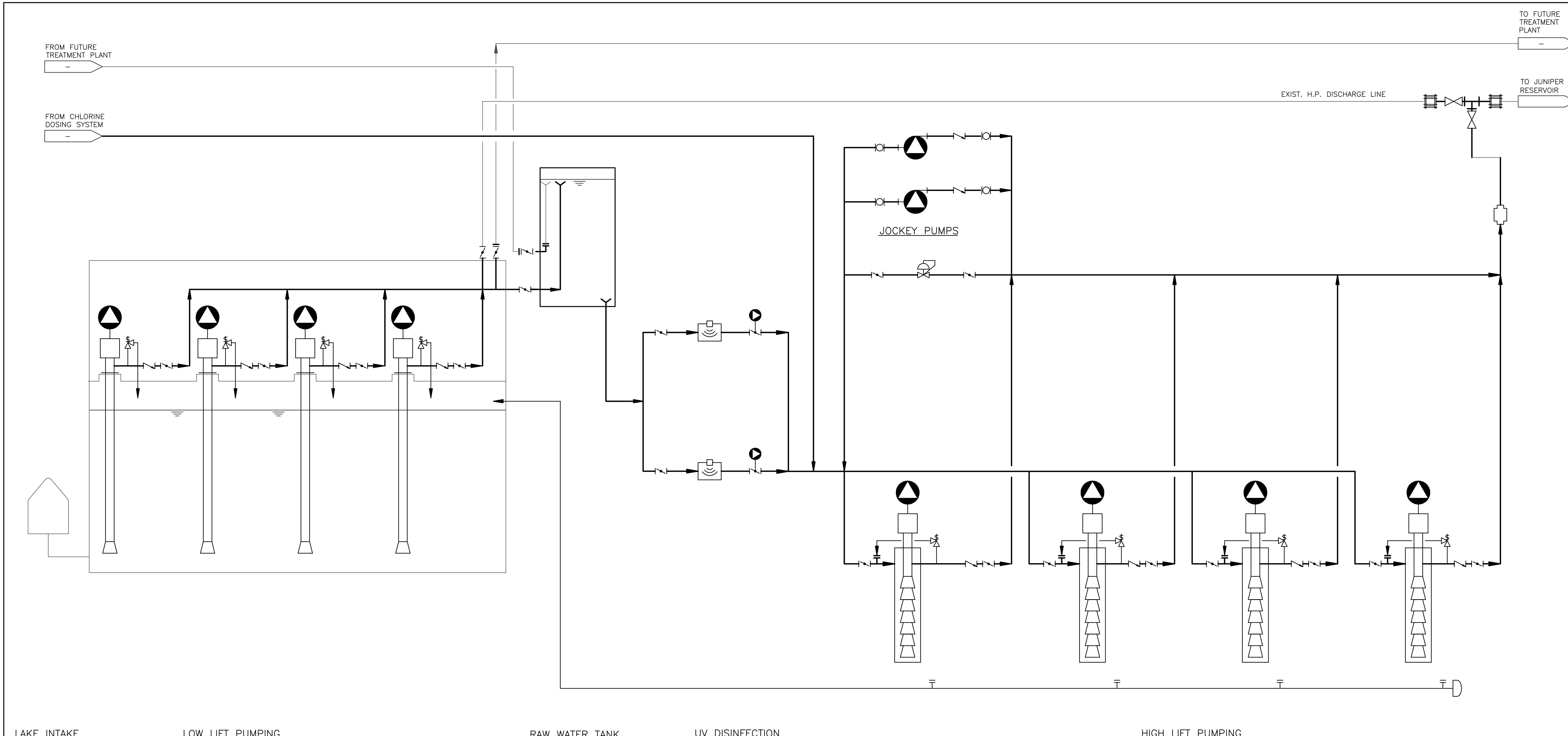
Good engineering practice involves designing the treatment system to be able to deliver the full maximum day demands with one process unit out of service. The Naramata water supply system is separated into two separate systems identified as the North System and the South System. These two systems are interconnected such that water can be backfed from the South System to the North System. For the Naramata water supply and treatment facilities we therefore propose that the water supply and distribution system be considered as one overall system and therefore one redundant unit should be provided for the overall system.

For Option 1, which involves upgrading and utilizing the two existing intake pump stations for supply and treatment purposes, the following approach would be appropriate:

- <u>South Lake Intake</u>: Adequate number of reactors to meet maximum day demand plus one equal sized redundant reactor.

- <u>Townsite Intake</u>: Adequate number of reactors to meet maximum day demand with <u>no</u> provision for redundancy.

All reactors at both sites will be of the same size and capacity to allow maximum flexibility and interchangeability of parts. As previously noted, in the event of a reactor failure at the North Intake, the North system could be fed from the South System although not at maximum day demands.



LEGEND

- VERTICAL TURBINE PUMP
- CENTRIFUGAL PUMP
- PRESSURE REGULATING VALVE
- CHECK VALVE
- BUTTERFLY VALVE
- MOTOR OPERATED VALVE
- BALL VALVE
- SLIDE GATE
- ULTRASONIC FLOWMETER
- MAGNETIC FLOWMETER
- UV UNIT
- COMPONENTS TO BE REMOVED OR ABANDONED
- EXISTING
- NEW

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NO.	DATE	BY	REVISION	CH'KD
A	02/05/05	B.C.	PRE DESIGN	SB

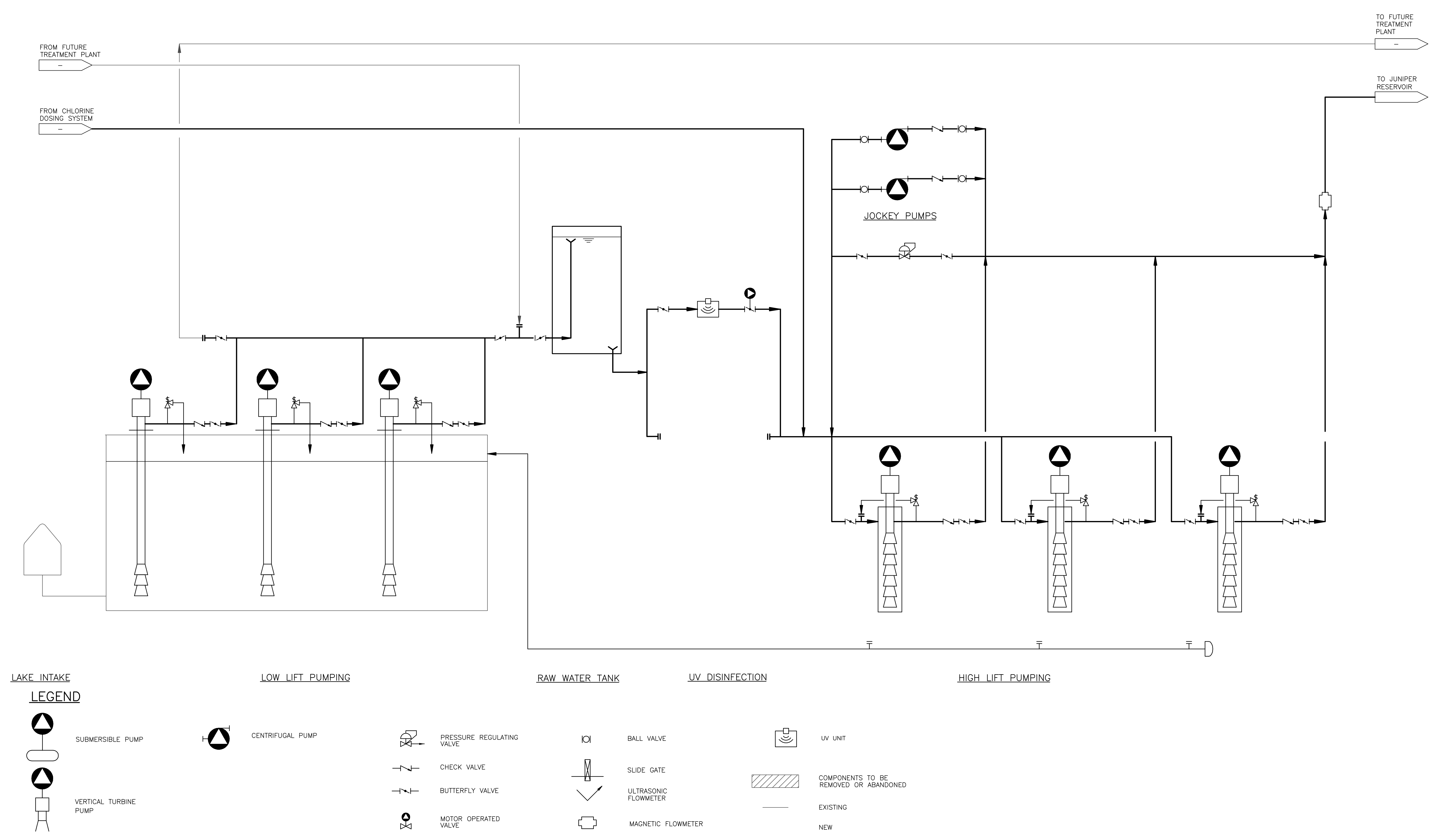
DRAWN	BC
DESIGN	SB
APPROVED	BH
DATE	JAN. 2005
SCALE	1:100

REGIONAL DISTRICT OF OKANAGAN SIMILKAMEEN

NARAMATA WATER SUPPLY IMPROVEMENTS
SOUTH LAKE PUMP STATION
PROCESS FLOW DIAGRAM

DIVISION: DIVISION

DRAWING NO.: SLPS-2 | REV. NO.: A



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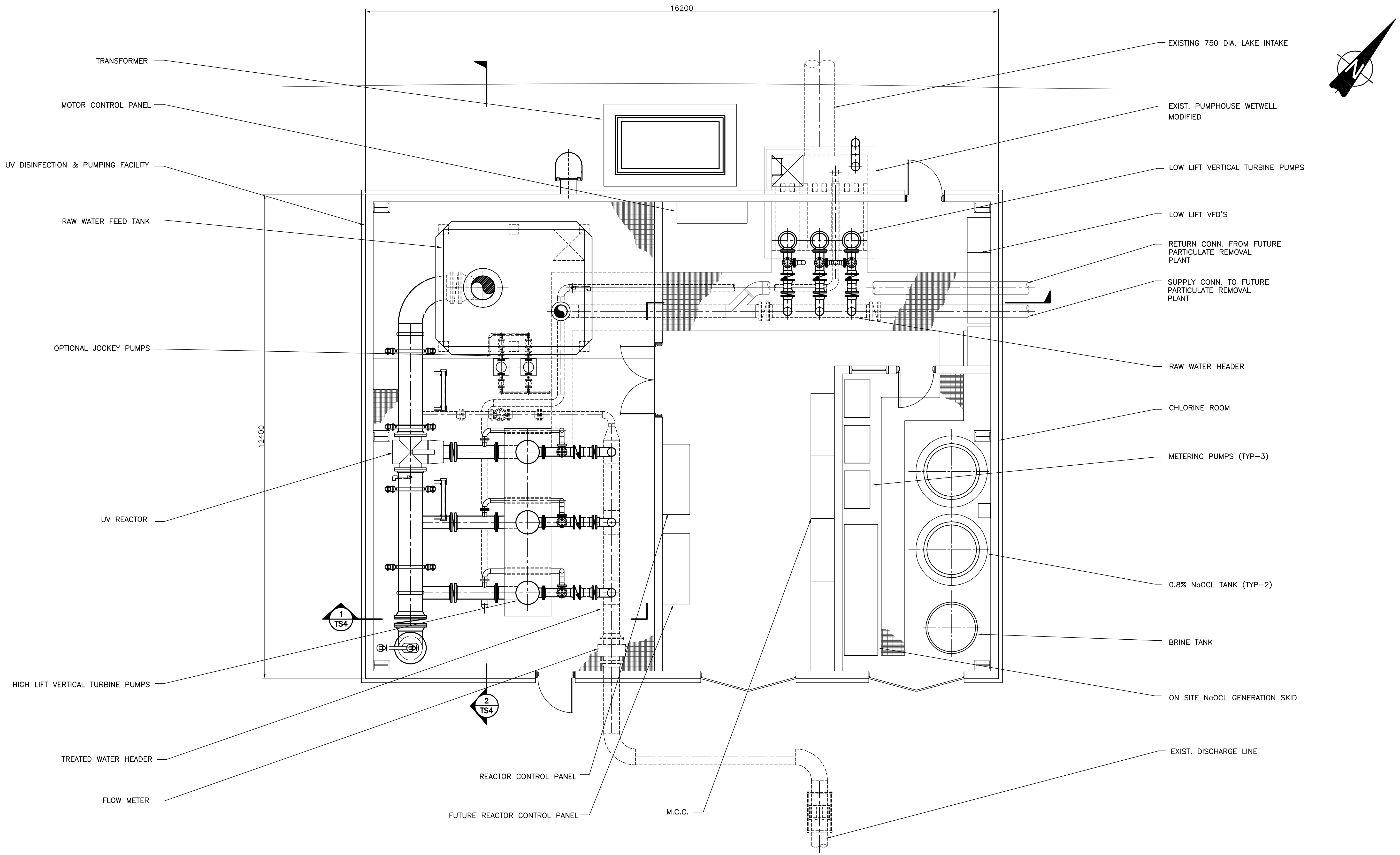
SCALE	NONE

REGIONAL DISTRICT OF OKANAGAN SIMILKAMEEN

NARAMATA WATER SUPPLY IMPROVEMENTS
TOWN SITE PUMP STATION
PROCESS FLOW DIAGRAM

DIVISION
DIVISION

DRAWING NO. TSPS-2
REV. NO. A



PLAN
1:100

NOTE:
1.0 LAYOUT BASED ON TROJAN 600mm DIAMETER REACTORS

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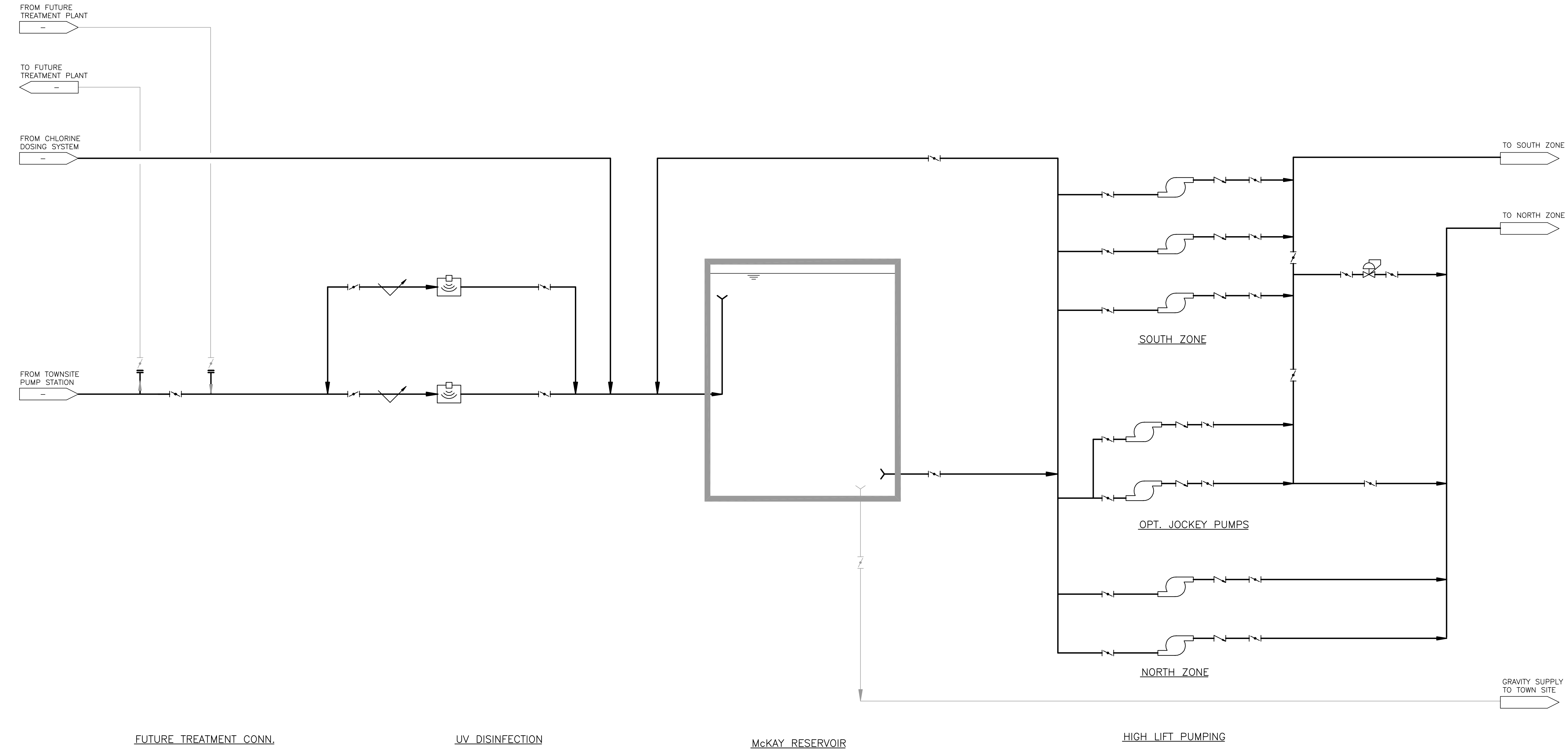
DESIGN	SB
APPROVED	BH
DATE	JAN. 2005
SCALE	1:100

REGIONAL DISTRICT OF OKANAGAN SIMILKAMEEN

NARAMATA WATER SUPPLY IMPROVEMENTS
TOWN SITE PUMP STATION
PLAN

DIVISION
DIVISION

DRAWING NO. TSPS-3
REV. NO. A



LEGEND

- SPLIT CASE END SUCTION PUMP
- PRESSURE REGULATING VALVE
- CHECK VALVE
- BUTTERFLY VALVE
- MOTOR OPERATED VALVE
- UV UNIT
- SLIDE GATE
- ULTRASONIC FLOWMETER
- MAGNETIC FLOWMETER
- COMPONENTS TO BE REMOVED OR ABANDONED
- EXISTING
- NEW

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DRAWN	BC
DESIGN	SB
APPROVED	BH
DATE	APR. 2005
SCALE	NONE

REGIONAL DISTRICT OF OKANAGAN SIMILKAMEEN

NARAMATA WATER SUPPLY IMPROVEMENTS
McKAY AVENUE WATER TREATMENT PLANT AND PUMP STATION
PROCESS FLOW DIAGRAM

DIVISION: DIVISION

DRAWING NO.: MAWTPS-5 | REV. NO.: A

For Option 2, all water treatment and treated water pumping equipment will be located in a common building adjacent to the existing reservoir on McKay Avenue and therefore the system can be designed to allow the redundant reactor to be capable of feeding either the North System or the South System at maximum day demands. This is a significant advantage for Option 2 over Option 1.

5 Ultraviolet Disinfection Equipment

5.1 Equipment Pre-Qualification

There are many UV disinfection equipment manufacturers, but not all of them have equipment which is suited to water disinfection. For the purposes of equipment pre-selection it was necessary to set criteria for determining manufacturer suitability. The two criteria used were:

- Does the manufacturer produce medium capacity (greater than 10 ML/d) UV reactors?
- Are the reactors validated for inactivation of the target pathogens?

Based on the two above criteria, five UV disinfection equipment manufacturers were identified and contacted. The five manufacturers were:

- Hanovia
- Calgon Carbon
- Infilco-Degremont
- Trojan Technologies
- Wedeco Technologies

The manufacturers responded with data on their UV disinfection equipment. Data collected included equipment dimensions, reactor capacities, lamp type and reactor head losses. Based on the data and responses submitted by the manufacturers, all manufacturers were deemed to be qualified. Table 2-4 summarizes the typical number of reactors required at each site for each manufacturer.

Table 2-4
Number of Reactors

	Hanovia	**Calgon Carbon**	**Infilco-Degremont**	**Trojan**	**Wedeco**
Suggested Model	900 dia Crossflow	900 dia Sentinel	500 dia. Aquaray	600 dia. Swift	400 dia. BX
South Lake 20.7 ML/d	1 service 1 standby	1 service 1 standby	1 service 1 standby	1 service 1 standby	2 service 1 standby
Townsite 15.3 ML/d	1 service	1 service	1 service	1 service	2 service
Totals	2 service 1 standby	2 service 1 standby	2 service 1 standby	2 service 1 standby	4 service 1 standby

The data presented in Table 2-4 is only preliminary information and based only on Option 1. The actual number and size of reactors will be left to the manufacturers to select based on the equipment supply RFP technical requirements.

5.2 Equipment Procurement

A UV disinfection equipment pre-selection document will be prepared and distributed to the five identified manufacturers based on the capacities and redundancy provisions summarized in Section 5.1. The pre-selection document will be prepared in the form of a request for proposals (RFP). This approach will give the RDOS greater flexibility in selecting the most favourable manufacturer. The RFP will require the manufacturers to provide technical details for their proposed UV disinfection equipment, as well as pricing information and operating costs. All of the above named suppliers have been shortlisted due to the fact that they have proven that they are capable of meeting the technical requirements. The evaluation of the UV equipment and recommendation for the award of the supply contract will therefore be based on a financial evaluation including both capital and life cycle costs.

The supply contract will include a Novation Agreement which will facilitate assigning the supply contract to the installation contractor after the installation contract has been awarded. This will ensure a single line of responsibility for equipment supply and installation during construction.

6 Chlorination Upgrades

6.1 CT Design Criteria

The chlorination system will be designed to provide 4-log virus inactivation. Based on a worst case scenario of a maximum pH of 9.1 and a minimum temperature of 4*C the required CT is 15.8 mg/L.min. Based on a residual of 1.85 mg/L at the end of the contact period the required contact time is 8.5 min.

6.2 Option 1

6.2.1 South Lake Intake Pump Station Site

Chlorine disinfection at this station is achieved using a conventional vacuum-based dosing system using ejectors and chlorine solution carrier delivered to pump discharge header in the pump station. The primary system components are:

- Weigh scale
- Tonner mounted vacuum regulator
- Remote mounted pressure relief valve on the Gas vacuum line
- Chlorinator
- Chlorine residual analyzer
- Chlorine ejectors

Chlorine contact is achieved through the supply pipeline where the length to the first customer has been determined to be 740 lin.m. Under maximum day demand conditions the contact time has been calculated to be 8.7 min.

The facility is in a relatively remote location away from residential and commercial development. The dispersion of a chlorine gas plume from a significant release would likely progress toward the lake.

The system was originally installed in the early 1970's and since that time has had some minor upgrades. In general, the existing system appears to be suitable for continued operation although some aging components should be replaced to ensure future reliability. During a recent review by McMullen & Associates, a number of minor modifications were identified. If the South Lake System is to continue to be operated, these modifications, as listed below, should be carried out as part of this project:

- Sealing all gaps and cracks between the Tank Room and Pump Room to contain leaking chlorine inside the Tank Room.
- Posting appropriate signage that indicates *"Toxic Gas in Use, Wear Appropriate Respiratory and Personal Protective Clothing and Equipment for Entry"*.

- Relocating Chloralert gas monitor to the Pump Room to allow workers to safely test the atmosphere before entering the Tank Room.
- Reconfiguring the exhaust ventilation system to contain leaking gases in the Tank Room until the area has been cordoned off and made safe.
- Relocating the emergency ventilation switch to the Pump Room so it can be used safely following a leak.

The chlorine system should also be upgraded to meet future capacity requirements. Typical modifications will include the replacement of chlorinators and some piping. The RDOS may also consider installing a scrubber to capture accidental chlorine release.

6.2.2 Townsite Intake Pump Station Site

Chlorine disinfection at this station is achieved using a conventional vacuum-based dosing system using ejectors and chlorine solution carrier delivered to the pump discharge headers in the pump station. The existing system is a 75 kg cylinder system which will require replacement as part of this project.

The facility is near the downtown area and is therefore in close proximity to residential and commercial development. The dispersion of a chlorine gas plume from a significant release could easily progress toward the downtown area under the right wind conditions.

Due to the fact that it has to be replaced under this project, we recommend that it be replaced with a packaged sodium hypochlorite generation system. Sodium hypochlorite generation involves utilization of electrolytic action to convert a brine solution to 0.8% sodium hypochlorite. The capital and operating costs are very similar to chlorine gas; however, the technology is much safer.

Based on a maximum day water demand of 140 l/s serving the North System including the Townsite at a dosage of 2.0 mg/l the system should be designed for a capacity of 24.2 kg/day.

Chlorine contact will be achieved through the new dedicated high pressure supply line. The first connection point to the distribution system will be located approximately 1000 lin.m. from the treatment plant. Under maximum day demand conditions the contact time has been calculated to be 11.4 min.

6.3 Option 2

The new chlorination facility under Option 2 will be located at the Mckay Avenue Water Treatment and Pump Station. With this facility being located near the downtown area we recommend that it be designed as a packaged sodium hypochlorite generation system.

Based on a maximum day demand of 345 l/s serving the entire system at a dosage of 2.0 mg/l the system should be designed for a capacity of 59.6 kg/day.

Chlorine contact will be achieved through each of the treated water supply supply lines. The following confirms the treated water supply line lengths to the first connection point and calculated contact times under future peak demand conditions:

Townsite 305mm Treated Water Gravity Supply Main - 800 lin.m. – 12 min.
North System 305mm Treated Water Supply Main - 800 lin. m. – 8.9 min.
South System 406mm Treated Water Supply Main - 780 lin.m. – 8.5 min.

In addition to the above pipeline contact time the existing McKay Reservoir cell no. 1 will provide some contact time even without any baffling.

6.4 Sodium Hypochlorite System Preliminary Design

The typical sodium hypochlorite generation system will include the following components:

- NaOCl generation equipment; water softener, heater, rectifier, controller, electrolytic cells, and brine proportioning pump.
- Brine tank.
- Solution storage tanks.
- Solution metering pumps.

Refer to Technical memorandum No. 3 for the proposed layout. The following provides a description of the system components and the number of units proposed for the project.

6.4.1 NaOCl Generation Equipment

The water used in the generation process must first be softened (removal of metal cations such as calcium, magnesium, etc.). The water is often heated to raise it to the optimum temperature range of 15 to 25 C. Prior to entering into the electrolytic cell, strong brine (30%) is diluted with heated and softened water to a weak brine solution (approximately 3%) using a proportioning device such as a pump or eductor. Powered by a low voltage, high amperage DC rectifier, the electro-chemical reaction converts the weak brine into sodium hypochlorite. The generation system controller can be ordered in various custom configurations for PLC type control. One package process unit is considered to suitable for this project on the basis that adequate solution storage is provided to allow adequate time for repairs in the event of a system breakdown.

6.4.2 Brine Tank (Salt Storage and Strong Brine Preparation)

A strong brine solution is required for the generation process. Salt can be delivered onsite in 25 kg bags, one tonne tote bags or by delivery truck equipped with pneumatic conveyors for very large applications. The tank is typically sized such that it holds about a month’s supply of salt plus allowance for delivery size and schedule. Brine tanks are typically polyethylene or FRP and are custom designed for brine making applications. One storage tank sized for one month's brine storage is considered appropriate for this project.

6.4.3 NaOCl Solution Storage Tanks

Sodium hypochlorite solution is typically stored in quantities of two or three days at maximum day demand. The solution generated onsite is 0.8% (8000mg/l) of equivalent chlorine. Residual hydrogen gas in the generation process will typically collect in solution piping entering the tank and the head space of the tank. Depending on the system size, this is passively vented or actively removed by forced air blowers. Tanks are either high density polyethylene or FRP construction. Two tanks, each sized for 2 days supply at maximum day demand and equipped with forced air ventilation is considered suitable for this project.

6.4.4 Metering Pumps

The NaOCl solution is delivered to process from the storage tanks using metering pumps. The typical arrangement is one operating and one standby for each application point. Most small to medium applications use diaphragm style pumps, while large applications may require peristaltic (hose) pumps. For this project the two operating and one redundant diaphragm style metering pumps each sized for one half of maximum day demand conditions will be specified.

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Technical Memorandum No. 3

Associated Engineering
GLOBAL PERSPECTIVE. LOCAL FOCUS.

Regional District of Okanagan-Similkameen

Naramata Water Supply Improvements

Intake Pump Stations and UV Facilities Predesign

April 2005

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Naramata Water Supply Improvements
Intake Pump Stations and UV Facilities Predesign

Issued: April 22, 2005
Previous: February 7, 2005

1 Objective

The objective of this technical memorandum is to outline the preliminary design of the pumping and water treatment facilities required to treat and deliver water from Okanagan Lake to the distribution system.

2 Existing Facilities

2.1 South Lake Intake Pump Station

The existing South Lake Intake Pump Station (built in the early 1970's) consists of three 200 hp pumps each with a capacity of 57 L/s (900 USgpm) at a TDH of 220 m (310 psi). There is also a fourth inactive smaller pump that has been abandoned. The power supply to this facility is provided at 480 volt. Pump operation is controlled by level at the Juniper Reservoir. A level transmitter at the reservoir transmits the level signal to the pump station PLC. The pump station has one surge anticipator/pressure relief control valve installed downstream of the pumps. The system delivers water into the distribution system via a 400 mm diameter ductile iron supply main.

The chlorination system at the South Lake Pump Station is a gas system fed by liquid chlorine tonners. A tonner-based system is typically capable of delivering 200 kg/day. However, there is likely to be restriction at the chlorinator. The capacity of the chlorinator should be confirmed. Operation of the system is activated via a solenoid valve, which is energized on pump start-up.

2.2 Townsite Intake Pump Station

The existing Townsite Intake Pump Station is a wood frame superstructure partially founded on a small reinforced concrete intake well substructure. The intake well was apparently designed to accommodate four vertical turbine pumps, however, the existing arrangement includes only two pumping units and it would appear hydraulically impractical to provide two additional units of the same capacity.

The two existing pumps are 75 hp units, each having a capacity of 44 L/s (700 USgpm) at a TDH of 90 m (125 psi). The power supply to this facility is 600 V. Pump operation is controlled by level at the McKay Reservoir. A level transmitter at the reservoir transmits the level signal to the pump station PLC. The pump system delivers water into the distribution system via a 300 mm diameter supply main. A 200 mm diameter pressure-reducing valve on a manhole outside the pump station reduces pressure from 968 kPa to 830 kPa.

To deliver water at adequate pressure into the higher elevation pressure zones, two booster stations located on Booth Road and Robinson Road can be used. Each station includes a 65 hp in-line unit having a capacity of 32 L/s (500 USgpm) at a TDH of 107 m (150 psi). These pumps can be run automatically from the Townsite Pump Station or manually from a local control.

The chlorination system at the Townsite Pump Station is a gas system fed by 75 kg (150 lb) cylinders. This type of system is typically capable of delivering 60 kg/day of chlorine. Operation of the chlorination system is activated by a solenoid valve, which is energized when the pump starts.

3 Upgrading Concepts

3.1 Option 1 - System Design Concept

The basic concept to be applied for each of the lake intake pump stations will include the following:

1. Low Lift Intake Pumps: Retrofitted into the existing pump station clearwells to lift water to an inlet head tank.

2. Inlet Head Tanks: Installed to an elevation suitable to allow gravity flow through the UV reactors to the high lift treated water pumps.

3. UV Treatment: Installed downstream of the inlet head tanks to provide primary disinfection of the raw water.

4. Chlorination Upgrading: Upgrading of chlorination facilities to allow chlorine to be fed at adequate dosages downstream of UV treatment equipment and to ensure operator and public safety.

5. High Lift Treated Water Pumping: Installed downstream of the two stage disinfection process to pump water at adequate pressure to deliver it to the zone balancing reservoirs.

6. Future Filtration: When future filtration is implemented, the flow will be diverted from the head tank to the filtration process from where the filtered water will be directed into the upstream end of the UV primary disinfection process.

3.2 Option 2 - System Design Concept

The basic concept to be applied for Option 2 will include the following:

1. Raw Water Intake Pumps: Retrofitted into the existing Townsite Pump Station clear well to lift water from Lake Okanagan to the McKay Reservoir.

2. UV Treatment: Installed at the McKay Reservoir site upstream of the reservoir to provide primary disinfection of the raw water prior to it entering the reservoir.

3. Chlorination: Provision of a new chlorination facility located at the McKay Reservoir site to allow chlorine to be fed at adequate dosages downstream of UV treatment equipment prior to the water entering the reservoir. The utilization of a NaOCl generation system will ensure operator and public safety.

4. High Lift Treated Water Pumping: Provision of an adequate number of high lift treated water pumps installed downstream of the two stage disinfection process and treated water reservoir to pump water at adequate pressure to deliver it to the zone balancing reservoirs.

5. Future Filtration: When future filtration is implemented, the flow will be diverted upstream of the UV equipment to the filtration process from where the filtered water will be directed into the upstream end of the UV primary disinfection process.

4 Option 1

4.1 South Lake Pump Station Upgrading

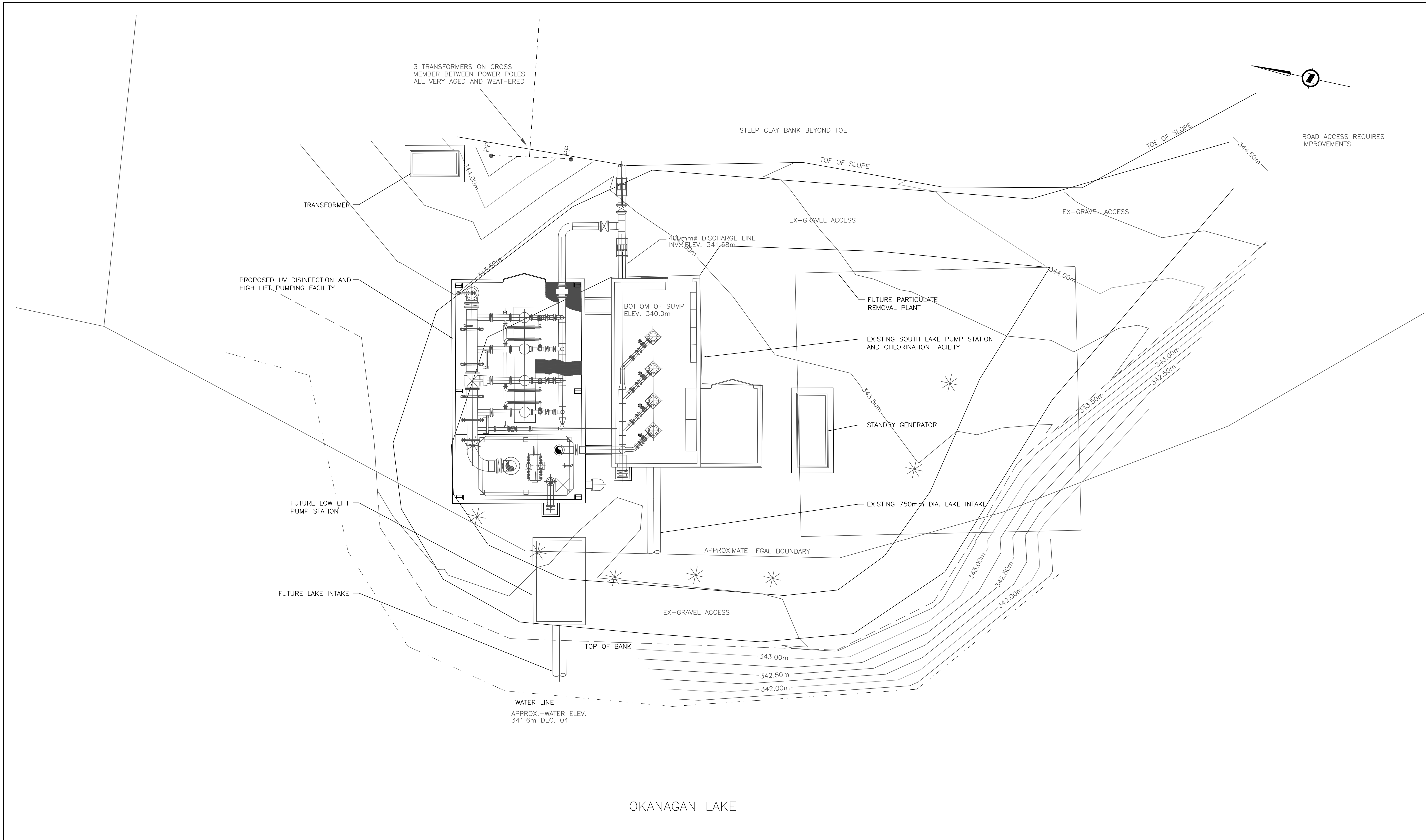
4.1.1 Site Layout

At the South Lake site it is proposed that a new structure housing the inlet head tank, the UV treatment process and high lift pumps will be provided on the north side of the existing pump station structure. Refer to Dwg. SLPS-1.

By locating it on the north side, the south portion of the site can be utilized by the contractor as a laydown area during construction. The existing pump station can also remain operational while the new structure is being constructed. Once the new structure is in place and the piping, valving, and equipment installed, the existing facility will be shutdown and all existing process mechanical and electrical components removed.

The standby generator will be installed on the south side of the existing building when the laydown area is no longer required.

The existing site grading will be left substantially unchanged. It will be necessary to either remove the existing access road on the north side as shown on Dwg. SLPS-1 or provide a retaining wall on the northeast corner of the site to allow it to be realigned around the new structure.



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REGIONAL DISTRICT OF OKANAGAN SIMILKAMEEN

NARAMATA WATER SYSTEM UPGRADE
SOUTH LAKE PUMP STATION
SITE PLAN

DIVISION: DIVISION

DRAWING NO. SLPS-1

REV. NO. A

4.1.2 General Arrangement

The general arrangement of the new facility is shown on Dwgs. SLPS-3 and SLPS-4. The existing building will be converted to a low lift pump station and will also house all of the electrical distribution panels. The new building will be approximately 12.8 m long by 7.6 m wide and 7.0 m high. The new building will house the inlet head, tank, UV equipment, and high lift pumps.

The head tank will be a prefabricated steel tank with a top water level set at approximately elevation 350.0 m. Water from the head tank will be directed into two UV treatment inlet headers. These headers will incorporate isolating valves, control valves, UV reactors and a chlorine feed connection. Treated water will then be directed into a treated water pump suction header. From the pump suction header, water will be pumped via one or more of four treated water high lift pumps into the 400 mm diameter discharge header and into supply. The discharge header will also incorporate a full bore magnetic flow element.

In parallel to the four large pumps, two small jockey pumps will be provided. The jockey pumps will be used to meet the far lower winter flow conditions.

4.1.3 Low Lift Pump System

The low lift pump system will consist of four vertical turbines set in the existing wet well. The pumps will have a duty point of approximately 80 L/s at 12 m TDH.

The low lift pumps will be typically 20 hp units and will be provided as VFD-driven variable speed units. The variable speed function is necessary to balance flows through the treatment system.

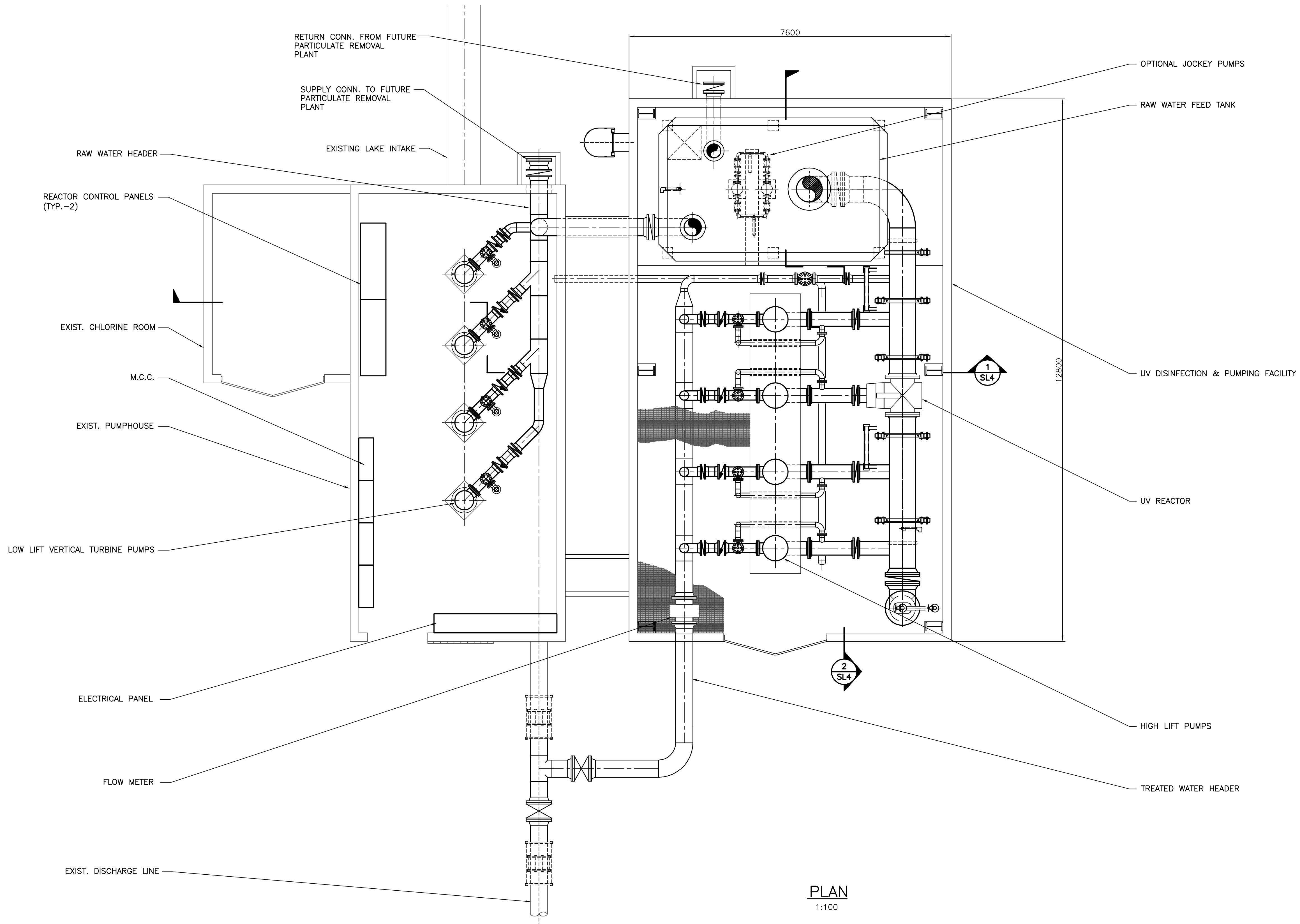
The low lift pumps will be provided with new piping and valving. New pump start-up bypass valves will also be provided.

4.1.4 High Lift Pump System

The high lift pump system will consist of four canned vertical turbine pumps with a duty point of approximately 70 L/s at 220 m TDH.

The high lift pumps will typically be 300 hp units and they will be provided as fixed speed units. It is intended that the high lift pump motors be water cooled and provided with soft-start drives. Providing water-cooled motors will greatly simplify the station ventilation requirements.

The high lift pumps will be provided with check valves, isolation valves and start-up bypass valves. The start-up bypass valves will assist in minimizing hydraulic transients on pump start-up and stop.



PLAN
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NOTE:
1.0 LAYOUT BASED ON TROJAN 600mm DIAMETER REACTORS

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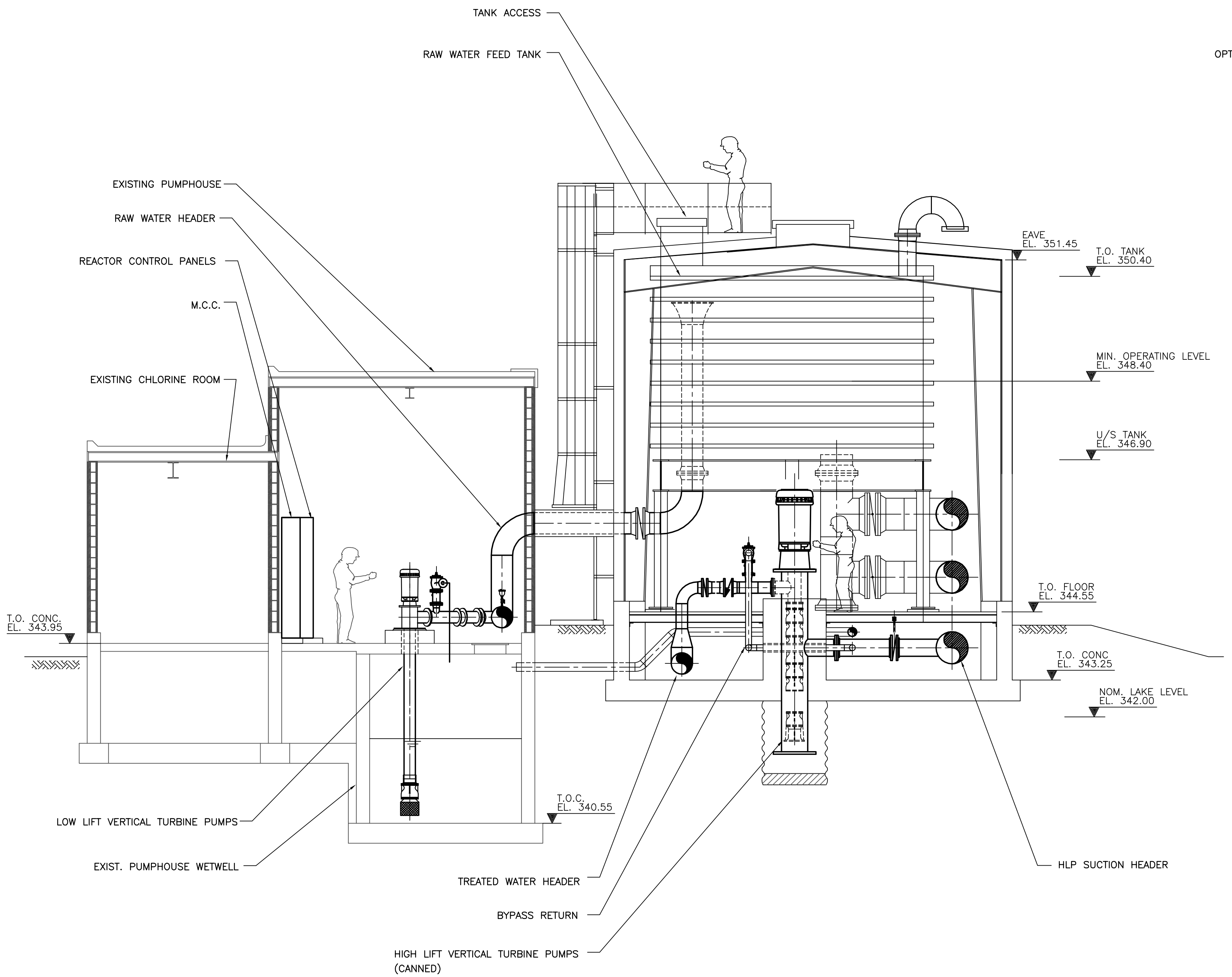
REGIONAL DISTRICT OF OKANAGAN SIMILKAMEEN

NARAMATA WATER SUPPLY IMPROVEMENTS
SOUTH LAKE PUMP STATION
PLAN

DIVISION: DIVISION

DRAWING NO.: SLPS-3
REV. NO.: A



SECTION 1/SL3
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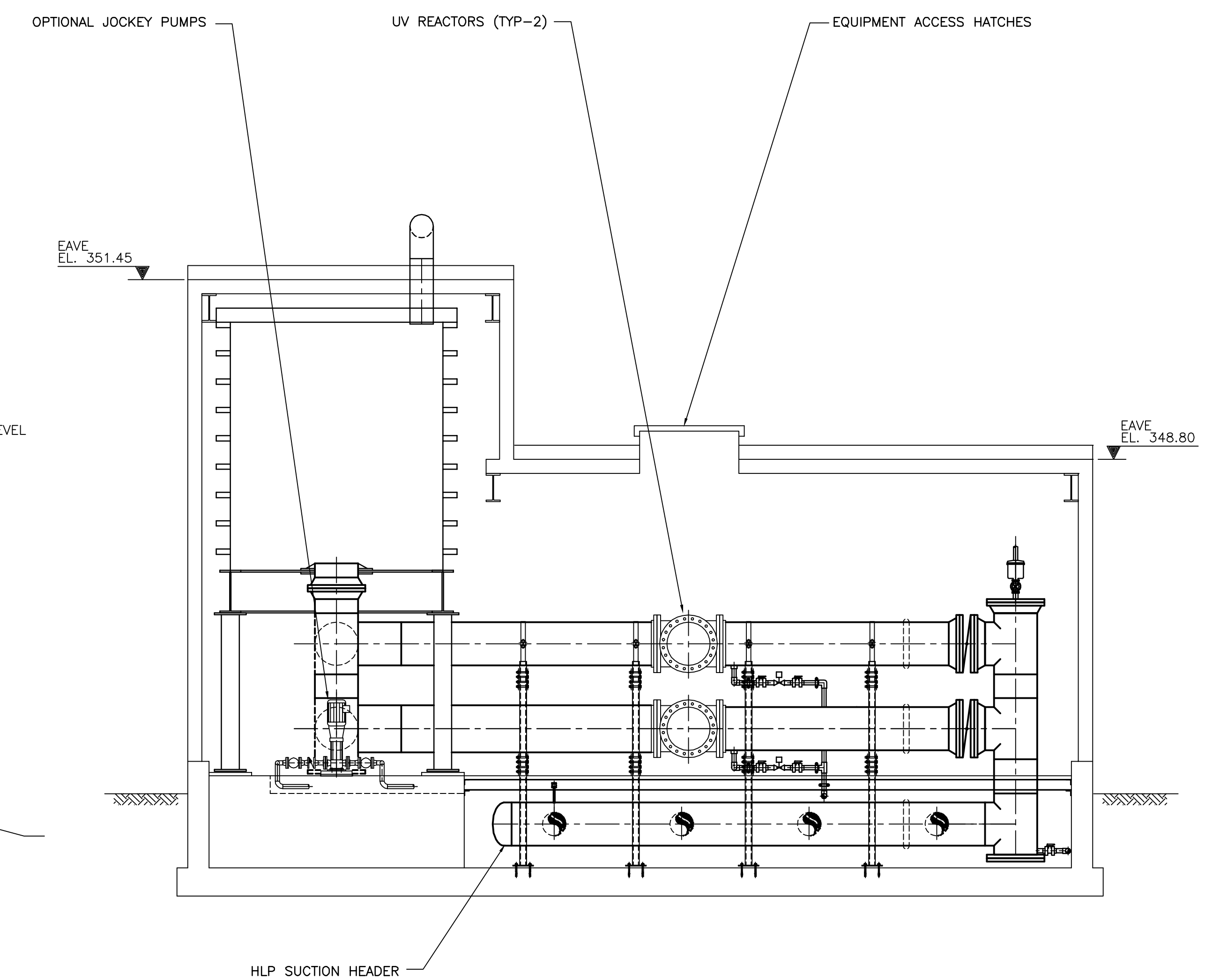

SECTION 2/SL3
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NOTE:
1.0 LAYOUT BASED ON TROJAN 600mm DIAMETER REACTORS

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REGIONAL DISTRICT OF
OKANAGAN SIMILKAMEEN

NARAMATA WATER SUPPLY IMPROVEMENTS
SOUTH LAKE PUMP STATION
SECTIONS

DIVISION
DIVISION

DRAWING NO. SLPS-4
REV. NO. A

The jockey pumps will be provided at a duty point of approximately 5 L/s at 220 m TDH. The exact capacity will be confirmed once hydraulic modelling is complete.

4.1.5 Structure

The structure has been designed to include a shallow (to minimize wet excavation) substructure supporting a 7.0 m high building superstructure.

The substructure will generally be 1.3 m below grade and will house the treated water piping. Although geotechnical investigation remains to be completed, it is assumed that it will be designed as a raft slab. The exterior walls will be cast monolithically with the base slab and designed to resist both hydrostatic and backfill pressures while supporting the superstructure. The centre of the substructure will incorporate four pump wells driven approximately 1.5 m below the base slab. These pump wells will house the canned vertical turbine high lift pumps and will be the only portion of the new structure located below the lake water surface.

The superstructure will be a pre-engineered building to house all above grade piping, valving and equipment. A double door on the east side of the building will provide maintenance access. A personnel access door will be located on the west side of the structure.

To satisfy the open floor space for process requirements, we propose a galvanized steel frame structure to form the main load carrying system. Concrete block masonry walls will enclose the steel frames and provide a waterproof and thermal envelope for the building. The roof structure will incorporate purlins and metal decking to support gravity loads and provide resistance for lateral loads. Perimeter gutters will provide drainage for the roof.

In the building process area, galvanized grated platforms will provide access to the UV equipment and high lift pumps.

At the South Lake site minimal attention will be given to architectural treatment as this facility is in an area of minimal visibility. Colour selection will be done to complement the existing building.

4.1.6 Electrical

An existing Fortis B.C. 3 phase, 25 kV pole line runs down the site. The existing 480 V service is to be replaced with a new 600 volt service. It is assumed that a new pad mount transformer will be supplied by and remain the property of Fortis B.C. It will be sited in the northeast corner of the site as shown on Dwg. SLPS-1.

The electrical service entry and all distribution panels and control panels will be located within the existing structure. Electrical distribution will be done utilizing Teck cable supported on an aluminium cable tray.

The requirements for standby power are being reviewed with the RDOS. As a minimum, standby power will be provided to meet control and instrumentation needs and emergency building lighting.

4.1.7 Building Mechanical

An electrically fired supply air ventilation unit will distribute filtered heated air to the new building. The supply air unit will incorporate motorized outdoor/return and dampers that are modulated to maintain the humidity and temperature conditions within the building. A roof mounted exhaust fan with two-speed control will be run to provide sufficient exhaust air to maintain a balance of outdoor air being introduced into the building at any given time. The controls will include programmable controller and night setback features.

Dry chemical and $C0_2$ fire extinguishers will be located in strategic locations throughout the building.

4.2 Townsite Pump Station

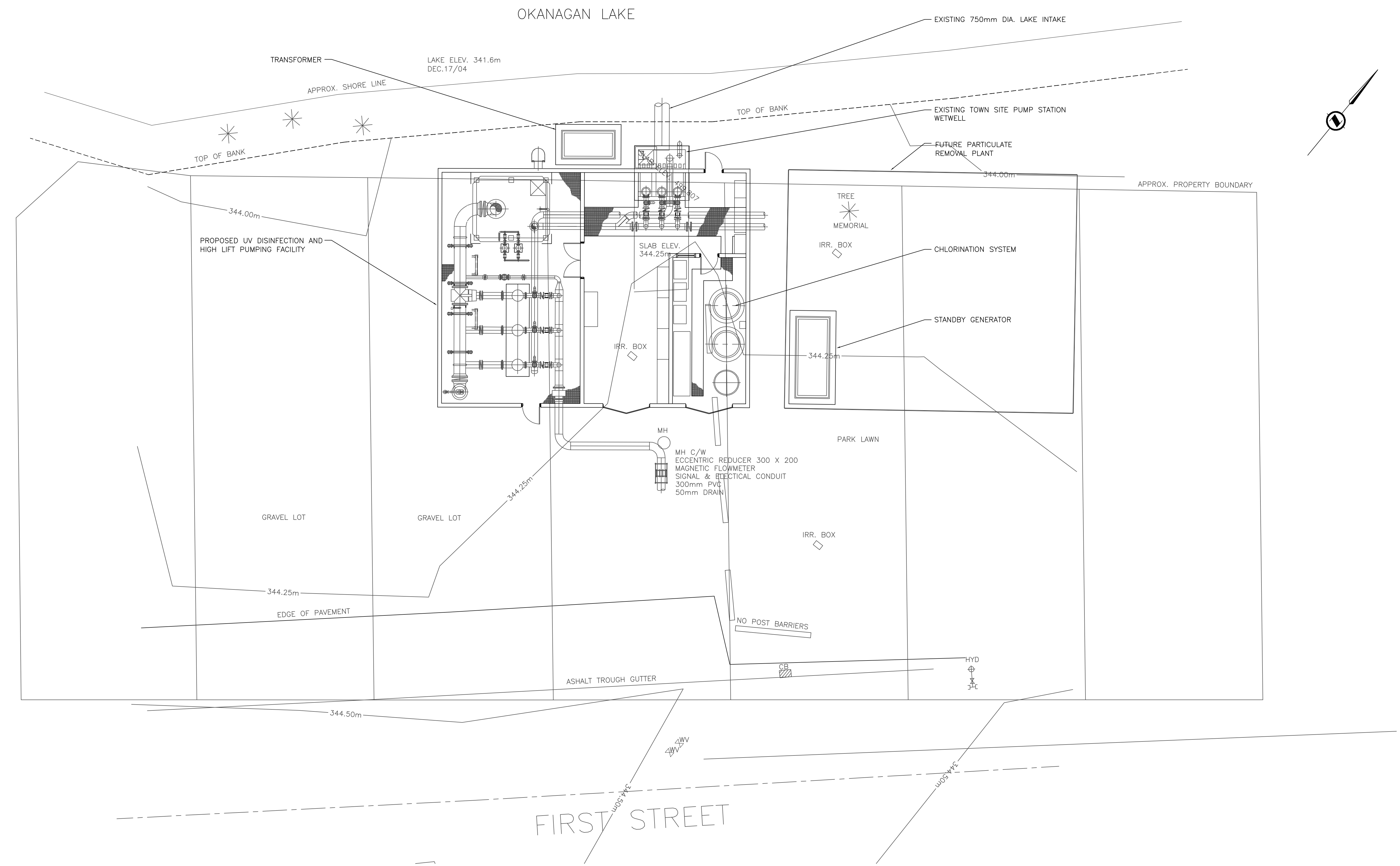
4.2.1 Site Layout

This building will house all process equipment, piping and valving, electrical equipment and building systems. At the Townsite facility, it is proposed to demolish the existing superstructure and construct a new building. The existing clearwell substructure will be retained and the new superstructure will be used to house all pumping and water treatment equipment. The footprint shown on Dwg. No. TSPS-1 occupies 3 lots in comparison to the one lot occupied by the existing facility. The RDOS is determining land ownership requirements of these lots.

Grading of the site will be left basically unchanged from the existing site grades. We are assuming that the Contractor will utilize the area to the south of the station for laydown purposes during the construction period.

Yard piping will consist of the new treated water supply main to the existing distribution system. The only sanitary waste stream originating within this facility will be grey water generated from washdown of floors etc. It is proposed that this water be discharged to a soakaway pit.

Access to the site will continue to be provided from First Street to a gravelled parking area on the south side of the new structure.



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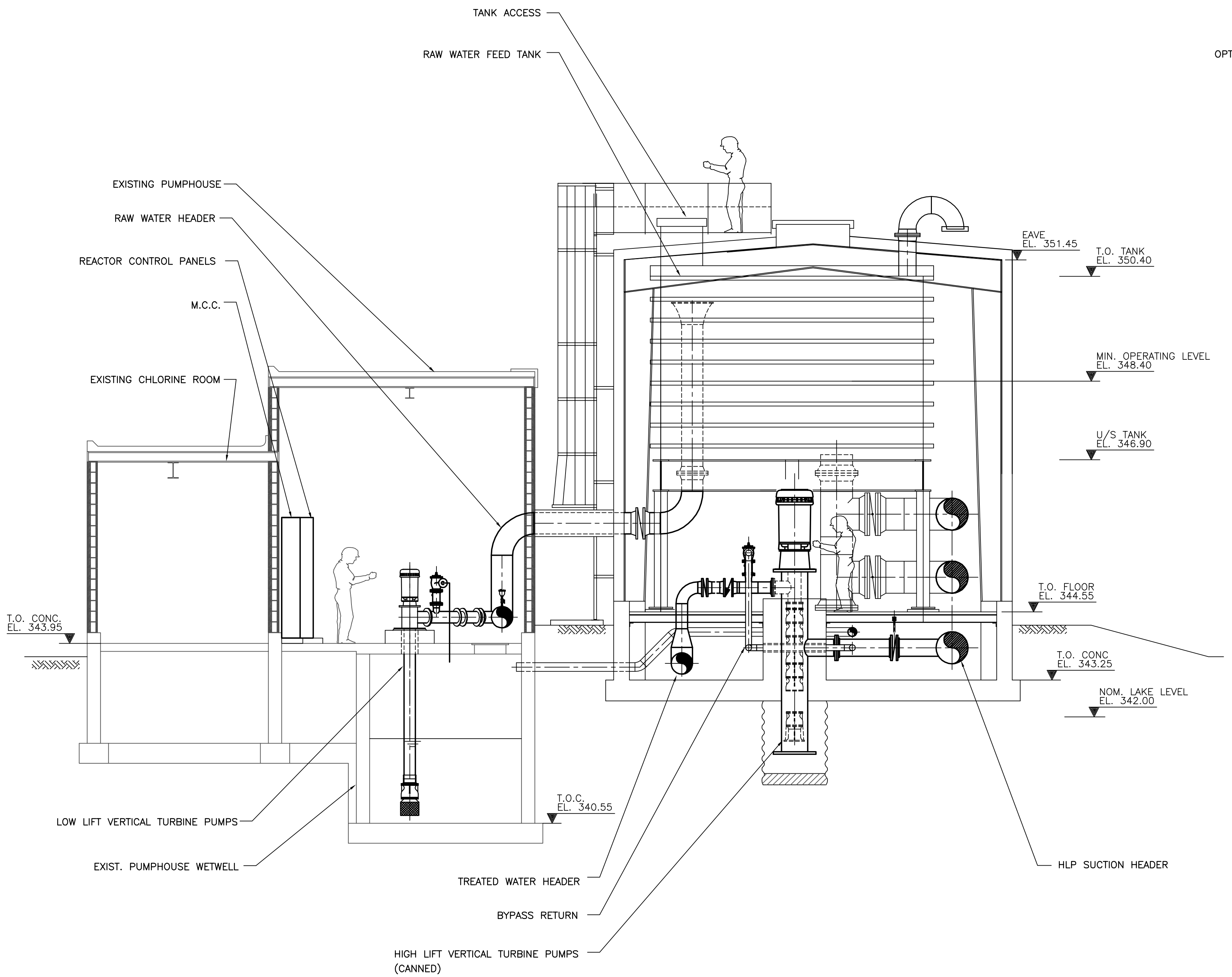
REGIONAL DISTRICT OF OKANAGAN SIMILKAMEEN

NARAMATA WATER SYSTEM UPGRADE
TOWN SITE PUMP STATION
SITE PLAN

DIVISION: DIVISION

DRAWING NO.: TSPS-1

REV. NO.: A



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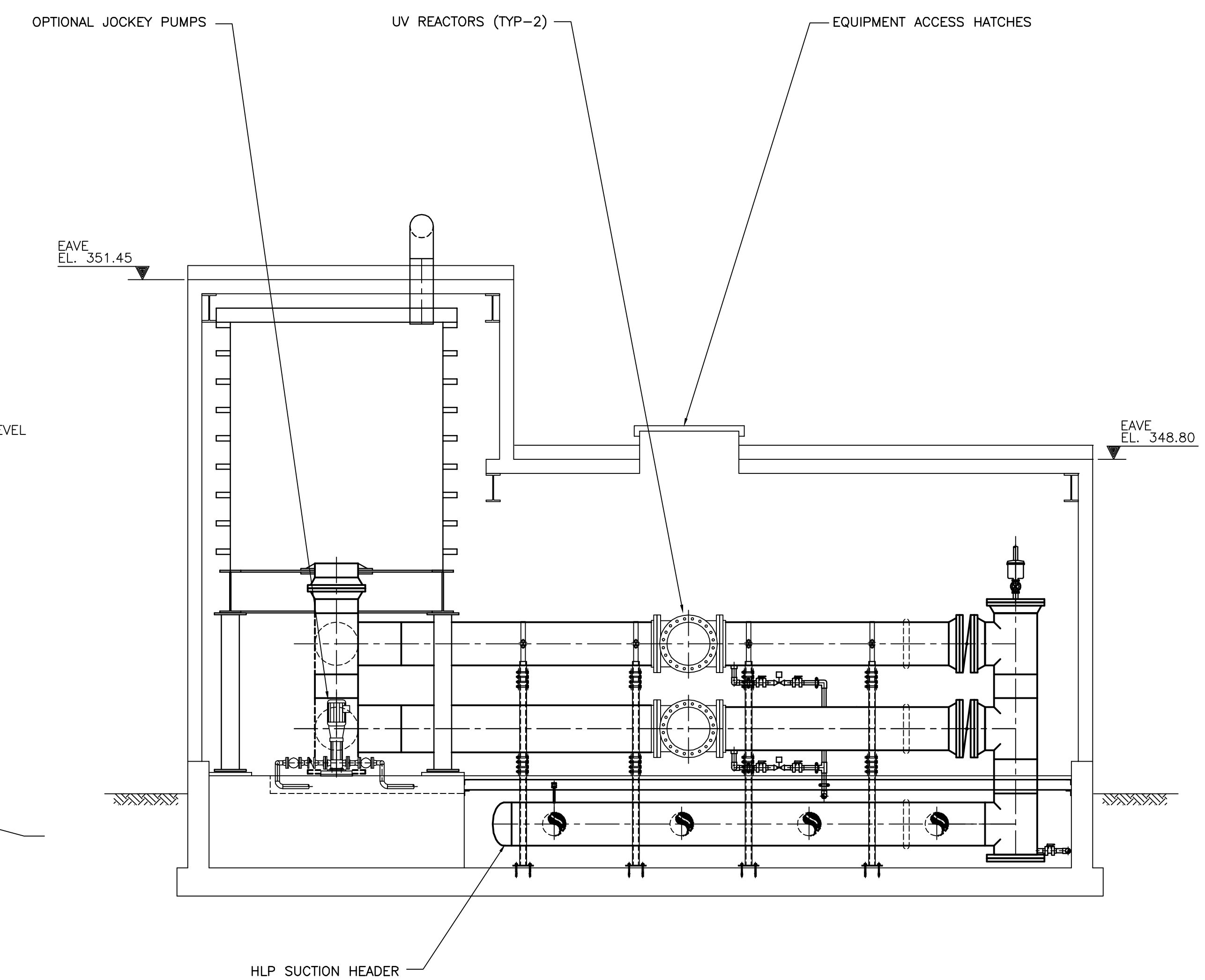

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NOTE:
1.0 LAYOUT BASED ON TROJAN 600mm DIAMETER REACTORS

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REGIONAL DISTRICT OF
OKANAGAN SIMILKAMEEN

NARAMATA WATER SUPPLY IMPROVEMENTS
SOUTH LAKE PUMP STATION
SECTIONS

DIVISION
DIVISION

DRAWING NO. SLPS-4
REV. NO. A

4.2.2 General Arrangement

The general arrangement of the new facility is shown on Dwgs. TSPS-3 and TSPS-4. The existing superstructure will be demolished and replaced with a new 16.2 m long by 12.4 m wide by 7.0 m

The low lift raw water supply pumps will be vertical turbine units set into the inlet clearwell on the north side of the structure. The head tank located on the northwest corner of the building will be a prefabricated steel tank with a top water level of 350.0 m. Water from the head tank will be directed into a UV treatment header. This header will incorporate isolating valves, control valves, UV reactor and a chlorine feed connector. Treated water will then be directed into a treated water pump suction header. From the pump suction header, water will be pumped via one or more high lift pumps into the 400 mm diameter discharge header and into supply. The discharge header will incorporate a full bore magnetic flow element.

In parallel to the three large pumps, two small jockey pumps will be provided. The jockey pumps will be used to meet the far lower winter flow conditions.

The chlorination system will be provided as an on-site hypochlorite generation system and this will be installed in a separate room on the east side of the facility.

4.2.3 Low Lift Pump System

The low lift pump system will consist of three vertical turbine pumps set in the existing wet well. The pumps will have a duty point of approximately 60 L/s at 12 m TDH.

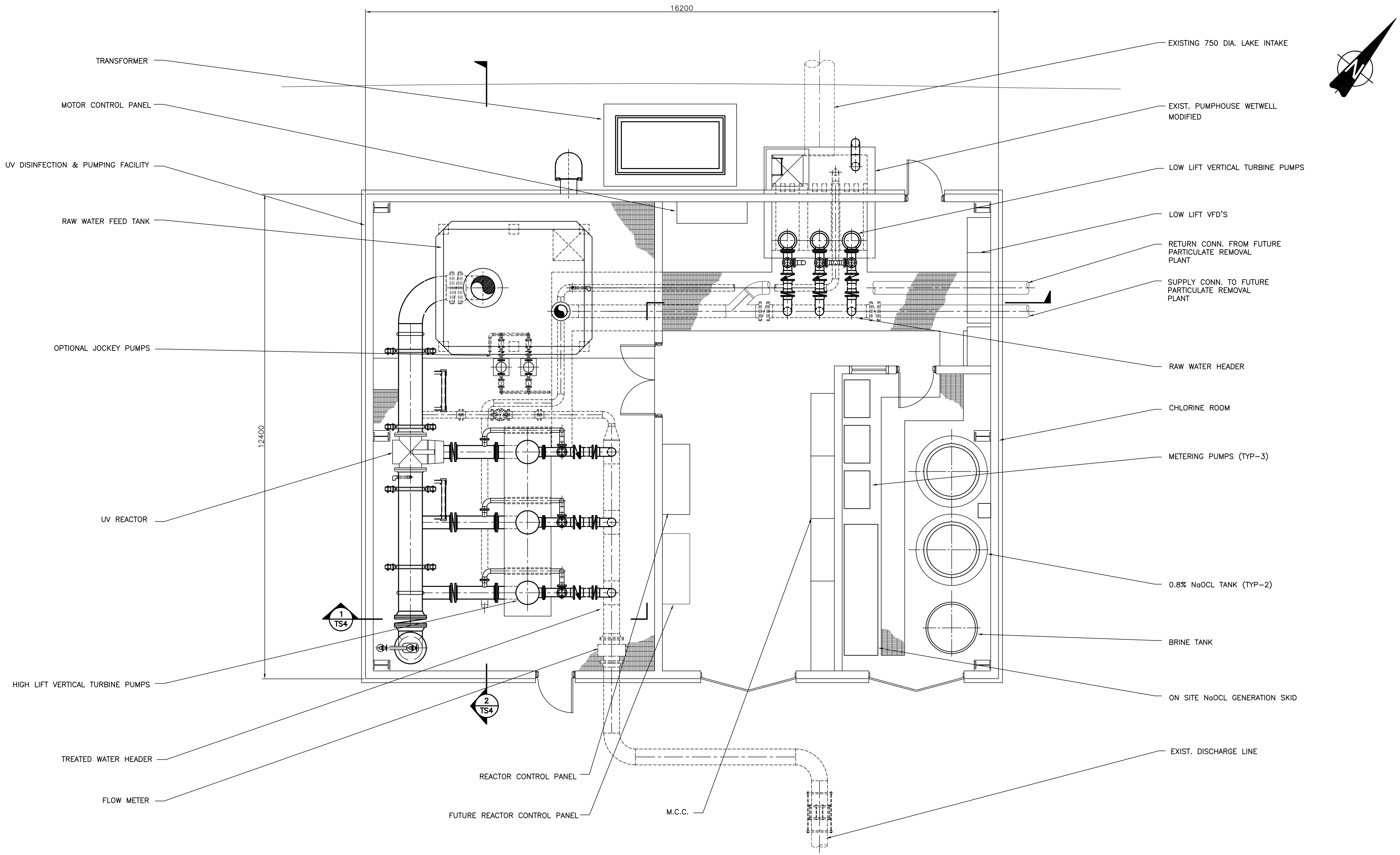
The low lift pumps will be typically 15 hp units and will be provided as VFD-driven variable speed units. The variable speed function is necessary to balance flows through the treatment system.

The low lift pumps will be provided with new piping and valving. New pump start-up bypass valves will also be provided.

4.2.4 High Lift Pump System

The high lift pump system will consist of three canned vertical turbine pumps with a duty point of approximately 50 L/s at 180 m TDH.

The high lift pumps will typically be 200 hp units and they will be provided as fixed speed units. It is intended that the high lift pump motors be water cooled and provided with soft-start drives. Providing water-cooled motors will greatly simplify the station ventilation requirements.



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NOTE:
1.0 LAYOUT BASED ON TROJAN 600mm DIAMETER REACTORS

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REGIONAL DISTRICT OF OKANAGAN SIMILKAMEEN

NARAMATA WATER SUPPLY IMPROVEMENTS
TOWN SITE PUMP STATION
PLAN

DIVISION
DIVISION

DRAWING NO.	REV. NO.
TSPS-3	A

The high lift pumps will be provided with check valves, isolation valves and start-up bypass valves. The start-up bypass valves will assist in minimizing hydraulic transients on pump start-up and stop.

The jockey pumps will be provided at a duty point of approximately 5 L/s at 220 m TDH. The exact capacity will be confirmed once hydraulic modelling is complete.

4.2.5 Structural

The structure has been designed to include a shallow (to minimize wet excavation) substructure supporting a 7.0 m high pre-engineered building superstructure.

The substructure will generally be 1.3 m below grade and will house the treated water piping. Although geotechnical investigation remains to be completed, it is assumed that it will be designed as a raft slab. The exterior walls will be cast monolithically with the base slab and designed to resist both hydrostatic and backfill pressures while supporting the superstructure. The centre of the substructure will incorporate four pump wells driven approximately 1.5 m below the base slab. These pumps wells will house the canned vertical turbine high lift pumps and will be the only portion of the new structure located below the lake water surface.

The superstructure will house all above grade piping, valving and equipment. A double door on the east side of the building will provide maintenance access. A personnel access door will be located on the west side of the structure.

To satisfy the open floor space for process requirements, we propose a galvanized steel frame structure to form the main load carrying system. Concrete block masonry walls will enclose the steel frames and provide a waterproof and thermal envelope for the building. The roof structure will incorporate purlins and metal decking to support gravity loads and provide resistance for lateral loads. Perimeter gutters will provide drainage for the roof.

In the building process area, galvanized grated platforms will provide access to the UV equipment and high lift pumps.

At the Townsite location we propose to provide an architectural design concept that complements the neighbourhood due to the high visibility of this structure. Further details of the architectural treatment will be provided in a later technical memorandum.

4.2.6 Electrical

An existing Fortis B.C. 3 phase, 12 kV line runs along First Street. The existing service is a 200 A, 600 V service. This service will have to be upgraded to approximately 800 A. A new pad-mount transformer would be provided by Fortis B.C. south of the new building.

The electrical service entry and all distribution panels and control panels will be located within the existing structure. Electrical distribution will be done utilizing Teck cable supported on an aluminium cable tray.

The requirements for standby power are being reviewed with the RDOS. As a minimum standby power will be provided to meet control and instrumentation needs and emergency building lighting.

4.2.7 Mechanical

An electrically fired supply air ventilation unit will distribute filtered heated air to the new building. The supply air unit will incorporate motorized outdoor/return and dampers that are modulated to maintain the humidity and temperature conditions within the building. A roof-mounted exhaust fan with two-speed control will be run to provide sufficient exhaust air to maintain a balance of outdoor air being introduced into the building at any given time. The controls will include programmable controller and night setback features.

To meet WCB requirements, the sodium hypochlorite room will be continuously ventilated at a minimum rate of three air changes per hour and 20 air changes per hour when occupied. To achieve this, the supply air ventilation system will include a two position motorized damper, filter section, supply fan and electric duct heater controlled by a room thermostat. An exhaust fan will remove air from the room at a higher rate to maintain a slight negative pressure within the room. An outdoor air inlet louvre complete with motorized damper and interlocked exhaust air fan will provide additional ventilation at the rate of 17 air changes per hour when the room is occupied.

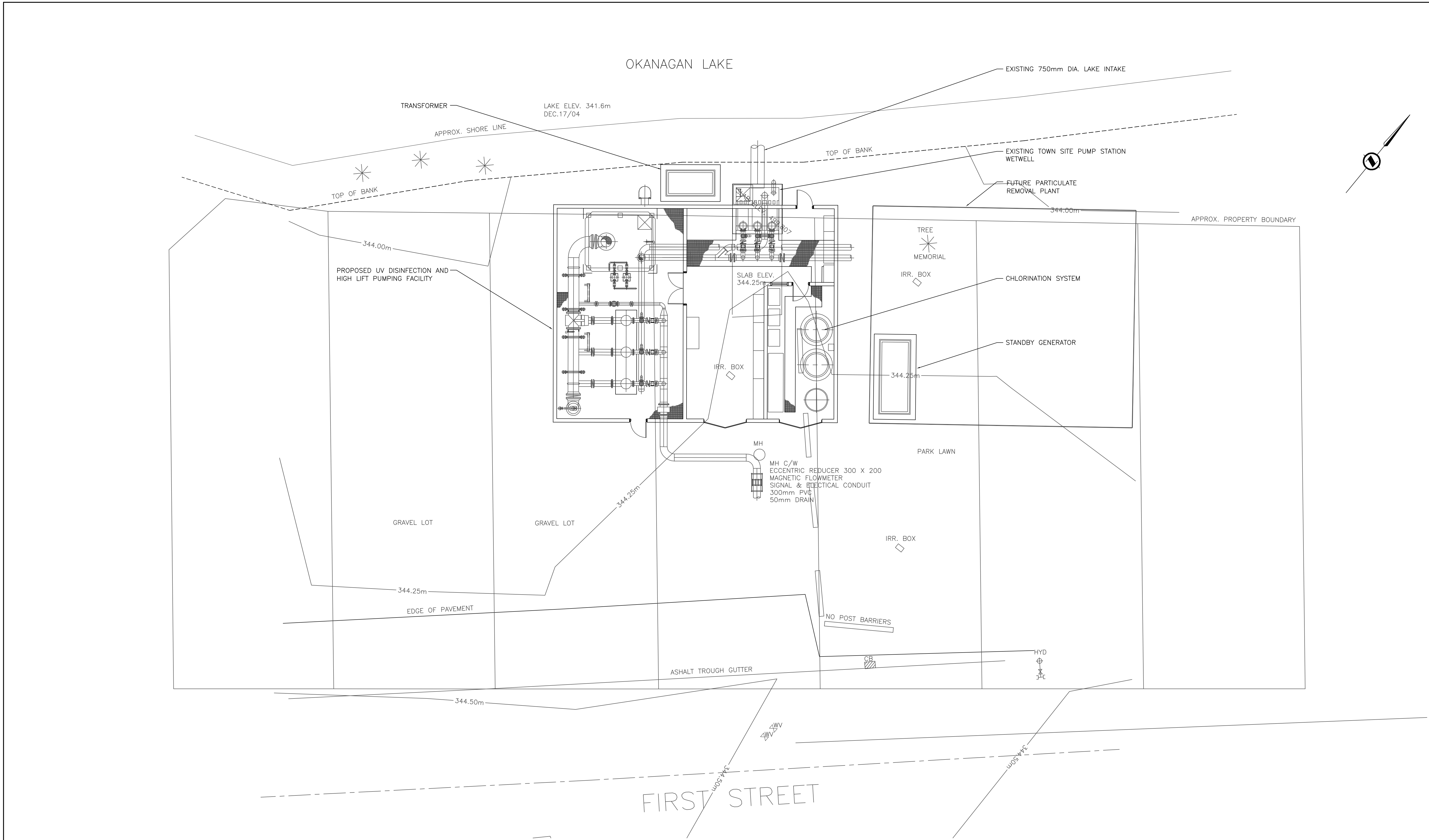
The ventilation for occupancy will be controlled by an on/off switch outside the room adjacent to the door.

5 Option 2

5.1 Townsite Raw Water Intake and Pump Station

5.1.1 Site Layout

At the Townsite facility, it is proposed to demolish the existing superstructure and construct a new building. The existing 750 mm intake pipe has the capacity to handle the entire combined water demands, however, the intake screen capacity will have to be increased. The existing clearwell substructure will be retained and the new superstructure will be used to house all pumping and water treatment equipment. The footprint shown on Dwg. No. TSRWPS-1 occupies the one lot occupied by the existing facility. The RDOS has the right



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REGIONAL DISTRICT OF OKANAGAN SIMILKAMEEN

NARAMATA WATER SYSTEM UPGRADE
TOWN SITE PUMP STATION
SITE PLAN

DIVISION: DIVISION

DRAWING NO.: TSPS-1 — REV. NO.: A

under the current right of way agreement to occupy the portion of this lot required for the pump station.

Grading of the site will be left basically unchanged from the existing site grades. We are assuming that the Contractor will utilize the area to the east of the station for laydown purposes during the construction period.

Yard piping will consist of the new treated water supply main to the existing distribution system. The only sanitary waste stream originating within this facility will be grey water generated from washdown of floors etc. It is proposed that this water be discharged to a soakaway pit.

Access to the site will continue to be provided from First Street to a gravelled parking area on the east side of the new structure.

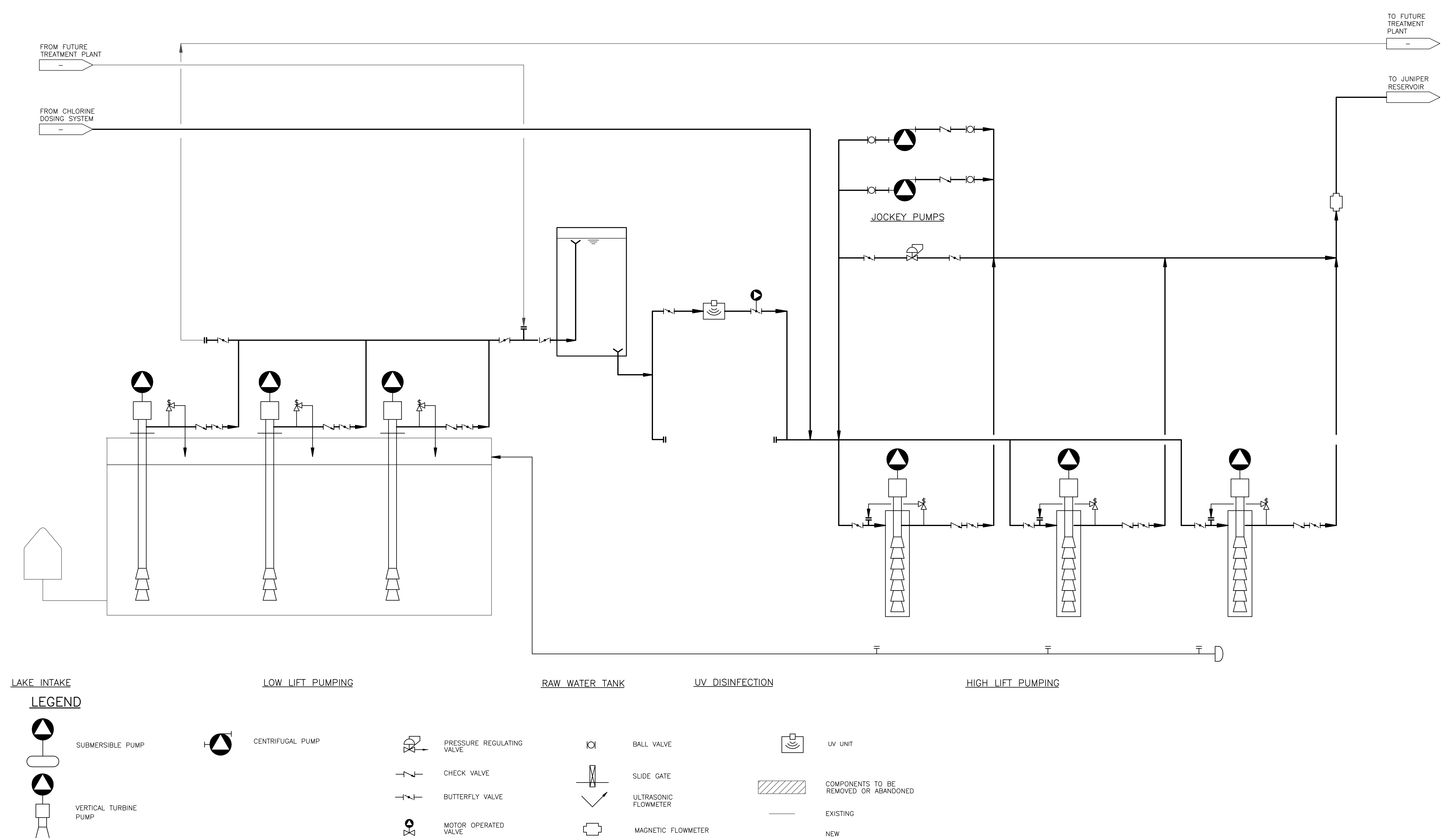
5.1.2 Intake

The existing ___ m long 750 mm intake is installed at a depth of __ m below normal lake level. The intake pipe has adequate capacity to convey the full maximum day demand for the entire system. However, the intake screen assembly will have to be upgraded due to screen capacity limitations. The simplest way to accomplish this would be through the provision of a second screen assembly. For this project a new screen assembly could be manufactured and installed adjacent to the existing screen. The other option would be to purchase an existing screen from the City of Kelowna. The City has two recently abandoned relatively new screens of suitable capacity that could be purchased and reused by the RDOS for the Naramata Water Supply Improvements project.

5.1.3 General Arrangement

The general arrangement of the new facility is shown on Dwg. TSRWPS-2. The existing superstructure will be demolished and replaced with a new 8.4 m long by 5.8 m wide by 4.0 m high building set over the existing clearwell and a new adjacent slab on grade.

The raw water supply pumps will be vertical turbine units set into the inlet clearwell on the north side of the structure. It should be noted that the existing clearwell is smaller than what would normally be designed for this capacity of station. The entrance bay is shorter than recommended by the Hydraulic Institute Standards. Also, the pump bays are small. While we believe that the proposed design is workable, this should be checked upon completion of construction. If problems occur, it should be extended toward the lake. From the clearwell, water will be pumped via one or more high lift pumps into the 400 mm diameter discharge header and into supply. The discharge header will incorporate a full bore magnetic flow element.



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REGIONAL DISTRICT OF OKANAGAN SIMILKAMEEN

NARAMATA WATER SUPPLY IMPROVEMENTS
TOWN SITE PUMP STATION
PROCESS FLOW DIAGRAM

DIVISION: DIVISION

DRAWING NO.: TSPS−2 | REV. NO.: A

5.1.4 Raw Water Pump System

The raw water pump system will consist of three vertical turbine pumps set in the existing wet well. The pumps will have a duty point of approximately 170 L/s at 92 m TDH. The exact capacity will be confirmed once hydraulic modelling is complete.

The pumps will be typically 300 hp units and will be provided as constant speed units. The raw water pumps will be provided with new piping and valving. New pump start-up bypass valves will also be provided.

5.1.5 Structural

The structure has been designed to utilize the existing clearwell modified to accommodate the new higher capacity pumps. The existing slab on grade will be demolished and replaced with a new 8.4 m by 5.8 m slab on grade. Although geotechnical investigation remains to be completed, it is assumed that it will be designed as a raft slab.

The superstructure will house all above grade piping, valving and equipment. A double door on the east side of the building will provide maintenance access. A personnel access door will be located on the west side of the structure.

To satisfy the open floor space for process requirements, we propose a galvanized steel frame structure to form the main load carrying system. Concrete block masonry walls will enclose the steel frames and provide a waterproof and thermal envelope for the building. The roof structure will incorporate purlins and metal decking to support gravity loads and provide resistance for lateral loads. Perimeter gutters will provide drainage for the roof.

At the Townsite location we propose to provide an architectural design concept that complements the neighbourhood due to the high visibility of this structure. Further details of the architectural treatment will be provided in a later technical memorandum.

5.1.6 Electrical

The existing 200 A, 600 V service will be replaced with a new 800 A 600 V service. A new pad-mount transformer would be provided by Fortis B.C. south of the new building.

The electrical service entry and all distribution panels and control panels will be located within the new structure. Electrical distribution will be done utilizing Teck cable supported on an aluminium cable tray.

The requirements for standby power are being reviewed with the RDOS. As a minimum standby power will be provided to allow operation of one raw water pump thereby allowing operation at 60% of existing max day demand and 50% of design max day demand.

5.1.7 Mechanical

An electrically fired supply air ventilation unit will distribute filtered heated air to the new building. The supply air unit will incorporate motorized outdoor/return and dampers that are modulated to maintain the humidity and temperature conditions within the building. A roof-mounted exhaust fan with two-speed control will be run to provide sufficient exhaust air to maintain a balance of outdoor air being introduced into the building at any given time. The controls will include programmable controller and night setback features.

5.2 McKay Road WTP and Pump Station

5.2.1 Site Layout

At the McKay Road Reservoir site it is proposed that a new structure housing the UV treatment process and high lift pumps will be provided on the north side of the reservoir structure. Refer to Dwg. MAWTPS-2.

By locating it on the north side, the east portion of the site can be utilized by the contractor as a laydown area during construction. The existing reservoir can also remain operational while the new structure is being constructed.

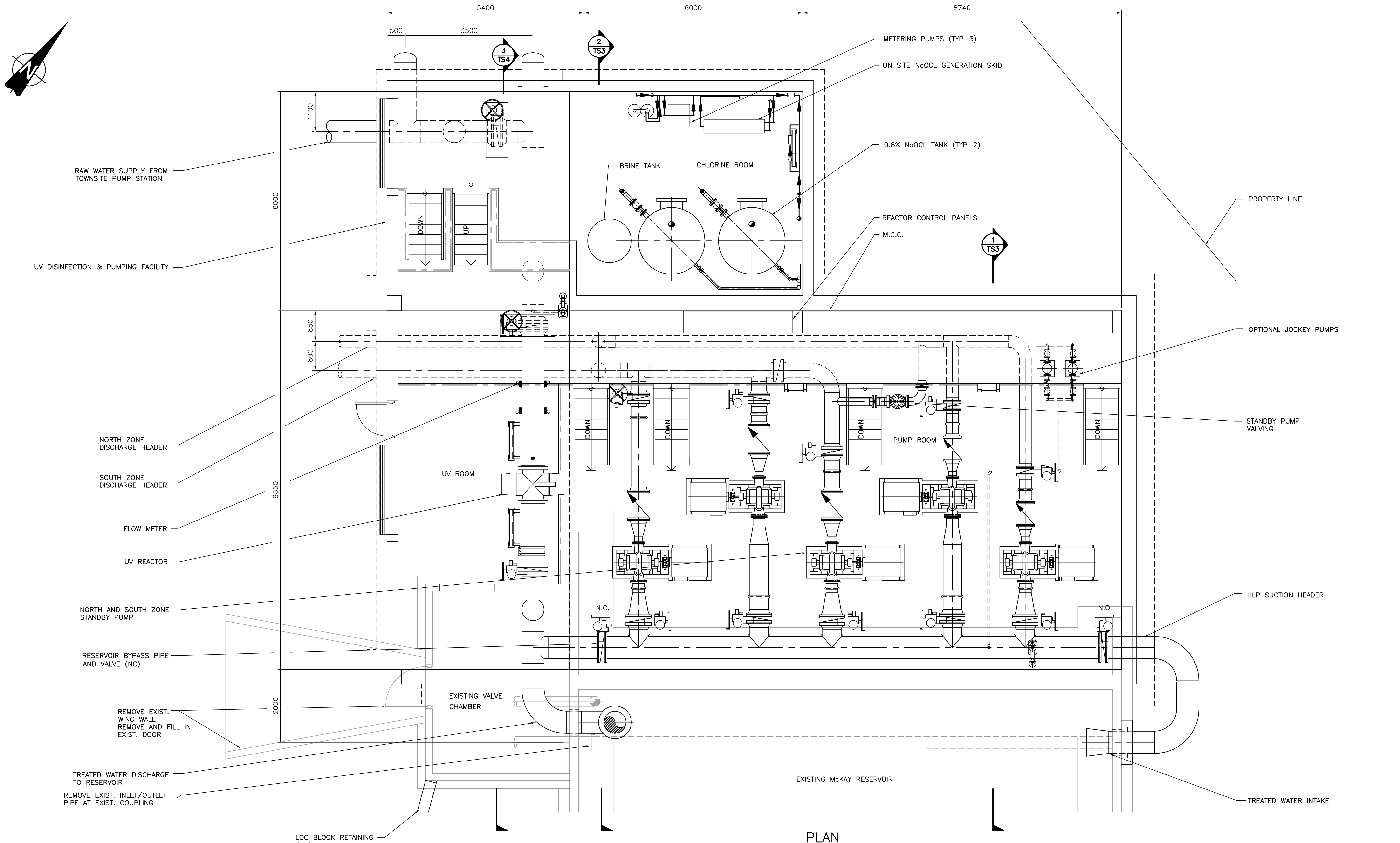
The standby generator will be installed on the south side of the existing reservoir when access to the laydown area is no longer required. A parking area will be developed in the southwest corner of the site.

The new structure will be partially buried in order to make the most efficient use of the existing site grading, however the roof will be left uncovered in order to allow roof hatches etc to allow removal of pumps and other equipment, if necessary.

5.2.2 General Arrangement

The general arrangement of the new facility is shown on Dwgs. MAWTPS-2, MAWTPS-3 and MAWTPS-4. A portion of the existing reservoir will be utilized for chlorine contact to supplement contact time in the treated water supply lines. Located in the area previously planned for Cell no. 2 of the McKay Reservoir. The new building will be approximately 18 m long by 16 m wide and 6 m high. The new building will house the UV equipment, chlorination equipment, high lift pumps and associated piping and valving.

Water from the Townsite Raw Water Pump Station will be directed into one of two UV treatment inlet headers. These headers will incorporate isolating valves, control valves, UV reactors and a chlorine feed connection each having the capacity to serve the full system demands. Treated water will then be directed into the existing reservoir. From the treated water reservoir, water will be pumped via one or more of the treated water high lift pumps into the 305 mm diameter North System Treated Water Supply Main and the 406 mm



PLAN
1:100

NOTE:
1.0 LAYOUT BASED ON TROJAN 600mm DIAMETER REACTORS

Associated Engineering
Suite 420
1628 Dickson Avenue
Kelowna, B.C., V1Y 9X1
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Fax: (250) 763-8880

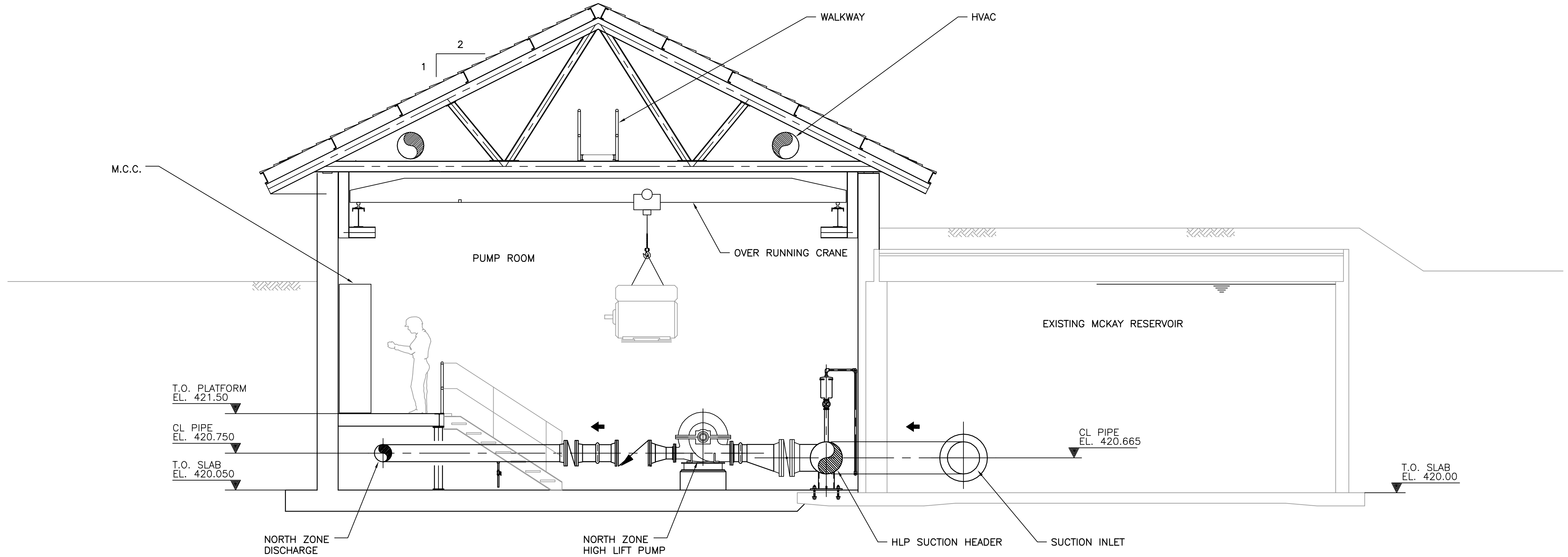
NO.	DATE	BY	REVISION	CH'KD
A	05/02/05	B.C.	FOR REVIEW	INIT

DRAWN	BC
DESIGN	SB
APPROVED	BH
DATE	APRIL. 2005
SCALE	1:100

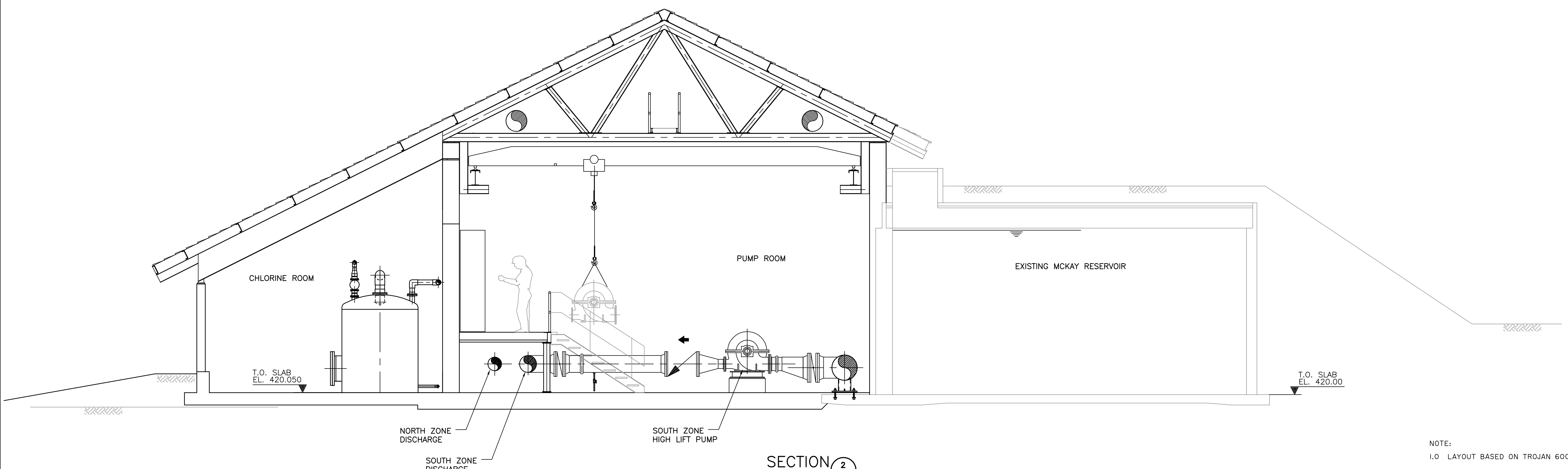
REGIONAL DISTRICT OF OKANAGAN SIMILKAMEEN

NARAMATA WATER SUPPLY IMPROVEMENTS
McKAY AVENUE WATER TREATMENT PLANT AND PUMP STATION
PLAN

DIVISION: DIVISION
DRAWING NO.: MAWTPS-2
REV. NO.: A



SECTION 1 / TS2
1:100



SECTION 2 / TS2
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NOTE:
1.0 LAYOUT BASED ON TROJAN 600mm DIAMETER REACTORS

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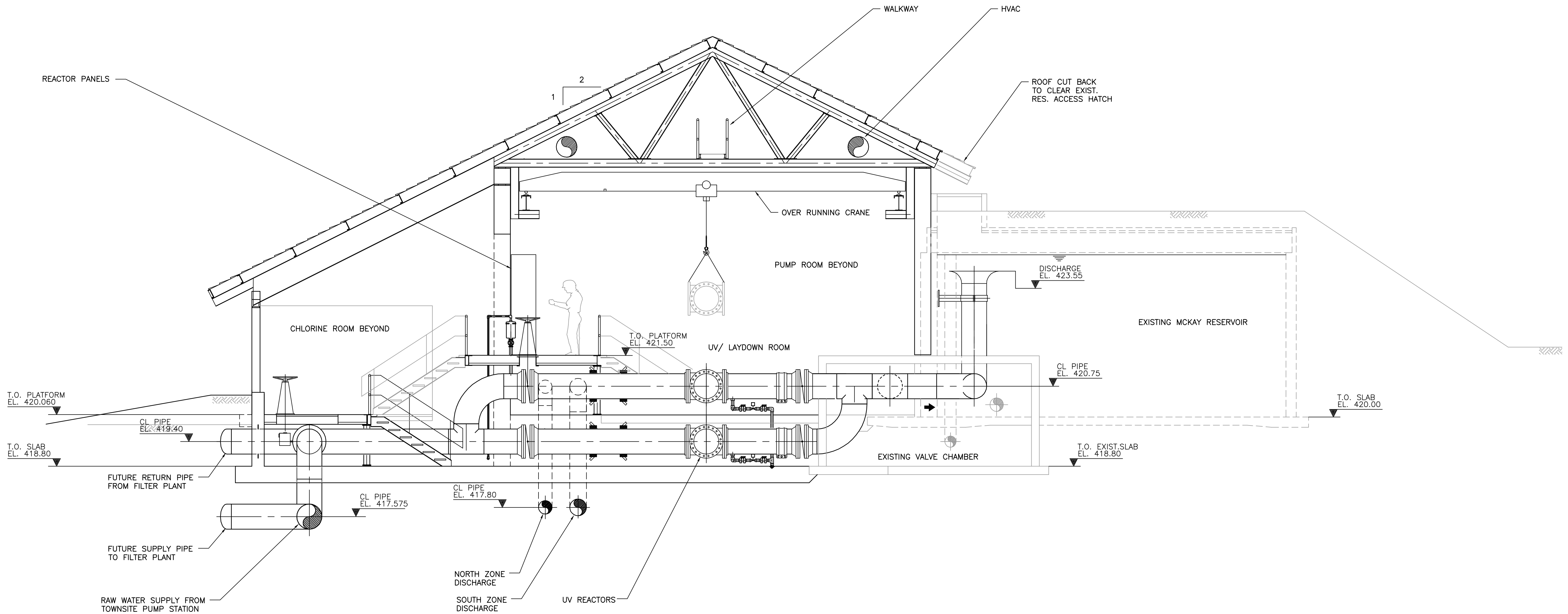
DESIGN	SB
APPROVED	BH
DATE	JAN. 2005
SCALE	1:100

REGIONAL DISTRICT OF
OKANAGAN SIMILKAMEEN

NARAMATA WATER SUPPLY IMPROVEMENTS
McKAY AVENUE WATER TREATMENT PLANT
AND PUMP STATION
SECTIONS

DIVISION
DIVISION

DRAWING NO. MAWTPS-3
REV. NO. A



SECTION 3/TS4
1:100

NOTE:
1.0 LAYOUT BASED ON TROJAN 600mm DIAMETER REACTORS

Associated Engineering
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1628 Dickson Avenue
Kelowna, B.C., V1Y 9X1
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NO.	DATE	BY	REVISION	CH'KD
A	05/02/05	B.C.	FOR REVIEW	INIT

DRAWN	BC
DESIGN	SB
APPROVED	BH
DATE	JAN. 2005
SCALE	1:100

REGIONAL DISTRICT OF
OKANAGAN SIMILKAMEEN

NARAMATA WATER SUPPLY IMPROVEMENTS
McKAY AVENUE WATER TREATMENT PLANT
AND PUMP STATION
SECTIONS

DIVISION: DIVISION

DRAWING NO.: MAWTPS-4 | REV. NO.: A

diameter South System Treated Water Supply Main. The existing 305mm reservoir inlet/outlet will be utilized to supply the Townsite area by gravity. Each discharge header will also incorporate a full bore magnetic flow element. The gravity Townsite supply header will also include a flow control valve to ensure that the supply rate doesn't exceed the maximum flow to meet CT requirements.

Consideration was given to providing lower capacity jockey pumps to meet the far lower winter flow conditions, however it was determined that due to the fact that the pumps would be supplying water to balancing reservoirs, jockey pumps would be unnecessary.

The chlorination system will be provided as an on-site hypochlorite generation system and this will be installed in a separate room on the north side of the facility. Refer to the enclosed drawing prepared by Chlortec showing a possible layout for the system.

5.2.3 North High Lift Pump System

The North high lift pump system will consist of two split case centrifugal pumps with a duty point of approximately 55 L/s at 100 m TDH. The exact capacity will be reconfirmed once hydraulic modelling is complete.

The high lift pumps will typically be 100 hp units and they will be provided as fixed speed units. It is intended that the high lift pump motors be water cooled and provided with soft-start drives. Providing water-cooled motors will greatly simplify the station ventilation requirements.

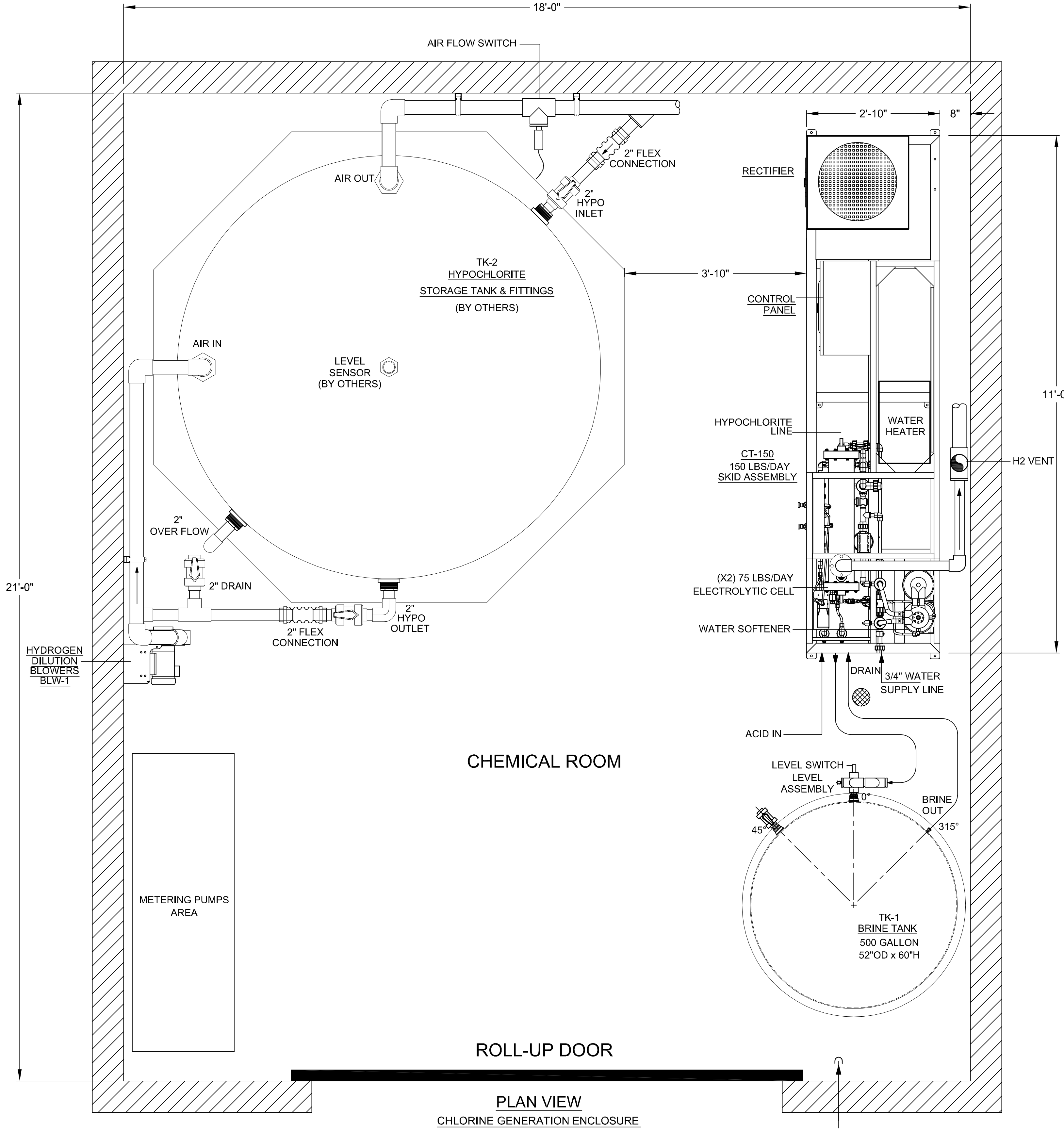
The high lift pumps will be provided with check valves, isolation valves and start-up bypass valves. The start-up bypass valves will assist in minimizing hydraulic transients on pump start-up and stop. Starting and stopping of the pumps will be controlled by level in the North Treated Water Reservoir.

5.2.4 South High Lift Pump System

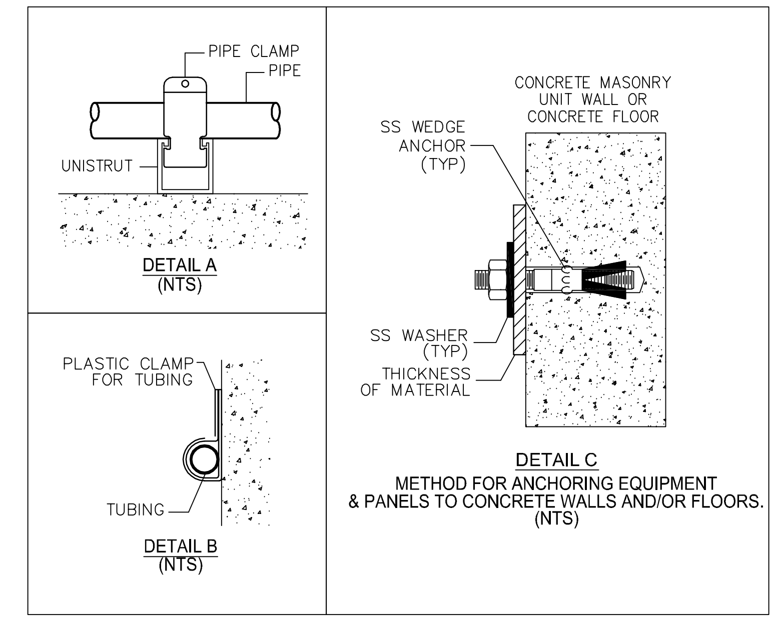
The South high lift pump system will consist of two operating and one redundant split case centrifugal pumps with a duty point of approximately 100 L/s at 130 m TDH. The redundant pump will have the capability of feeding either the North or South Systems by providing a pressure reducing valve on the discharge header between the two supply systems. The exact capacity will be reconfirmed once hydraulic modelling is complete.

The high lift pumps will typically be 250 hp units and they will be provided as fixed speed units. It is intended that the high lift pump motors be water cooled and provided with soft-start drives. Providing water-cooled motors will greatly simplify the station ventilation requirements.

REV	DATE	DESCRIPTION	DRAWN BY	CHECKED BY	APPROVED BY
1	05/11/05	ISSUED FOR INFORMATION	FJ		



PLAN VIEW
CHLORINE GENERATION ENCLOSURE
EQUIPMENT & PIPING LAYOUT
SCALE: 1" = 2'-8"



NOTE:

THE DIMENSIONS OF THIS HYPOCHLORITE GENERATION ROOM MIGHT NOT CORRESPOND TO FIELD CONDITIONS. THIS IS ONLY A REPRESENTATION OF THE SPACE REQUIRED TO ACCOMODATE A CT-150 AND THE ASSOCIATED COMPONENTS SPECIFIED FOR THIS PROJECT.

NOTES:

1. SEE PROCESS & INSTRUMENTATION DIAGRAM FOR PIPING MATERIAL, SIZES AND PIPING ROUTING.
2. ALL PIPING, FITTINGS & VALVES ARE PVC SCH. 80. ALL TUBING ARE BLACK POLYETHYLENE.
3. EXACT LOCATION OF EQUIPMENT AND INTERCONNECTING PIPING ROUTING MAY VARY DEPENDING ON FIELD CONDITIONS.
4. CLORTEC RECOMMENDS ADDING FLOOR DRAINS FOR THE CELLS, THE ANALYZER AND THE TANKS.
5. FLOOR UNDER THE BRINE TANK, STORAGE TANK, PUMP STAND AND THE HYPOCHLORITE GENERATOR SKID NEEDS TO BE LEVELED FOR PROPER INSTALLATION.
6. INSTALLATION IS DONE BY OTHERS.

PRELIMINARY

SEVERN TRENT SERVICES

CLORTEC

2660 COLUMBIA STREET TORRANCE, CA 90503
TELEPHONE No: (310)-618-9700 E-MAIL:
FAX No: (310)-618-1384 WEB SITE: www.severntrentservices.com

NARAMATA, BC

CT-150 (150 LBS/DAY)
ON-SITE HYPOCHLORITE GENERATION
EQUIPMENT & PIPING LAYOUT

UNLESS OTHERWISE NOTED
TOLERANCES:

TYPE:	INCHES	[MM]
FRACTIONS	± 1/8"	
.X	± .1"	± 2.5
.XX	± .02"	± .51
.XXX	± .005"	± .127
ANGLES	± 1°	

SCALE:	CLORTEC JOB No:	SIZE:	REV:
-		B	1

DWG No:	SHEET:	
F5-0798-C-ML-001	1	1

The high lift pumps will be provided with check valves, isolation valves and start-up bypass valves. The start-up bypass valves will assist in minimizing hydraulic transients on pump start-up and stop. Starting and stopping of the pumps will be controlled by level in the Juniper Reservoir.

5.2.5 Structural

The structure has been designed to have the base slab set at the same elevation as the existing reservoir. Although geotechnical investigation remains to be completed, it is assumed that it will be designed as a raft slab. The west and north exterior walls will be cast monolithically with the base slab and designed to resist both hydrostatic and backfill pressures while supporting the superstructure. The existing reservoir west wall will become the east wall of the new building. The south wall facing the road will be an architecturally treated masonry wall and will incorporate entry and maintenance doors.

The superstructure will house all piping, valving and equipment. A double door on the south side of the building will provide maintenance access. A personnel access door will also be located on the south side of the structure.

The roof structure will incorporate purlins and metal decking to support gravity loads and provide resistance for lateral loads. Perimeter gutters will provide drainage for the roof.

5.2.6 Electrical

A new 600 volt service will be required to provide electrical service to the site. It is assumed that a new pad mount transformer will be supplied by and remain the property of Fortis B.C. It will be sited in the northeast corner of the site as shown on Dwg. SLPS-1.

The electrical service entry and all distribution panels and control panels will be located within the existing structure. Electrical distribution will be done utilizing Teck cable supported on an aluminium cable tray.

The requirements for standby power are being reviewed with the RDOS. As a minimum, standby power will be provided to meet control and instrumentation needs and emergency building lighting.

5.2.7 Mechanical

An electrically fired supply air ventilation unit will distribute filtered heated air to the new building. The supply air unit will incorporate motorized outdoor/return and dampers that are modulated to maintain the humidity and temperature conditions within the building. A roof-mounted exhaust fan with two-speed control will be run to provide sufficient exhaust air to maintain a balance of outdoor air being introduced into the building at any given time. The controls will include programmable controller and night setback features.

To meet WCB requirements, the sodium hypochlorite room will be continuously ventilated at a minimum rate of three air changes per hour and 20 air changes per hour when occupied. To achieve this, the supply air ventilation system will include a two position motorized damper, filter section, supply fan and electric duct heater controlled by a room thermostat. An exhaust fan will remove air from the room at a higher rate to maintain a slight negative pressure within the room. An outdoor air inlet louvre complete with motorized damper and interlocked exhaust air fan will provide additional ventilation at the rate of 17 air changes per hour when the room is occupied.

The ventilation for occupancy will be controlled by an on/off switch outside the room adjacent to the door.

Prepared by:

Sean Bolongaro, P.Eng.
Design Lead

Reviewed by

W.J. (Bill) Harvey, P.Eng.
Project Manager

SB/BH/lp

Technical Memorandum No. 4

Regional District Of Okanagan-Similkameen

Narmata Water Supply Improvements

Scada System Predesign

May 2005

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TECHNICAL MEMORANDUM NO. 4

Naramata Water Supply Improvements
SCADA System Predesign

Issued: May 6, 2005
Previous Issue: February 25, 2005

1 Objective

The objective of this technical memorandum is to outline the preliminary design of the overall SCADA System and to enable the design, installation, and commissioning of an interim communication system between the South Lake Intake Pump Station and the Juniper Reservoir that will conform to the overall SCADA requirements.

2 Background

The Naramata water supply and distribution system has been developed over the past several decades to supply irrigation and domestic water demands. Upgrading of the system, including the controls components, has been done on a piecemeal basis. The proposed Water Supply Improvements Project provides the RDOS with the opportunity to implement an integrated SCADA system to serve the present and future needs of the community, and also improve system operational efficiency and responsiveness.

In February, the RDOS experienced a failure in its communication system between the South Lake Intake Pump Station and the Juniper Reservoir. This necessitated implementation of interim improvements to allow the system to continue to operate on an interim basis until the Water Supply Improvements Project is completed. It was agreed that these interim improvements should be planned and implemented to fit into the overall new SCADA system.

3 Control Systems Hardware

3.1 Existing Hardware

Some of the existing Naramata facilities use Modicon PLCs. These existing Modicon PLCs control the operation of the South Lake Pump Station and the Townsite Pump Station, as well as other facilities. Technical support is provided by Interior Instrument Tech Service Ltd. of Kelowna and service to date has been excellent.

3.2 Neighbouring Communities

Modicon PLCs are also used in Penticton. The City of Penticton is in the process of replacing older PLC types with Modicon Quantum PLCs. They also use the newer 'Concept' programming software for configuration of the PLCs.

The City of Kelowna also uses these Modicon PLC's. The City of Kelowna is in the process of upgrading their pump stations and installing UV equipment and, as part of that project, has specified new Quantum 140 CPU-434-12 PLC's.

3.3 SCADA Hardware

To take advantage of the nearby support and to be able to 'share' spare hardware we recommend using Modicon Quantum PLCs for the new pump station and UV facilities. We will request that the UV supplier and the on-site generation supplier use this line of PLCs to make them consistent and compatible with the SCADA and master PLCs. The master PLCs at the two upgraded facilities will be Modicon Quantum PLCs. The Quantum 140 CPU-434-12 will be specified.

The SCADA system operator interface software will be Wonderware. Naramata is familiar with this software and it is also used by the City of Penticton.

4 SCADA System

4.1 SCADA System Communication

The options for system communications include leased land lines, spread spectrum radio, and licensed radio communication. We recommend the SCADA system use licensed radio communication between the sites similar to neighbouring communities. Previous radio path studies have been done between some of the sites by Omega Communications. We have reviewed these studies and recommend that Omega Communications complete the studies required for the entire SCADA system once the SCADA sites have been confirmed.

4.2 Potential SCADA Sites

The following is a preliminary list of the potential SCADA sites:

1. South Lake Pump Station
2. Townsite Pump Station
3. Juniper Reservoir
4. Arawana Reservoir
5. Mackay Road Reservoir
6. South Creek Intake
7. North Creek Intake
8. Robinson Road Booster Pump Station

9. Booth Road Booster Pump Station
10. Juniper Pump Station
11. Public Works Building
12. North Reservoir (proposed)

The Robinson and Booth booster pump stations will no longer be required as part of the upgrading project, however, the PRV's will be retained. SCADA communication will therefore not be required at the sites. The South Creek Intake and North Creek Intake will be retained as backup facilities and the need for SCADA communication will be driven by budget availability. The above list does not include any allowance for future facilities required to serve future developments as these will be funded from future development cost charges. The most significant of these would be future Arawana Booster Station and higher elevation treated water reservoir.

5 SCADA System Implementation

5.1 Current Requirements

The communication between the South Lake Pump Station and Juniper Reservoir is no longer functioning. Before the upgrade of the two intake pump stations for the UV project, a SCADA/Communication system must be implemented to enable operation of the South Lake Pump Station with the Juniper Reservoir.

5.2 Interim SCADA System

An interim SCADA system is required that will fit into the overall Naramata future SCADA system. Direct radio communication between South Lake and Juniper is not possible due to the silt bluff near the pump station. Previous radio path surveys, by Omega Communications, indicated that it would be possible to communicate from South Lake to the Townsite Pump Station or the Public Works building and then to Juniper Reservoir. The Townsite Pump Station or the Public Works Building could be a repeater station for the communication between South Lake and Juniper.

Again, as outlined in the attached summarized pump station project notes, the existing Townsite Pump Station superstructure will be demolished for the upgrade project. This location therefore would not be a good location for the repeater before the upgrade work. We recommend that a repeater station be located at the Public Works Building for the interim communication between the South Lake Pump Station and Juniper Reservoir.

5.3 South Lake Pump Station

A SCADA PLC is required for the interim communication with Juniper Reservoir and a SCADA master PLC is eventually required for the pump station and UV project. We propose that the station master PLC be installed in the existing station to serve, in the interim, as a communications means to Juniper Reservoir, and in the future as the station master PLC. In this manner the SCADA and master PLC of the upgrade project will be ready for use.

The exact location of the master PLC control panel for the station needs further consideration along with the upgrade project requirements. If the project proceeds on the basis of Upgrade Option 2, this PLC may be relocated to the McKay Road site and replaced with a small PLC.

Minimum requirements for the master PLC are:

- One PLC CPU P/N 140CPU-434-12
- Modbus Plus communication with other control PLCs.
- Ethernet communication to an 8 port Ethernet switch (included in control panel)
- Two 32 pt 120 VAC Digital Input Modules
- Two 16 pt Isolated Digital Output Modules
- One 16 pt 4-20 mA Analog Input Module
- One 8 pt 4-20 mA Analog Output Module
- One Ethernet Licensed Frequency Radio and Antenna

In the future the facility will contain an Operator Interface; however, that is not proposed as part of this interim upgrade.

5.4 Public Works Building

Repeater radios and antenna will be installed at the Public Works Building. In the future this installation may remain or be used at the Townsite Pump Station. In any event the Public Works Building, in the future, will contain a PC for monitoring the whole SCADA system.

5.5 Juniper Reservoir

A radio will be added at the Juniper Reservoir to communicate the Reservoir Level from the existing PLC to the South Lake Pump Station through the Public Works radio repeater. It the existing PLC is not compatible it will be replaced.

6 Interim Upgrading Implementation

The interim requirements are:

.1 Make a request for and provide a licensed radio frequency for Naramata.
.2 Design an interim SCADA system.
.3 Fabricate the pump station control panel and other communication components required.
.4 Install, test, and commission the interim SCADA system so that the South Lake Pump Station can again be controlled by the level in the Juniper Reservoir.
.5 Coordinate this work with the pump stations design upgrade project and the overall SCADA system improvements.

There is some urgency in getting this work underway as the South Creek Intake water supply will soon not be a suitable source of water for the Naramata distribution system.

We therefore propose to request a quotation to undertake this work from IITS and one other reputable local supplier/integrater. IITS, through their past involvement, is familiar with the sites in Naramata and can immediately proceed with the procurement, design, and fabrication of the interim SCADA system.

7 Overall SCADA System Upgrading Implementation

7.1 System Requirements

The overall SCADA System upgrading will follow from the standards established for the interm upgrade as described in preceding sections. As part of the overall Water Supply Improvements Project the remainder of the system will be developed to include the following additional sites:

Upgrade Option 1

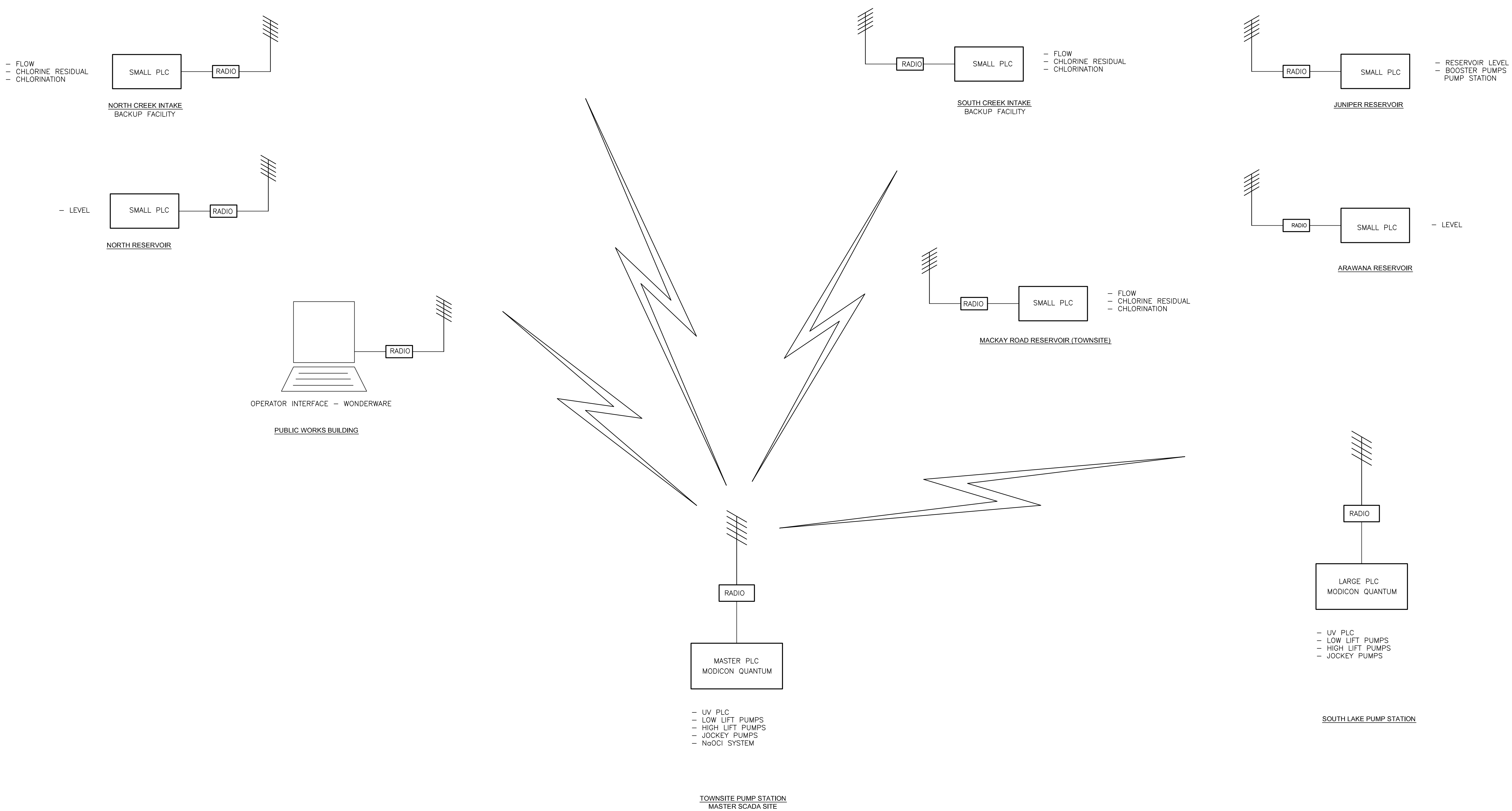
- Townsite Pump Station – Master PLC
- McKay Reservoir – Small PLC
- Juniper Reservoir – Small PLC
- Arawana Reservoir – Small PLC
- North Reservoir – Small PLC

The proposed system for Upgrade Option 1 is shown on Dwg. No. SCA –1.

Upgrade Option 2

- Townsite Raw Water Pump Station – Small PLC
- McKay Road Water Treatment Plant – Master PLC
- Juniper Reservoir – Small PLC
- Arawana Reservoir – Small PLC
- North Reservoir – Small PLC

The proposed system for Upgrade Option 2 is shown on Dwg. No. SCA-2.



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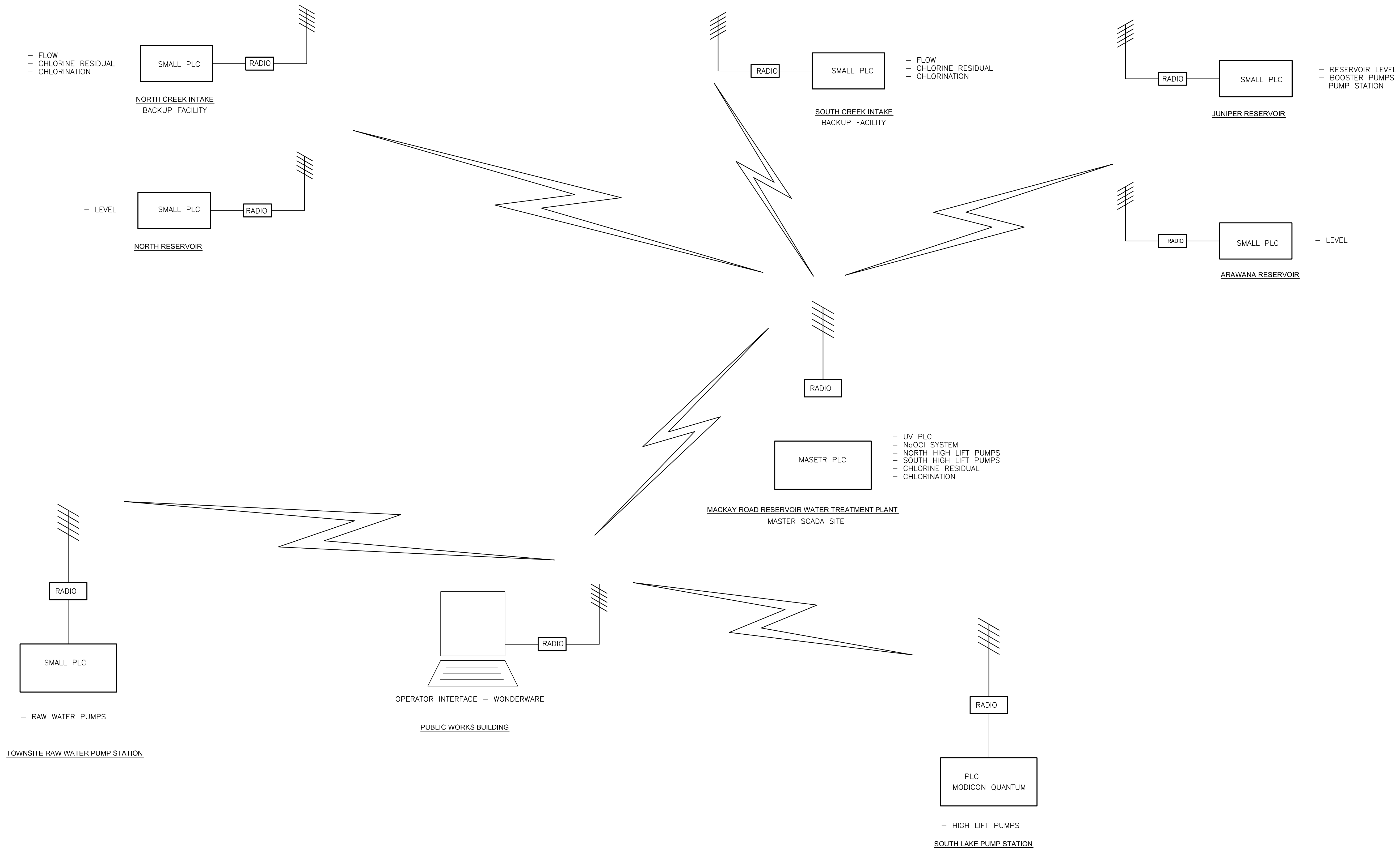
NO.	DATE	BY	REVISION	CH'KD
B	05/09/05	ARM	CLIENT REVIEW	SB
A	02/22/05	ARM	PRE DESIGN	SB

DRAWN	ARM
DESIGN	ML
APPROVED	
DATE	MAY 2005
SCALE	N.S.

REGIONAL DISTRICT OF OKANAGAN SIMILKAMEEN

NARAMATA WATER SUPPLY IMPROVEMENTS
SCADA SYSTEM BLOCK DIAGRAM
OPTION 1

DIVISION	
042629	
DRAWING NO.	REV. NO.
SCA—	1A



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Associated Engineering

NO.	DATE	BY	REVISION	CH'KD
B	05/09/05	ARM	CLIENT REVIEW	SB
A	02/22/05	ARM	PRE DESIGN	SB

DRAWN	ARM
DESIGN	ML
APPROVED	
DATE	MAY 2005
SCALE	N.S.

REGIONAL DISTRICT OF OKANAGAN SIMILKAMEEN

NARAMATA WATER SUPPLY IMPROVEMENTS
SCADA SYSTEM BLOCK DIAGRAM
OPTION 2

DIVISION	
042629	
DRAWING NO.	REV. NO.
SCA–2	A

7.2 System Implementation

Numerous options exist for implementation of the system, however; the simplest from a risk perspective is to include the work as part of the overall water supply system construction contract. The contractor will therefore be responsible for installation and energization of hardware. PLC programming responsibility should be assigned to either the design consultant or a programming specialist selected by the RDOS. This decision will be made during detail design.

Prepared by:	Reviewed by
Mario Laurin, P.Eng. Instrumentation and Controls	W.J. (Bill) Harvey, P.Eng. Project Manager

ML/BH/lp

Technical Memorandum No. 5

Regional District of Okanagan-Similkameen

Naramata Water Supply Improvements

Treated Water Storage

May 2005

Table of Contents

SECTION		PAGE NO.
Table of Contents		**i**
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2.2	Capacity	2
2.3	Design Criteria	2
2.4	Siting	3
2.5	Tank Materials and General Arrangement	3
2.6	Tank Access	3
2.7	Piping and Controls	4

Naramata Water Supply Improvements
Treated Water Reservoirs

Issued: May 6, 2005
Previous: February 23, 2005

1 Objective

The objective of this technical memorandum is to confirm the preliminary design of the new treated water storage facilities including design criteria, siting, materials of construction, geometry, and piping requirements.

2 North Reservoir

2.1 Description

The North Reservoir is required to provide balancing storage for the north portion of the water system, which operates at a HGL of 515m. Beyond providing balancing storage for the North System, the North Reservoir water level will be used to control the treated water pumps supplying the North System. It will also be used to augment fire flows to the Townsite area.

2.2 Capacity

Technical Memorandum No. 1 confirms the capacity requirements for the reservoir. During the initial draft of this Technical Memorandum it was assumed that a capacity of 900,000 Litres was required. During the Preliminary Design Workshop it was determined that the design flows would be significantly reduced. The revised capacity as confirmed in the April 2005 issue of Technical Memorandum No. 1 is still 900,000 Litres because of a significant storage shortfall on the North and Townsite systems.

2.3 Design Criteria

The North Reservoir is to be designed to meet the following design criteria:

- Top Water Level – 515 m
- Seismic Design – NBCC
- Seismic Zone – Za & Zv = 1, v = .05
- Wind Load q100 – 0.68 kPa
- Roof Snow Load – Ss = 1.9 kPa, Sr = 0.3 kPa
- Freeboard – 0.5 m
- Maximum Outflow – 90 L/s

2.4 Siting

Two alternatives have been considered for the reservoir siting. One alternative involves siting the reservoir on the slope east of Naramata Road and Hook Place. The final site selection would be dependant on land acquisition, however; for the purpose of the evaluation it has been assumed that the structure will be constructed on a side slope at an elevation of approximately 505 to 510 metres. During the Preliminary Design Workshop, RDOS staff expressed concern about this siting due to land acquisition issues and requested that an alternative be developed based on a site adjacent to the North Intake.

2.5 Tank Materials and General Arrangement

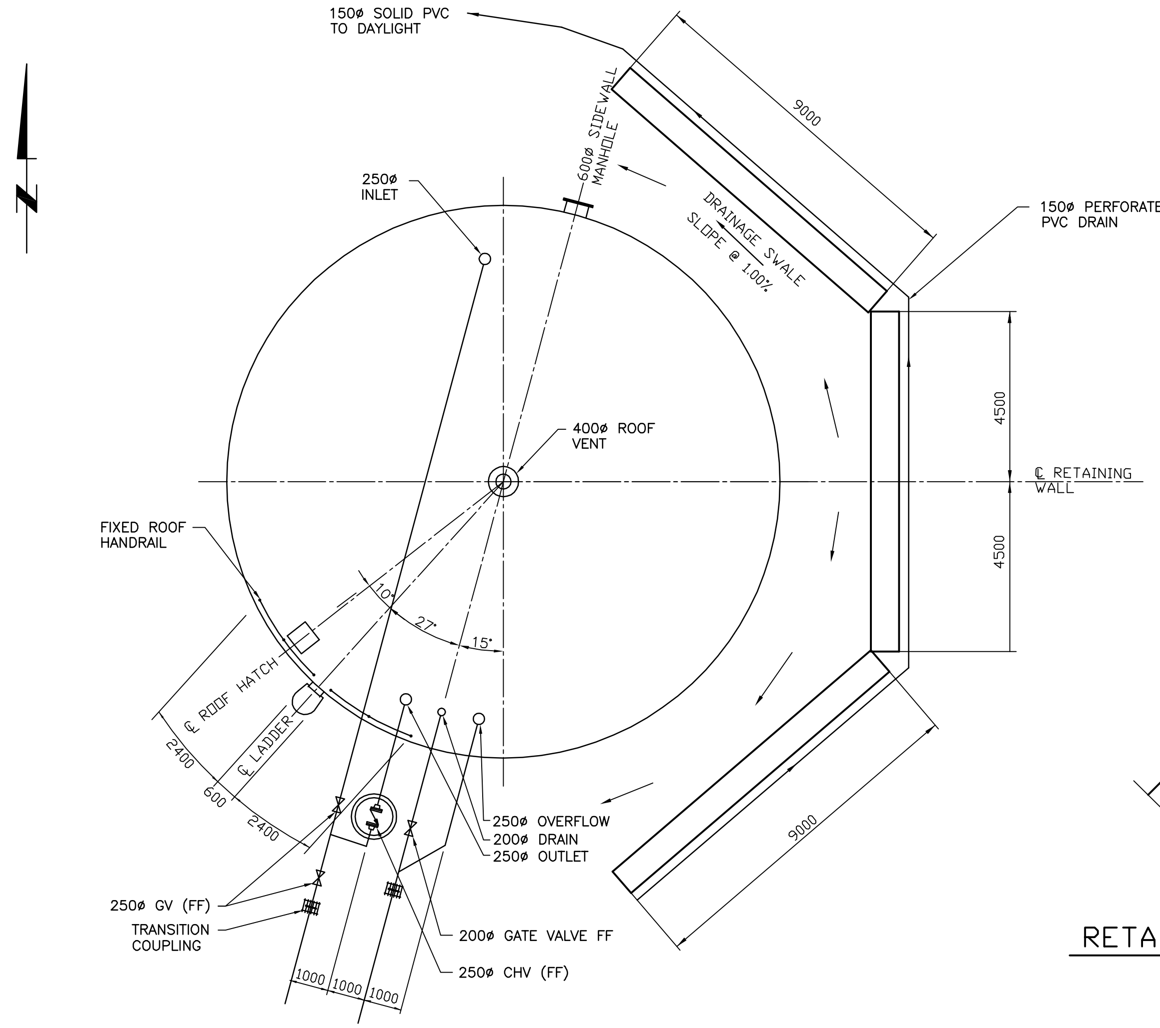
Tanks in this size range can either be constructed of reinforced concrete (1or 2 cells) or bolted or welded steel. The most economical of these alternatives in this size range is bolted steel. AWWA Standard D-103 covers bolted steel tank design. Steel tanks are made of plates with factory-applied coatings and bolted construction. The tanks are assembled on site and placed on a reinforced concrete base.

Two options exist for tank coatings glass fused or epoxy. Both systems have their merits, however; we have had good success with epoxy coatings and recommend this approach. Bolts for the tanks are galvanized with the heads nylon copped for erosion protection on the interior of the tank. Repairs to the lining are done with epoxy touch-up paint. Exterior touch-up paints would match the shop applied exterior coating. For the exterior coating we would recommend the optional zinc-rich primer/epoxy/urethane, four-coat system if the tank is un-insulated. Due to the fact that it will be an above ground structure we are proposing that it be provided with RSI 3.5 Styrofoam insulation overlay by a prefinished metal cladding. The proposed general arrangement of the structure (based on 900,000 litres capacity) is shown in Drawing No. NRES-1.

During the Preliminary Design Workshop, the RDOS staff expressed a concern about the use of bolted steel tankage. They indicated that the RDOS was prepared to pay a cost premium for using reinforced concrete. A proposed general arrangement for the reinforced concrete option (based on 900,000 litres capacity) is shown on Drawing No. NRES-2.

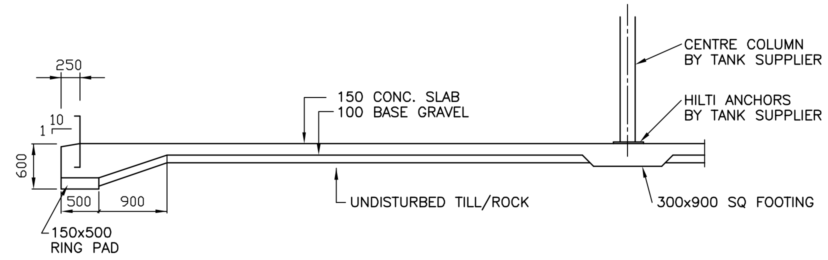
2.6 Tank Access

For the bolted steel option, we are proposing that an external ladder with a lockable cage be provided. The ladder will begin 2.5 m above grade and will provide access to the roof hatch. A 610mm diameter roof manhole with hinged cover would be provided on the roof. A perimeter railing is proposed on the roof of the tank for safety purposes. In addition to the roof access a 610mm diameter wall manhole with bolt-on hinged cover is proposed for the base of the tank to provide access for cleaning purposes.



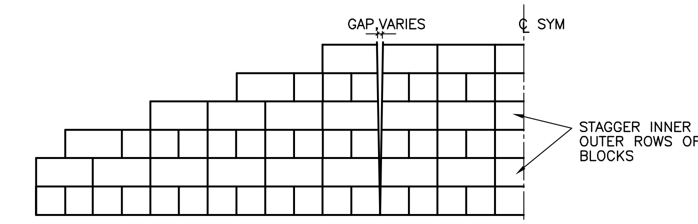
RESERVOIR PLAN

1:100



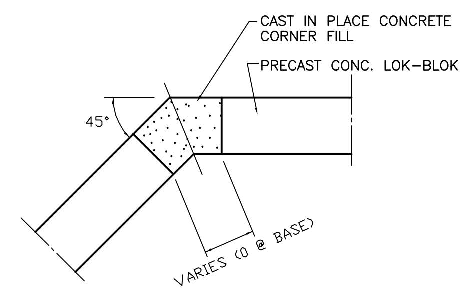
TYPICAL RESERVOIR BASE DETAIL

NTS



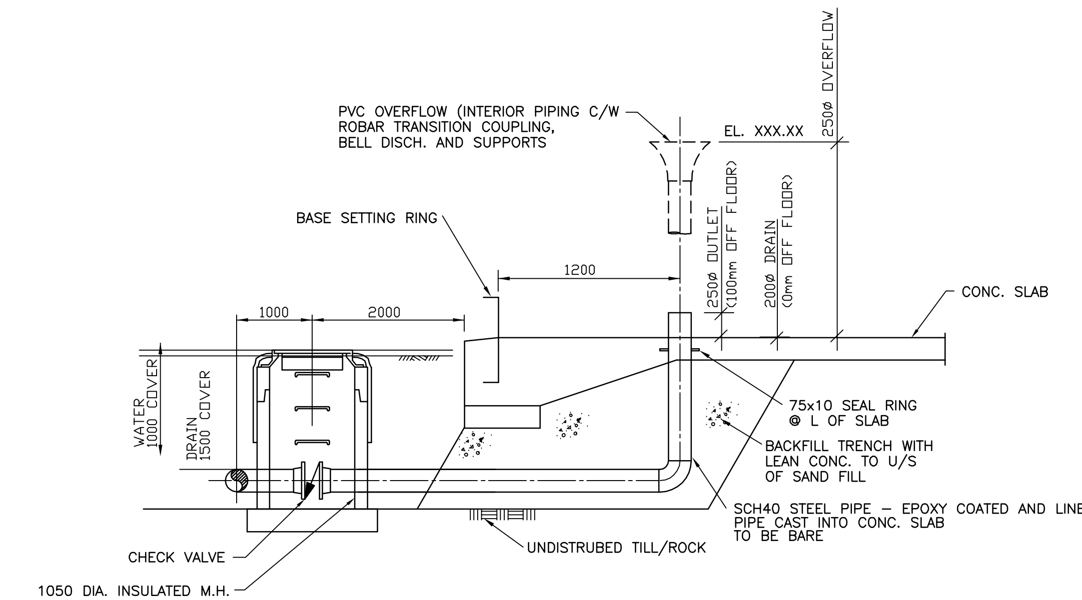
PART ELEVATION OF RETAINING WALL

NTS



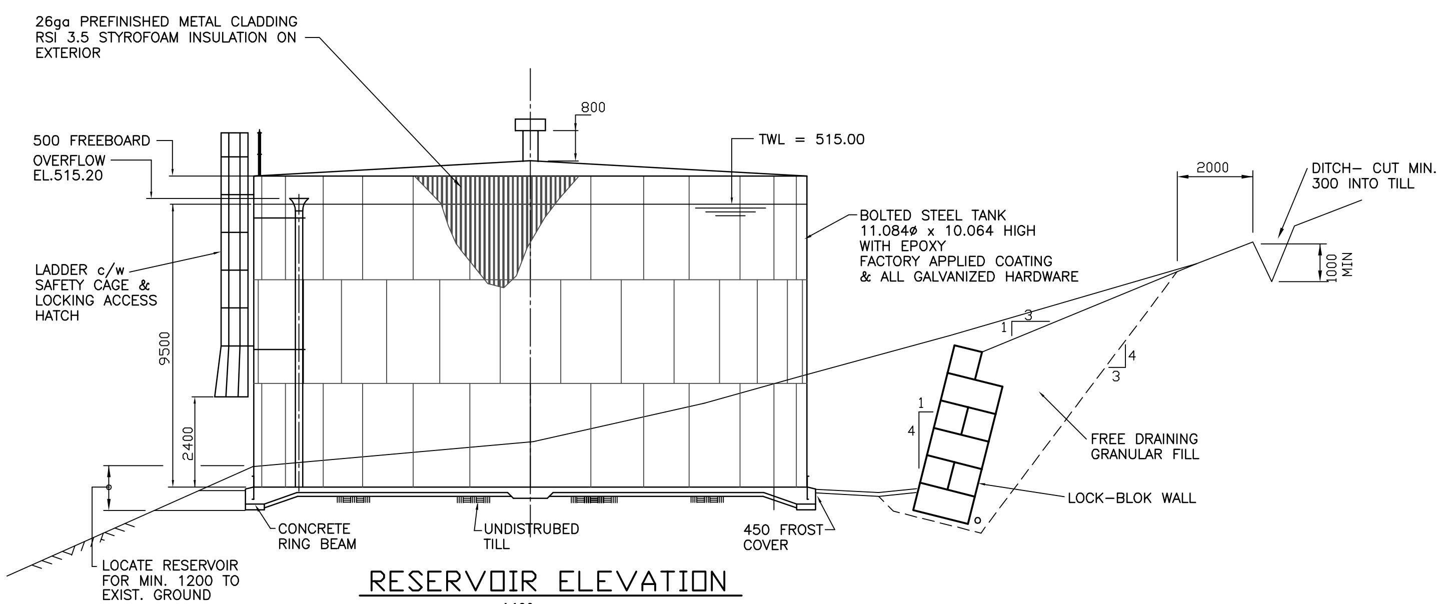
RETAINING WALL CORNER DETAIL

NTS



OUTLET PIPING DETAIL

NTS



RESERVOIR ELEVATION

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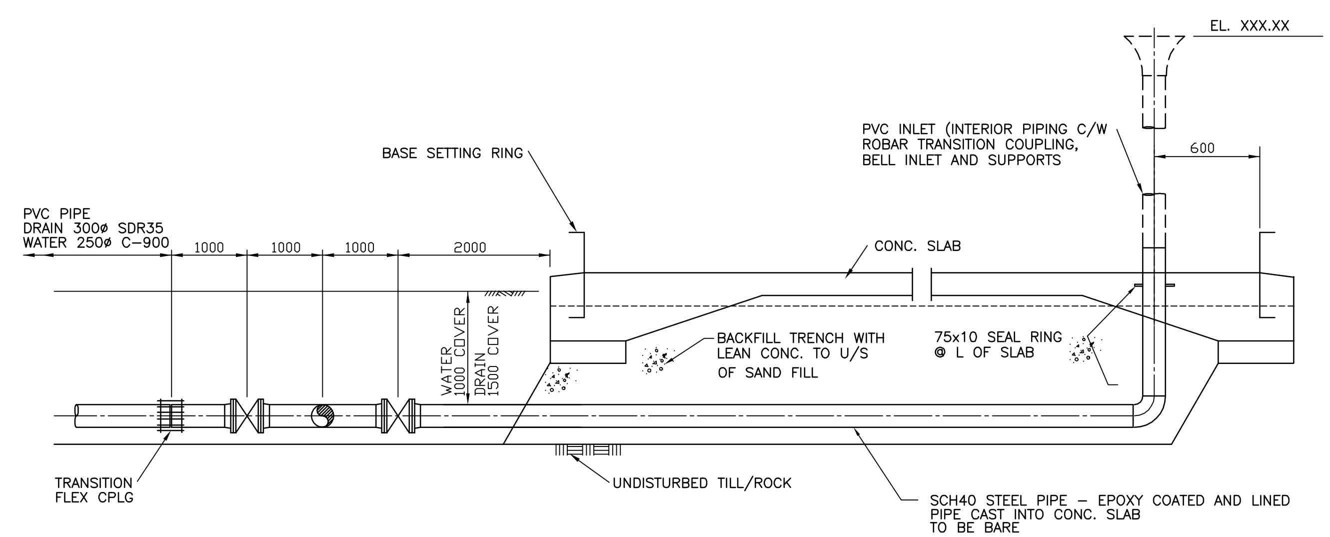

INLET PIPING DETAIL

NTS

R.D.O.S. Engineering Services

Associated Engineering

Suite 420
1628 Dickson Avenue
Kelowna, B.C., V1Y 9X1
Tel: (250) 763-3638
Fax: (250) 763-8880

NO.	DATE	BY	REVISION	CH'KD
A	02/25/05	B.C.	PREDESIGN	BH

DRAWN	BC
DESIGN	BH
APPROVED	BH
DATE	FEB. 2005
SCALE	1:100

REGIONAL DISTRICT OF
OKANAGAN SIMILKAMEEN

NARAMATA WATER SUPPLY IMPROVEMENTS
NORTH RESERVOIR
PLAN – ELEVATION AND DETAILS

DIVISION	
042629	
DRAWING NO.	REV. NO.
NRES-1	A

For the reinforced concrete option, we are proposing that the structure be buried on the side slope of the access road to the North Intake. An access hatch will be provided for access from the roof and an internal ladder provided for access.

2.7 Piping and Controls

Separate 250mm diameter inlet and outlet pipes are proposed in addition to a 250mm diameter overflow and 100mm diameter drain. The inlet pipe will rise to the tank top water level while the outlet pipe will be provided at the base of the tank and equipped with a check valve to ensure single direction flow. These separate inlet/outlet pipes will ensure better water circulation within the tanks and minimize the potential for water stagnation. An ultrasonic level transmitter will be provided for level control purposes. The local RTU will be provided in an enclosed part near the base of the tank to provide level signals to the Master Control Station.

Prepared by

Reviewed by

W.J. (Bill) Harvey, P.Eng.
Project Manager

Technical Memorandum No. 6

Regional District of Okanagan-Simikameen

Naramata Water Supply Improvements

Watermains and System Deficiency Upgrades

April 2005

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Appendix A - Proposed Watermain Alignment - Photos		

TECHNICAL MEMORANDUM NO. 6

Naramata Water Supply Improvements
Watermains and System Deficiency Upgrades

Issued: April 29, 2005
Previous: February 24, 2005

1 Objective

The objective of this technical memorandum is to confirm requirements for watermains and deficiency upgrades.

2 Supply Pipelines

2.1 Option 1

In Technical Memorandum No. 1, under Option 1, the need for a new high pressure supply main was identified. The proposed main would be 356mm diameter and two alternative alignments were proposed in that Technical Memorandum. One option included aligning the new main from the Townsite Pump Station and UV Facility along First Street, Anna Avenue, Mill Road, Gladys Avenue, Rosebud Avenue and Boothe Road to a tie-in on the existing 254mm main west of Partridge Road. The other option involved aligning the new main along First Street, Anna Avenue, Fourth Street, and Robinson Avenue to the existing Robinson Booster/PRV near Salting Road. A 305mm main would be extended from Robinson along Salting Road to a tie-in with the existing 254mm main west of Partridge Road. For the purpose of this report we have assumed the Boothe Road option due to the fact that it is less expensive and would assure less disruption in the Townsite area.

The main would be specified as a Class 52 Ductile Iron main with cement mortar lining and polyethylene encasement. It would be rated for an operating pressure of 2100 kPa.

With the new high pressure main in place, the Boothe and Robinson Booster pumps will be permanently abandoned but the existing PRV's left operational to allow backfeeding to the Townsite 424m pressure zone from 515m pressure zone during emergency operating conditions.

2.2 Option 2

In Technical Memorandum No. 1, under Option 2, the need for a new 610mm raw water supply main as well as treated water supply mains supplying water to the North and South Distribution Systems was identified.

The proposed alignment for the 610mm raw water supply main is shown on drawing WM-1. This pipe will be specified as AWWA C905 Class 200 PVC pipe. The proposed supply main alignment has been selected with a view to minimizing disruption of existing roads while utilizing existing road rights of way to the extent practical. It's alignment follows First Street, Robinson Avenue, Second Street, the lane west of Robinson Avenue, Fourth Street, Ritchie Avenue, Eighth Street, Sherwood Place, Robinson Avenue, the unused McKay Avenue right of way and McKay Avenue to the proposed water treatment plant site. There is an existing lane which parallels Robinson Avenue from Second Street to Eighth Street however from Fourth Street to Eighth Street the backyards of several residences encroach it, therefore for this portion of the pipe alignment we have shown it following Ritchie Avenue. The least expensive option would be to follow the undeveloped lane where asphalt resurfacing would not be required. We also note that a portion of the alignment on the undeveloped McKay Road right of way follows a trail up a steep bank which will require geotechnical review. Should the geotechnical investigation reveal potential problems an alternate alignment has been shown on drawing WM-1 following Eighth Street, Patterson Road, Bartlett Road, Lower Debeck Road and McKay Road. This alignment is longer than the proposed alignment and would therefore be more costly if geotechnical issues don't exist on the preferred alignment.

The North System Treated Water Supply Main is proposed to be a 305mm Class 51 ductile iron main aligned in a common trench with the Raw Water Supply Main along McKay Road and Robinson Avenue to Salting Road. The portion along Salting Road to the 254mm tie-in is proposed to be a 254mm Class 51 ductile iron main. An additional tie-in will be provided at Bartlett Road to allow this system to backfeed the Townsite system through the Bartlett PRV under a fire demand condition. No tie-ins will be allowed upstream of this location to ensure that the CT criteria are met.

The South System Treated Water Supply Main is proposed to be a 406mm AWWA C905 Class 200 PVC main. It will be aligned along McKay Road, Lower Debeck Road, Naramata Road, and Arawana Road to a tie-in to the existing 305mm main at Gammon Road. An additional tie-in will be made to the existing 152mm main on Naramata Road. No tie-ins will be allowed upstream of this location to ensure the CT criteria are met.

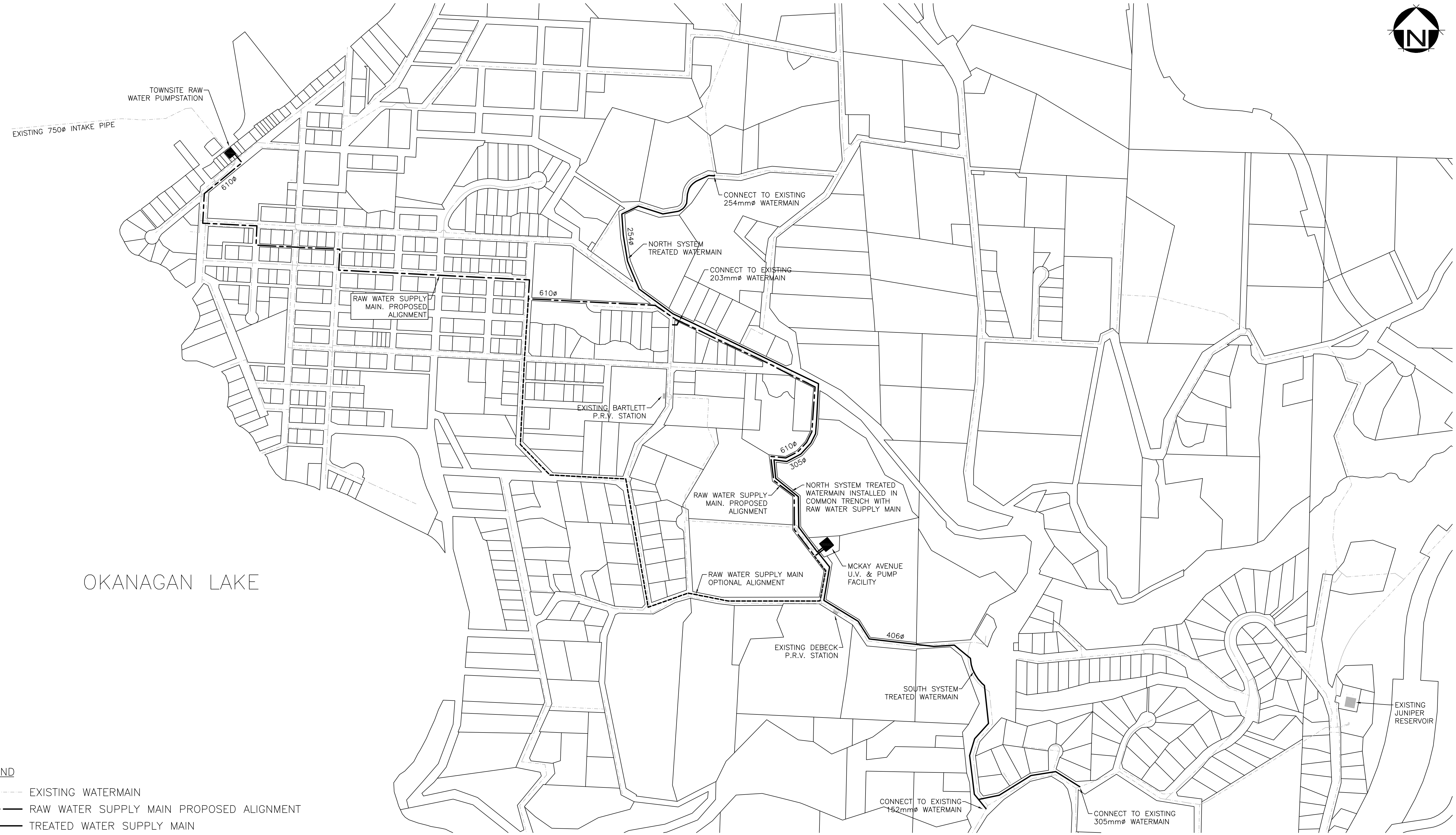
Refer to Appendix A which includes photographs along the proposed alignments of the above noted mains.

3 High Maintenance Watermain Upgrading

In previous reports two existing distribution mains have been identified as high priority for replacement due to their poor condition. The following summarizes these mains:

3.1 Naramata Road Watermain – Lot 20A to Lot 1

Based on information included in previous reports it is our understanding that the existing 102mm main on Naramata Road between Lot 20A and Lot 1 as well as mains on Little John Road and Hyde Road are in poor condition with high pipe failure incidence. It is therefore proposed to replace this pipe with a new 204mm AWWA C900 PVC main on Naramata Road and 150mm diameter laterals on Little John and Hyde Roads. In



LEGEND

- EXISTING WATERMAIN
- RAW WATER SUPPLY MAIN PROPOSED ALIGNMENT
- TREATED WATER SUPPLY MAIN
- RAW WATER SUPPLY MAIN OPTIONAL ALIGNMENT

Suite 420
1628 Dickson Avenue
Kelowna, B.C., V1Y 9X1
Tel: (250) 763-3638
Fax: (250) 763-8880
Associated Engineering

NO.	DATE	BY	REVISION	CH'KD
A	04/26/05	JB	FOR REVIEW	BH

DRAWN	JB
DESIGN	BH
APPROVED	
DATE	04/26/05
SCALE	1:8000

REGIONAL DISTRICT OF OKANAGAN SIMILKAMEEN

NARAMATA WATER SUPPLY IMPROVEMENTS PROPOSED WATERMAIN ROUTING PLAN

DIVISION: WATER

DRAWING NO.: WM-1

REV. NO.: A

conjunction with this main replacement, consideration should be given to installing a small diameter domestic main in a common trench (100mm on Naramata Road and 50mm on Little John and Hyde Road). Upgrading of the Naramata Road watermain will also eliminate a bottleneck in the distribution system in this area as the hydraulic model showed this pipe having high velocities.

3.2 Intersection of Naramata Road and Arawana Road

The operations staff advise that several repairs have been required to the existing 152mm main in this area. In previous reports it has been recommended that the existing 152 main on Naramata Road between Gammon Road and Aikens Loop be replaced with a 305mm main to improve pump capacity, fire flow and enhance system looping. Our modelling does not indicate any major capacity issues in this pipe therefore we would recommend prioritizing replacement of the section in poor condition between Gammon Road and Old Main Road. We would recommend installation of a 254mm AWWA C900 PVC main for the replacement section.

4 Watermain Replacement to Address Fire Flows

In previous reports it has been recommended that high priority be given to watermain upgrades in the following areas to address fire flow constraints.

4.1 Eighth Street Between Robinson Avenue and Ellis Avenue

The existing main on Eighth street has been identified as a constraint for providing fire flows to the school and downtown area. Our modelling supports this conclusion. We would recommend installation of a 254mm main in this area.

4.2 Naramata Road Between Old Main Road and Aikens Loop

The existing 152mm main on Naramata Road between Old Main Road and Aikens Loop has been previously recommended for upgrading to improve fire flows and enhance system looping. Our modelling indicates that replacement of this pipe should be the lowest priority of the improvements recommended herein. If funds are available for its replacement we would recommend installation of a 254mm main with the primary objective of improving system looping.

5 Confined Space Entry Improvements

Previous reports have identified the need for improvements at the Juniper Pump Station, Bartlett PRV Station, DeBeck PRV Station, and Smethurst PRV Station. These recommendations are addressed toward improving worker safety and reducing operational costs. Specifically the proposed improvements are summarized as follows:

.1 Juniper Pump Station – installing side door entry into the Pump Station substructure from Juniper Drive

.2 Bartlett PRV Station – provisions of above ground structure and relocation of piping into new structure

.3 DeBeck PRV Station – widening of existing stairwell, access door and HVAC improvements

.4 Smethurst PRV Station – installing side door entry into the chamber association with other structural improvements, installation of lighting and heating, and replacement of valving, controls, and pipe work. (Note: land ownership for this structure site needs to be confirmed).

Respectfully Submitted

Reviewed by

W.J (Bill) Harvey, P.Eng.
Project Manager

Enclosures:
Appendix A – Proposed Watermain Alignment - Photos

APPENDIX A - PROPOSED WATERMAIN ALIGNMENT - PHOTOS

1. Townsite Pump Station – looking west

2. First Street – looking southwest

3. First Street – looking south

4. Robinson Avenue – looking east from First Street

.5 First Street – looking south from Robinson Avenue (possible alternate alignment)

6. Ritchie Avenue – looking east from First Street (possible alternate alignment)

7. Second Street – looking south from Robinson Avenue

8. Lane south of Robinson Avenue – looking east from Second Street

9. Lane south of Robinson Avenue– looking east from Third Street

10. Lane south of Robinson Avenue – looking east from Fourth Street
(alignment shifted to Ritchie Avenue due to property encroachment)

11. Lane south of Robinson Avenue – looking east from Sixth Street
(alignment shifted to Ritchie Avenue)

12. Lane south of Robinson Avenue – looking west from Sixth Street
(alignment shifted to Ritchie Avenue)

13. Eighth Street – looking south from Robinson Avenue

14. Lane south of Robinson Avenue – looking west from Eighth Street
(alignment shifted to Ritchie Avenue)

15. Ritchie Avenue – looking west from Eighth Street

16. Sherwood Place (school yard) – looking east from Eighth Street

17. Sherwood Place – looking west from Robinson Avenue

18. Robinson Avenue – looking southwest from Sherwood Place

19. McKay Avenue Right of Way – looking south from Robinson Road

20. Robinson Road – looking northwest from McKay Avenue

21. McKay Road – looking north from McKay Reservoir

22. McKay Road – looking north

23. McKay Road – looking northwest

24. McKay Road Right of Way – looking north

25. McKay Road Right of Way – looking northwest (above steep bank)

26. McKay Road Right of Way – looking east traversing steep bank

27. McKay Road Right of Way – looking north from bottom of bank toward Robinson Creek Crossing

28. McKay Road – looking south from McKay Reservoir

29. McKay Road – looking north toward McKay Reservoir from Lower DeBeck Road

30. Lower DeBeck Road – looking southwest from McKay Road

31. Lower DeBeck Road – looking northwest toward McKay Road

32. Lower DeBeck Road – looking east toward Naramata Road

33. Lower DeBeck Road – looking east toward Naramata Road

34. Lower DeBeck Road – looking southwest toward Naramata Road

35. Naramata Road – looking south from Lower DeBeck Road

36. Naramata Road – looking south toward Arawana Road

37. Naramata Road – looking north toward Lower DeBeck Road

38. Arawana Road – looking east from Naramata Road

49. Naramata Road – looking south from Arawana Road

40. Arawana Road – looking west from Spruce Drive

41. Arawana Road – looking east toward Gammon Road from Spruce Drive

Technical Memorandum No. 7

Regional District of Okanagan-Similkameen

Naramata Water Supply Improvements

Cost Estimates and Schedule

May 2005

Table of Contents

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4	**Project Implementation**	**3**
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Enclosure A – Capital Cost Estimate Breakdown		**5**

Naramata Water Supply Improvements
Cost Estimates and Schedule

Issued: May 6, 2005
Previous: February 24, 2005

1 Objective

The objective of this Technical Memorandum is to confirm the estimated capital costs and schedule required to complete the proposed construction.

2 Cost Estimating Basis

The following confirms the basis of the costs:

- Accuracy – The cost estimate is based on the costs of construction as of February 2005 in Canadian dollars. The total estimated cost is considered accurate to approximately +10%/-15%. It should be noted that the construction work has been quite volatile over the past year and we have attempted to make provisions to address recent cost escalation.

- Equipment – Costs for major equipment have been based on quotations or recent tenders from similar projects.

- Escalation – Escalation is not included.

- Engineering – Engineering costs have been carried at 10% of the estimated construction costs.

- Contingencies – The contingency allowance is provided to cover those costs that are unforeseen at the time the estimate is produced and may become apparent as detailed design and construction proceed. Contingencies have been carried at 15% of the estimated construction costs.

- Exclusions – This estimate covers the capital costs for the design and construction of the Naramata Water Supply Improvements but does not include certain indirect project costs including:
  - Interest during construction
  - RDOS project administration costs
  - Foreign currency variations (equipment)
  - Escalation
  - GST

3 Project Capital Cost Estimates

A detailed breakdown of the cost estimates is provided in Enclosure A. The following is a summary of the estimates for each of the project components:

Upgrade Option 1

• South Lake Pump Station and UV Facility	$2,294,000
• Townsite Pump Station and UV Facility	$2,019,000
• Townsite High Pressure Supply Main	$ 524,000
• North Treated Water Reservoir	$ 358,000
• Disconnection of Existing Creek Intakes	$ ---
• Upgrading of Townsite and Bartlett PRV's	$ 10,000
• SCADA Upgrade	$ 39,000
• System Deficiency Upgrades	$ 556,000
Total Construction	**$5,800,000**
Townsite Facility Land Acquisition	**$ 300,000**
25% Allowance for Engineering and Contingencies	**<u>$1,450,000</u>**
Grand Total Project Costs	**$7,550,000**

Upgrade Option 2

• Townsite Raw Water Pump Station & Intake Screen	$ 710,000
• Raw Water Supply Main	$1,183,000
• McKay Road Water Treatment Plant	$2,492,000
• Treated Water Supply Mains	$ 835,000
• North Treated Water Reservoir	$ 358,000
• Disconnection of Existing Creek Intakes	
• SCADA Upgrades	$ 39,000
• System Deficiency Upgrades	$ 399,000
Total Construction	**$6,097,000**
25% Allowance for Engineering & Contingencies	**<u>$1,525,000</u>**
Grand Total Project Costs	**$7,622,000**

4 Project Implementation

The project implementation schedule for both upgrade options is provided herein. Based on a construction start of September 1, 2005 construction should be substantially complete in March 2006. We are proposing that construction be scheduled to avoid disrupting water supply and minimize disruption of streets during the July/August tourist season. Construction scheduling has therefore been based on a September start date.

4.1 Option 1

The proposed sequencing and schedule will necessitate shutting down the Townsite intake pump station beginning September 1, 2005 and South Lake intake pump station November 17, at which time the entire water supply would be delivered from the two creek intakes. Both facilities would return to operation in February.

4.2 Option 2

The proposed sequencing will necessitate shutting down the Townsite intake pump station and McKay Reservoir beginning September 1. The South Lake pump station will remain operational throughout the entire construction period and thereby supply the entire system.

Refer to the attached schedule for more information.

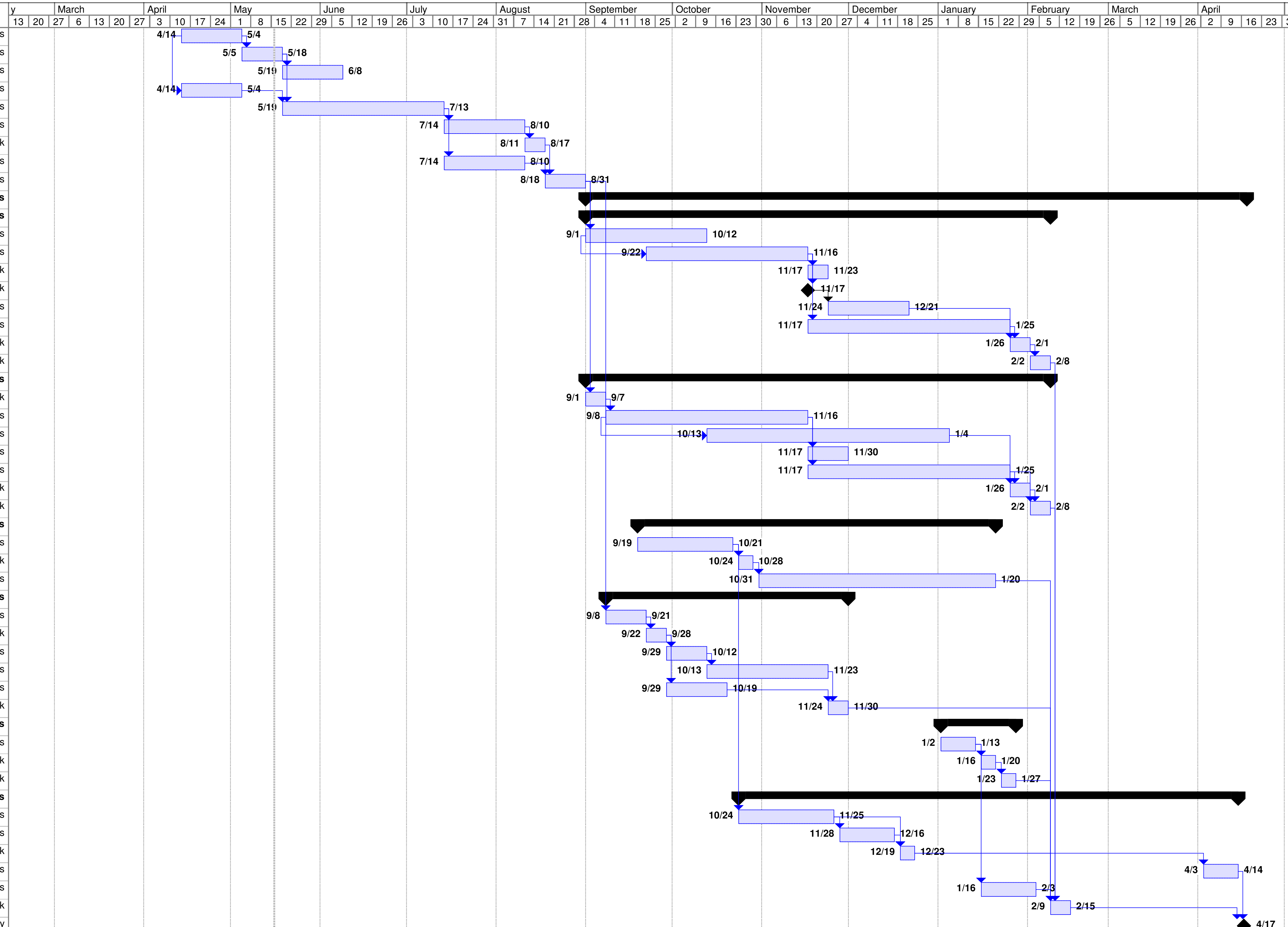
Prepared by

Reviewed by

W.J. (Bill) Harvey, P.Eng.
Project Manager

Naramata Water Supply Improvements
Upgrade Option 1
Construction Schedule

ID		Task Name	Duration
1		Tender UV Equipment Supply	3 wks
2		Review Proposals and Recommend UV Supply Award	2 wks
3		UV Equipment Supply Contract Award	3 wks
4		Site Investigations	3 wks
5		Detail Design	8 wks
6		Tender Construction	4 wks
7		Review Tenders and Recommend Const. Contract Awar	1 wk
8		Regulatory Approvals & Permmits	4 wks
9		Construction Contract Award	2 wks
10		**Construction**	**163 days**
11		**South Lake Intake Pumps & UV**	**115 days**
12		New Building	6 wks
13		Mechanical	8 wks
14		New Power Service	1 wk
15		Shutdown Existing Pump Station	1 wk
16		Install Low Lift Pumps and Piping	4 wks
17		Electrical Installation in Existing Structure	10 wks
18		Supply Line Tie-in	1 wk
19		Testing & Startup	1 wk
20		**Townsite Intake Pumps & UV**	**115 days**
21		Demolish Existing Building	1 wk
22		New Building	10 wks
23		Mechanical	12 wks
24		New Power Service	2 wks
25		Electrical & Instrumentation	10 wks
26		Supply Line Tie-in	1 wk
27		Testing & Startup	1 wk
28		**High Pressure Watermain**	**90 days**
29		Pipe Installation	5 wks
30		Testing	1 wk
31		Road Restoration	12 wks
32		**North Reservoir**	**60 days**
33		Site Excavation & Grading	2 wks
34		Yard Piping	1 wk
35		Structural Base Slab	2 wks
36		Walls and Roof	6 wks
37		Offsite Watermain	3 wks
38		Hydrostatic Testing	1 wk
39		**Juniper Pump Station**	**20 days**
40		Mechanical	2 wks
41		Electrical & Instrumentation	1 wk
42		Testing & Startup	1 wk
43		**System Upgrades**	**125 days**
44		Naramata Road Watermains Pipe Installation	5 wks
45		8th Street Watermain Pipe installation	3 wks
46		Testing	1 wk
47		Road Restoration	2 wks
48		Confined Space Entry Upgrades	3 wks
49		Overall System Commissioning	1 wk
50		Project Complete	1 day



Project: NaramataConstructionSchedu
Date: Mon 5/16/05

Task | Progress | Milestone | Summary | Rolled Up Task | Rolled Up Milestone | Rolled Up Progress | Split | External Tasks | Project Summary | Group By Summary

Naramata Water Supply Improvements
Upgrade Option 2
Construction Schedule

ID	Task Name		
1	Tender UV Equipment Supply	4/14	5/4
2	Review Proposals and Recommend UV Supply Award	5/5	5/18
3	UV Equipment Supply Contract Award	5/19	6/8
4	Site Survey and Investigations	4/14	5/4
5	Detail Design	5/19	7/13
6	Tender Construction	7/14	8/10
7	Review Tenders and Recommend Const. Contract Award	8/11	8/17
8	Regulatory Approvals & Permits	7/14	8/10
9	Construction Contract Award	8/18	8/31
10	**Construction**		
11	**Townsite Raw Water Intake Pump Station**		
12	Shutdown Existing Pump Station		9/1
13	Demolish Superstructure and Contents	9/2	9/8
14	New Building	9/8	10/5
15	Mechanical	9/29	11/23
16	New Power Service	11/24	11/30
17	Electrical and Genset Installation	11/24	2/1
18	Supply Line Tie-in	2/2	2/8
19	Testing & Startup	2/9	2/15
20	**McKay Avenue Water Treatment Plant & Pump Station**		
21	Site Preparation & Excavation	9/19	9/30
22	WTP Building - Concrete Walls	10/3	11/11
23	Yard Piping and Backfilling	11/14	12/2
24	WTP Building Roof and Interior Finishing	11/14	12/9
25	Mechanical	11/14	2/3
26	New Power Service	12/5	12/16
27	Electrical and Genset Installation	12/12	2/17
28	Raw Water and Treated Water Supply Line Tie-ins	2/20	2/24
29	Testing & Startup	2/27	3/3
30	**Raw Water Supply Main**		
31	Pipe Installation	9/19	11/11
32	Testing	11/14	11/18
33	Road Restoration	4/3	4/28
34	**Treated Water Supply Mains**		
35	North System Supply Main Installation	9/19	10/21
36	South System Supply Main Installation	10/24	11/25
37	Testing	11/28	12/2
38	Road Restoration	4/3	4/21
39	**North Reservoir**		
40	Site Excavation & Grading	9/8	9/21
41	Yard Piping	9/22	9/28
42	Structural Base Slab	9/29	10/12
43	Walls and Roof	10/13	11/23
44	Hydrostatic Testing	11/24	11/30
45	**SCADA Upgrades**		
46	Electrical & Instrumentation	1/2	1/6
47	Testing & Startup	1/9	1/13
48	**System Upgrades**		
49	Naramata Road Watermains Pipe Installation	9/19	10/21
50	8th Street Watermain Pipe installation	10/24	11/11
51	Testing	11/14	11/18
52	Road Restoration	4/3	4/14
53	Confined Space Entry Upgrades	2/24	3/16
54	Overall System Commissioning	3/6	3/10
55	Project Complete		5/1

Project: NaramataConstructionSchedu
Date: Mon 5/16/05

Task | Progress | Milestone | Summary | Rolled Up Task | Rolled Up Milestone | Rolled Up Progress | Split | External Tasks | Project Summary | Group By Summary