Technical Memorandum No. 1

Associated Engineering

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Regional District of Okanagan-Similkameen

Osoyoos Irrigation District Water Supply and Treatment Cost/Benefit Review

Systems Options Development

August 2008

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TECHNICAL MEMORANDUM NO. 1

Osoyoos Irrigation District
Water Supply and Treatment Cost/Benefit Review
System Options Development

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1 Objective

The objective of this Technical Memorandum is to review the feasibility of various alternative supply sources and to develop water treatment solutions based on the sources being carried forward for system options development.

2 Existing System

2.1 Existing Infrastructure

The existing water system is managed by the Osoyoos Irrigation District on the east bench of Osoyoos Lake, just east of the town of Osoyoos. The system was constructed in 1967 and is currently on a Standing Boil Water Notification. The system consists of the following components:

- 140 Domestic Connections
- 40 agricultural connections
- 163 ha agriculture
- Submerged screen intake - 10.7 m deep
- 21 inch corrugated pipe – 300 m ft intake to pump house on 45th St.
- Vertical turbine pumps in wet well
- 158 L/s @ 113 m TDH
- Gas chlorination system

- ***Lake Intake*:** A 21 inch corrugated steel pipe extending 300 m into Osoyoos Lake to a depth of 10.7 metres. The intake consists of a screened intake, and it is not known at this time whether the screen meets current Ministry of Environment Fish Exclusion standards.

- ***Supply Pump Station*:** The intake pipeline is connected to a concrete sump and pump station on the shore of the lake on 45th Street on the south end of the Town of Osoyoos. The pump station consists of four electric vertical turbine pumps totalling 420 hp. The station includes a gas chlorination system that injects into the sump, based on flow and pump operation. The capacity of the pump station is reported to be 158 L/s, however 195 L/s has been noted on some occasions. It is likely necessary to upgrade/replace the existing facility due to its poor structural and mechanical condition. Chlorine contact time is insufficient, and typically down to 3 minutes in the summer.

- ***Water Reservoir:*** A balancing reservoir of 180,000 Litres exists midway into the District. The reservoir is too small to provide proper fire protection.

- ***Distribution System*:** The existing distribution system consists of pipes ranging in diameter from 75 mm to 300 mm diameter of varying material. Of particular concern is a short stretch of 300 mm diameter steel pipe near the pump station. This pipe is prone to failure, and must be replaced. The system serves approximately 140 domestic and 40 irrigation connections, including 163 ha of irrigated lands. Apparently flow restriction devices were added to the agricultural connections to limit flows.

- ***Supply Pipelines*:** The existing supply pipelines are 400 mm and 300 mm diameter ductile iron pipe installed in 1979. They are assumed to be in reasonable condition.

2.2 Existing Operating Costs

The following table summarizes the 2008 operations budget, excluding special projects:

Table 1-1
OID 2008 Budgeted Operating Costs

Administration	$2,500
Water Manager Contract	$15,000
Water Distribution & Pump Maintenance	$30,000
Chlorination	$10,000
Power	$60,000
Water Quality Monitoring	$500
Insurance	$10,000
Provincial Fees	$1,000
WCB	$250
Telephone (Dedicated System)	$2,000
Total	**$131,250**

3 Potential Supply Sources

The following is a review of potential additional supply sources to Osoyoos Lake.

3.1 Town of Osoyoos

The Town of Osoyoos supplies all urban development within its town limits with groundwater supplied from six deep wells. Generally, the drinking water is documented to meet or exceed Canada Drinking Water guidelines. Town water is not fluoridated or chlorinated. The Town is on the Conditions on Permit Program and will meet IHA's 4-3-2-1-0 treatment objective in the future.

Outside Town limits, water is supplied from Osoyoos Lake or from the Okanagan River through intakes and pump stations. This water is treated with a chlorination system.

Osoyoos water has a high natural pH (level of hardness) which can affect the taste.

3.2 Groundwater

A preliminary assessment of groundwater availability can be found in Appendix D of this Technical Memorandum. The assessment was performed by Golder Associates out of their Kelowna, BC office. This assessment reviewed various groundwater and geological reports, databases and maps, with the objective to assess the feasibility of developing a groundwater supply for the District.

It may be possible, based on the stratigraphy of the western portion of the District, to develop a domestic water supply for domestic indoor use only. There is inadequate capacity to provide irrigation to lawns or gardens from this supply.

- Shallow aquifers: There are some shallow wells owned by rural users. These wells are generally small, and are found in the shallow coarse materials associated with gullies or small streams. These wells are low producing, area dependent, and have the potential to contain traces of nitrates and pesticides.

- Deeper aquifers: Based on the geology of the area, there is evidence of at least two, and probably three confined aquifers accessible to the District. While previous tests have shown there is water in this area, it is uncertain as to the capacity. The aquifers have fine grained soils, and are also difficult to develop.
  - The quality of this water should be good to excellent. Previous testing in the area has shown some levels of Manganese and Iron.
  - If the groundwater option is to be examined further, we suggest some test drilling to sample materials, before going to the expense of developing a well.
  - The cost of developing the well will need to include significant development time to deal with the fine grain sand issue,

- Further analysis will be required to ensure that these aquifers are not GUDI (Groundwater Under Direct Influence of Surface Water). If a GUDI well is used, treatment, including filtration, will be required.
- Location of the well(s) will likely be on private property. Land ownership rules and costs must be clearly identified before deciding with further groundwater analysis.

Under current legislation, groundwater must be chlorinated to maintain minimum chlorine residuals in the distribution system and avoid bacterial contamination.

The Golder study recommends that water quality testing be completed for a full suite of parameters including metals, fertilizers, pesticides and microbiology be conducted to determine the quality of groundwater before the construction of a test well. Test wells should follow to confirm long-term flow requirements.

4 Treatment Requirements – Osoyoos Lake Water

4.1 Raw Water Quality

OID water supply is currently drawn from Osoyoos Lake, the lowest lake on the Okanagan River system before crossing southward into the United States. The lake is primarily divided into a deeper north end, and a shallower south end nearer to the outlet. The OID inlet is in the southern portion of the Lake, and can typically experience higher temperature and colour problems than in the lower portion. The water quality from Osoyoos Lake is considered to be fair, although fluctuating due to high temperatures in the summer. There is little information available on raw water quality near the OID pump inlet. The deepest points in the southern portion of the lake are no greater than 12 metres.

Earlier studies have shown that water quality parameters in the Okanagan River near Oliver typically read True and Apparent colours higher than Okanagan Lake (between 5 to 20 Colour units), hardness values between 100 to 150 mg/L and Turbidity values well over 5 NTU, particularly during spring freshet. The turbidity values have generally remained around the 1 NTU level during the year, except where higher temperatures and nutrient levels increase the turbidity and colour levels in the water. We believe that this water can be consistently treated using conventional filtration methods. Since no water quality has been provided in this report, we can only suggest possible treatment strategies. Testing should be completed to determine the final strategy required.

4.2 Water Quality Objectives

In 2006 Interior Health Authority established the 4-3-2-1-0 Drinking Water Objective. Under this objective the following criteria were established:

- log virus removal
- 3 log Giardia and Cryptosporidium removal or inactivation

- 2 stages of treatment – see below
- 1 NTU turbidity maximum
- 0 bacterial indicators

Under the new objective a minimum of 2 stages of treatment is required for water that is at risk of containing pathogens. Filtration and disinfection should be considered on most water supplies to ensure a safe supply of water. UV light and chlorination can be considered for source water that meets the criteria for the exclusion of filtration as outlined in the Guidelines for Canadian Drinking Water Quality.

Interior Health now requires purveyors to issue a water quality advisory when turbidity values exceed 1.0 NTU and a boil water advisory if turbidity exceeds 5.0 NTU. Ultimately, all surface waters are to be filtered and this is to be taken into account in the planning of water treatment improvements by each water purveyor.

4.3 Water Treatment Strategy

For the purpose of this study it is important to be able to compare options based on a common water treatment approach. The raw water source for all options under consideration is either Osoyoos Lake water or groundwater. Osoyoos Lake water is considered to be a fair quality raw water source, and requires filtration.

Direct filtration involves chemical coagulation and mixing, flocculation, filtration, and chlorination. Clarification and filtration involves the same process steps as direct filtration with the addition of clarification prior to filtration. Membrane filtration involves the use of semi-permeable membranes to remove particulate mater from the water. Depending on source water quality and membrane technology, pre-treatment may be required for removal of organic carbon and colour.

All of these treatment processes produce liquid and solid wastes that require treatment and/or disposal. A common practice is to discharge water treatment wastes to sanitary sewer, however, at the present time this option is not available for the OID. Therefore, treatment options should include provisions for residual treatment. The selected treatment strategy for the OID should take into consideration local lake limnology, depth of intake, and residuals handling.

For the purpose of comparing options for the OID, the general filtration component includes clarification and filtration. This is a proven treatment process currently used by other users in the Okanagan valley for treating lake water. It should be noted that there is a strong possibility that both membrane filtration and direct filtration would be suitable treatment processes, however, residuals treatment would be more challenging and the direct filtration process would require the provision of UV to meet Giardia and Cryptosporidium removal requirements.

We have assumed that UV disinfection without filtration is not viable due to the high turbidity encountered in Osoyoos Lake. The IHA filtration deferred will not apply in this instance.

4.4 Point of Entry Devices

Point of Entry (POE) devices are considered as a treatment process for those options where rural homes are supplied with irrigation water only. These POE's must meet the IHA 4-3-2-1-0 protocol. Ultrafiltration membrane filters, with GAC pre-filtration and post-membrane UV disinfection are proposed, and would provide turbidity removal, UV disinfection, and a dual barrier to pathogens. GAC filters would reduce the organic carbon and colour.

Our cost estimates assume that these three stage units would be installed in residences where raw water treatment is required. Chlorination would continue at the lake intake site, and raw water would be fed directly into the POE devices. We have assumed that chlorination would not be required downstream of the POE devices in the individual house plumbing systems. This assumption should be reviewed and confirmed with IHA.

The amended BC Drinking Water Protection regulation (DWPR s. 3.1) states that a small system of 500 or less users is exempt from section 6 of the Drinking Water Protection Act if each recipient of the water from the system has a POE or point of use treatment system that makes the water potable. By being exempt from section 6 of the Act in this way, the water purveyor is no longer required to provide water that is potable before it reaches the consumer's home, but:

- Point of entry devices can be applied for under Section 3.1 of the DWPR.
- Agreements must be in place between the property owner and the water supplier. This agreement must allow access for maintenance and testing for the Point of Entry device.
- Chlorination of the water would not be required down stream of the POE device inside the individual houses.
- A monitoring plan would be necessary for the raw water quality and primary disinfected (chlorinated) water prior to the POE devices.

5 Treatment Requirements – Groundwater Source

5.1 Disinfection

Chlorination using free chlorine is proposed for disinfecting the groundwater extracted from the aquifer, assuming the well is not GUDI. This form of disinfection would provide a residual in the distribution system to control microbial re-growth. For this study, we have assumed that sodium hypochlorite generation technology would be installed at a central treatment facility, and include the following:

- Salt delivery and storage system.
- Brine tank.
- NaOCl generation equipment including water softener, heater, rectifier, controller, electrolytic cells, and brine proportioning pump.

- 0.8% NaOCl storage tanks.
- Solution metering pumps.

6 Water Demand Design Criteria

The water supply and treatment components should be designed to meet maximum day demand (MDD). Through discussions with the OID Water Manager, Bill Stewart, we have determined that existing demand information is intertwined with irrigation supplies. Flow information during winter consumption months has been used as the basis for confirming residential demand. Refer to Table 1-2 for a summary of water demand statistics.

- ***Residential Demand***: The OID can potentially service up to 140 residential connections within the prescribed urban area, and an additional 40 rural home connections. For this study, we have assumed that larger lot irrigation is supplied by the existing irrigation system, and residential demand is defined as the indoor water demand for a typical (non-agricultural) lot. We have assumed 300 L per person per day, with 3 people per residence. This equates to a demand as follows:

  MDD = 140 urban residences x 900 L/d = 0.126 ML/d
  = 40 rural residences x 900 L/d = 0.036 ML/d
  = 0.162 ML/d + contingency
  = 0.175 ML/d for all domestic demand.

- ***Agricultural Demand***: The agricultural lands total approximately 163 Ha (400 acres). Using a design criteria of 6 USgpm (0.378 L/s) per acre, this equates to an MDD = 13.15 ML/d.

- ***Total Combined Demand***: Based on the above, the total combined demand would equate to 13.30 ML/day. This would appear to be a reasonably conservative value for the purpose of comparing options.

- ***Impact of Water Metering***
  The upgrade project would include installation of flow meters on all properties which will probably further reduce annual demands. For the purpose of this report we have not reduced the maximum day demands as it is unclear what impact metering will have on peak demands.

When the project proceeds into preliminary and detailed design, we would recommend that this design basis be reviewed as there would appear to be an opportunity to reduce the design demands with the implementation of flow metering.

Table 1-2 Water Demand Estimates

Item	No of connections.	Unit Consumption L/cap/day	Daily Use ML/day	Annual Use ML/yr	Q (USgpm)	Pump Power[3] hp	Pump Power[3] kW
Current Water Use [1]							
Urban Domestic (2.5 people / household)	100	300	0.08	27	100	12	9
Rural Domestic (4 people / household)	40	300	0.030	11	40	5	4
Sub Total	140		0.105	38	140	17	13
Future Requirement [1]							
Urban Domestic (2.5 people / household)	40	300	0.03	11	5.5	0.7	0.5
Rural Domestic (4 people / household)	5	300	0.004	1	0.7	0.1	0.1
Sub Total	45		0.034	12	6	0.8	0.6
Agriculture [2]	ha	Usgpm/ac					
	163	6	13.15	2400	2,416	301	224

Notes:

1. Estimate of daily water use for indoor use only.
2. Agricultural demand is over 6 months
3. Pump power based on 113 meters of pressure

7 Distribution System Upgrades

True Engineering (1988) identified the need for distribution system upgrades required to the OID system. Several of their proposed options from 1988 continue to be valid today. The key change to today are that the water treatment criteria are stricter, and more costly to implement than in 1988. We have used several quantities from the 1988 study in our evaluation.

The following works are included with each option:

- All options include TRUE Engineering's recommendation to loop the systems, which allows for less water stagnation in the pipelines, improving some odour and corrosion conditions. These upgrades are common to all options and are included in all cost estimates.

- Existing raw water connections to the households will be maintained for irrigation and fire flow protection where system separation is proposed. Any new pipeline connected to a residence will provide potable water for indoor use only.

- Options requiring system separation include a booster pump and reservoir to assist the pump system in delivering consistent water pressures. Fire Flows will continue to be provided through the existing irrigation system.

- All options include the installation of flow meters.

8 Servicing Options

The following options were examined conceptually and include capital and operating costs.

8.1 Option 1 – Osoyoos Lake Treated Supply

- ***Concept:*** This option assumes that all water, including irrigation water, is to be treated to IHA requirements. This requires a new pump station, water treatment facility and distribution system upgrades. Refer to **Plan 1-1**.

- ***Raw Water Intake:*** The raw water source would continue to be Osoyoos Lake. Although it is preferable to obtain water at deeper depths, this is not possible in the arm of Osoyoos Lake. The existing pump station would be converted to a low lift facility to the treatment plant.

- ***Water Treatment:*** A new water treatment plant would be required in the vicinity of the existing pump station. For the purpose of this evaluation we have assumed conventional filtration to treat 12 ML/day, including flocculation, clarification, filtration, chlorination and residue management and a building.

- ***Water Supply System:*** The water supply system would include the following components:

    - <u>High Lift Treated Water Pump Station</u>: The treated water pump station would be sized to deliver 13.3 ML/d from a clearwell on the discharge side of the water treatment plant. The pump station would consist of 2 duty pumps and 1 standby pump, and would incorporate standby power (or drive) for 50% of delivery capacity.

    - <u>Supply Pipeline</u>: A 400 mm diameter pipeline would supply water from the pump station, and reconnect to the existing distribution system.

- ***Potential Issues:***

    - The operation and maintenance costs for the filtration plant will have a significant impact on future O&M rates.

    - The OID would be responsible for acquiring a site for the proposed water treatment plant. While we have included an allowance for land acquisition, the cost and availability of land in this area is uncertain at this time.

8.2 Options 2 and 2a – Osoyoos Lake Treated Domestic Supply

- ***Concept:*** Similar to the True Report of 1988, this option involves separation of the system into raw water irrigation and treated residential supplies, including both urban and rural residences receiving treated water. A new smaller plastic pipeline system would be installed according to **Plan 1-2**. A new water treatment facility would include a new high lift pumping facility and a treated water supply line to the distribution system. The existing intake and pump station would continue to operate for irrigation and fire flow.

- ***Raw Water Intake:*** The raw water source would continue to be Osoyoos Lake. Although it is preferable to obtain water at deeper depths, this is not possible in the arm of Osoyoos Lake. During winter operation, the entire system must remain pressurized to provide both for residential and fire flows.

- ***Water Treatment:*** A new water treatment plant with a 0.175 ML/day capacity would be constructed in the vicinity of the existing pump station to treat the residential component. For the base case, we have assumed a conventional filtration plant. The irrigation supply system would be supplied with untreated water. Double backflow prevention devices would be required.

  - Option 2a assumes that POE devises can be used to treat the rural residences instead of piping water to each.

- ***Water Supply System:***

  - High Lift Treated Water Pump Station: The treated water pump station would be sized to deliver 0.175 ML/d from the water treatment plant all residential users. The pump station would consist of 2 duty and 1 standby pumps and would incorporate standby power (or drive) for 50% of delivery capacity.

  - Treated Water Pipelines: A 150 mm diameter supply pipeline would supply treated water from the pump station to a new pipeline system in the urban area of the District.

  - Existing Supply Components: All existing supply components would be refurbished and re-used under this option.

- ***Potential Issues:***

    - The OID would be responsible for acquiring a site for the new water treatment plant facility and pump station. While we have included an allowance for land acquisition, the cost and availability of land in this area is uncertain at this time.

    - Any splitting of distribution system carries an increased risk of cross –connection. OID would require a comprehensive cross-connection control program and bylaw.

8.3 Options 3 and 3a – Groundwater Domestic Supply

- ***Concept:*** This option requires a split residential system to be supplied by groundwater. This water supply would likely not require much of the water treatment examined earlier, provided the wells are not GUDI. In the 1988 True study, groundwater availability in this area was estimated to be not viable. In addition, there may be requirements to remove hardness, odour, colour or other unpleasant items. Refer to **Plan 1-3**.
    - Option 3 assumes a system split to all users.
    - Option 3a assumes that some rural residences will use POE devices, minimizing long pipeline runs.

- ***Groundwater Supply System:*** Groundwater would likely be supplied through two, possibly three wells. The locations of the wells are important, as they determine the final cost of distributing water. Golder Associates have performed a literature and data investigation of aquifers in the area. Three potential sites for further examination of deeper aquifers are noted on the attached “Figure 3” in Appendix B taken from the Golder report.

- ***Water Treatment:*** Groundwater will require chlorination in order to eliminate bacterial re-growth in the distribution pipeline.

- ***Water Distribution System:***

    - <u>Treated Water Supply Pipeline</u>: A separated system consisting of 25 to 100 mm pressurized plastic pipeline would supply water to the residences.

    - <u>Existing Supply Components</u>: The existing Intake and pumping station would still be required to supply irrigation and fire flow water.

- ***Potential Issues:***

    - If the groundwater demand is limited to indoor use only (no lawn watering), then we may be able to suggest a residential demand of 300 Litres per capita per day. This would result in a Maximum Daily demand requirement of 0.175 ML/day. These values should be re-examined during final design.

- Although groundwater is available throughout the area, its locations are limited. It is hoped that the wells can be situated within the District boundary, however this may not be the case. A thorough ground water study is required before proceeding with design of this option.

- Any splitting of distribution system carries an increased risk of cross –connection. OID would require a comprehensive cross-connection control program and bylaw.

- Fire flows continue to be through the raw water system.

- Estimates for land acquisition for the wells and pipeline right-of-way are included in the cost estimate, although discussions for realty never occurred.

8.4 Option 4 – Osoyoos Lake Supply with Point of Entry Treatment

- ***Concept:*** This option assumes that the District can continue to provide raw water to all clients, who in turn will have a point of entry device attached to the supply side of residences. This project requires upgrades to the overall distribution system and rehabilitation of the pump station. Refer to **Plan 1-4**.

- ***Raw Water Intake:*** The raw water source would continue to be Osoyoos Lake. Although it is preferable to obtain water at deeper depths, this is not possible in the arm of Osoyoos Lake. The existing pump station would be upgraded to meet the requirements of devices and district.

- ***Water Treatment:*** Pilot testing should be performed to determine the optimal water treatment requirements. Point of Entry systems are available with multiple unit processes similar to those in water treatment plants.

- ***Potential Issues:***

  - IHA would accept Point of Entry devices only according to a variety of conditions. For example, maintenance of the units would be the responsibility of the District, not the home owner. If these conditions are not met, IHA places a Boil Water Order on the entire District.

  - Annual operations and Maintenance costs are significantly higher over the long term than more conventional treatment methods.

  - Backflow prevention devices would be required for each delivery.

8.5 Option 5 – Town of Osoyoos Supply

- ***Concept***: This option connects the OID to Town of Osoyoos water distribution system. The OID would also require a booster pumping station and supply pipeline to deliver water to the WBID. Refer to **Plan 1-5**. This option was not included in our cost analysis since certain critical operational views were not known.

- ***Raw Water Source:*** The raw water source for this option would be the Town of Osoyoos groundwater supply system. The Town has stated by letter that at this time it is not considering the provision of water supply to the OID (see Appendix C). We have also assumed that the OID system would require pipeline separation into irrigation and residential components. These pipeline requirements are similar to those determined in Option 2.

- ***Water Treatment***: The Town does not treat or disinfect water from its groundwater sources.

- ***Water Supply System***: The water supply system would include the following components:

  - Connection to Town of Osoyoos System: A separated water system could be connected to the Town of Osoyoos water system via a supply main connected at the east end of 37th Street.

  - Booster Treated Water Pump Station: A booster pump station sized to deliver 0.175 ML/day would be installed. The pump station would consist of 1 duty and 1 standby pump, and would incorporate standby power (or drive) for 50% of the delivery capacity. The pump station would be supported by a reservoir,

  - Treated Water Supply Pipeline: A separated system consisting of 25 to 100 mm pressurized plastic pipeline would supply water to the residences.

  - Existing Supply Components: The existing intake and pump station would still be required to supply irrigation and fire flow water.

- ***Key Issue:***

  - The Town of Osoyoos will not provide water to the OID. The Town of Osoyoos has responded to a letter request from the RDOS concerning options for connections. The RDOS letter and response are included in Appendix C.

  - The Town of Osoyoos currently does not comply with all the conditions on its permit, nor does it meet the 4-3-2-1-0 objectives.

9 Cost Estimates

9.1 Cost Estimating Basis for on-Site Facilities

The capital cost estimates used for the comparison of the options have been developed using unit pricing for all components (See Table 1-3). The unit pricing is based on 2008 dollars and includes a 30% allowance for engineering and contingencies (see Appendix A). Unit pricing used for developing the cost estimates is included in the appendices. Breakdowns for the costs are also provided in the appendices. Cost estimates for Option 5 – Connection to the Town of Osoyoos have not been provided since the Town has not agreed to supply water and have not provided information on connection fees and operating costs.

The operation and maintenance costs have been determined by separating out energy costs from other O&M costs and basing the other O&M costs on percentage of capital costs, depending on the type of facility or construction.

Table 1-3
Capital and O&M Costs

Option	Name	Supply and Distribution System Capital Cost	Water Treatment Capital Cost	Capital Cost	Initial Annual O&M Cost
1	Osoyoos Lake Treated Supply	$2,283,000	$7,968,350	$10,251,350	$528,026
2	Osoyoos Lake Treated Domestic Supply	$3,420,000	$358,800	$3,778,800	$35,896
2a	Osoyoos Lake Treated Domestic Supply (POE in Rural Residences)	$2,125,000	$622,800	$2,747,800	$58,896
3	Groundwater Domestic Supply	$3,613,000	$23,400	$3,636,400	$20,466
3a	Groundwater Domestic Supply (POE in Rural Residences)	$2,211,000	$221,400	$2,432,400	$43,240
4	Osoyoos Lake Supply with POE Systems	$764,000	$1,188,000	$1,952,000	$138,820

9.2 Life Cycle Cost Estimates

9.2.1 Life Cycle Costing Basis

Capital costs were applied in the life cycle costing on a one time basis at the front end of the life cycle. It was assumed that there would be no phasing of the capital works.

Operation and maintenance costs were projected over a 20 year life. It was assumed that demands would remain constant over the 20 year period and therefore operation and maintenance costs were also constant except for inflation. An inflation factor of 2% per annum was applied to future operating costs.

9.2.2 Provincial Funding Assumptions

The costing included herein shows the impact of the RDOS obtaining 2/3 funding assistance on all capital costs within its direct control.

9.2.3 Life Cycle Cost per Connection

In order to compare options on an equitable basis the life cycle costs were calculated on a cost per connection basis. The costs per connection were calculated using the net capital cost assuming a government contribution of ⅔ of the onsite costs.

9.2.4 Life Cycle Cost Estimates

For each option the calculated increase in annual taxes per connection has been shown in **Table 1-4**. This cost represents the increased annual cost for debt retirement and operation and maintenance that will have to be covered by OID ratepayers if the improvements are implemented. These costs are over and above the rates.

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Table 1-4
Life Cycle Costs

Option	Name	Capital Cost	Capital Cost Based on Gov't Grant of 2/3 of Capital Costs	Inflated O&M Life Cycle Cost – 20 year	No. of Connections	Net Life Cycle Cost Per Connection	Total Annual Cost per Lot
1	Osoyoos Lake Treated Supply	$10,251,350	$3,617,000	$12,829,640	180	$103,524	$5,176
2	Osoyoos Lake Treated Domestic Supply	$3,778,800	$1,460,000	$872,177	180	$17,863	$893
2a	Osoyoos Lake Treated Domestic Supply (POE in Rural Residences)	$2,747,800	$1,116,000	$1,431,017	180	$17,900	$895
3	Groundwater Domestic Supply	$3,636,400	$1,412,000	$497,270	180	$15,352	$768
3a	Groundwater Domestic Supply (POE in Rural Residences)	$2,432,400	$1,011,000	$1,050,607	180	$14,851	$743
4	Osoyoos Lake Supply with POE Systems	$1,952,000	$851,000	$3,372,972	180	$26,326	$1,316

Notes:
1) Assumed Interest Rate 5.00%
2) Assumed Inflation Rate 2.00%
3) Land Acquisition costs are not applicable for grant.

APPENDIX A - COST TABLES

Regional District of Okanagan-Similkameen
Osoyoos Irrigation District Water Supply Improvements
Options Review Study
Technical Memorandum No. 1
Table 1
System Options Costs

OPTION	NAME	Supply and Distribution System Capital Cost	Water Treatment Capital Cost	Capital Cost	Net Capital Cost Based on Gov't Grant of 2/3 of Onsite Costs[3]	Annual Debt Serving Cost (Notes 1 and 2)	20 Year Debt Servicing Cost	Initial Annual Operating Cost	Total Inflated 20 Year O&M Cost - 2007-2026 (Note 2)	Total 20 Year Debt Servicing and O&M Cost	No. of Connections	Total Cost Per Lot	Total Annual Cost per Lot
1	Osoyoos Lake Treated Supply	$2,283,000	$7,968,350	$10,251,350	$3,617,000	$290,237	$5,804,749	$528,026	$12,829,640	$18,634,388	180	$103,524	$5,176
2	Osoyoos Lake Treated Domestic Supply	$3,420,000	$358,800	$3,778,800	$1,460,000	$117,154	$2,343,084	$35,896	$872,177	$3,215,261	180	$17,863	$893
2a	Osoyoos Lake Treated Domestic Supply (POE in Rural Residences)	$2,125,000	$622,800	$2,747,800	$1,116,000	$89,551	$1,791,015	$58,896	$1,431,017	$3,222,031	180	$17,900	$895
3	Groundwater Domestic Supply	$3,613,000	$23,400	$3,636,400	$1,412,000	$113,303	$2,266,051	$20,466	$497,270	$2,763,321	180	$15,352	$768
3a	Groundwater Domestic Supply (POE in Rural Residences)	$2,211,000	$221,400	$2,432,400	$1,011,000	$81,125	$1,622,505	$43,240	$1,050,607	$2,673,112	180	$14,851	$743
4	Osoyoos Lake Supply with POE Systems	$764,000	$1,188,000	$1,952,000	$851,000	$68,286	$1,365,729	$138,820	$3,372,972	$4,738,701	180	$26,326	$1,316

Notes:
1) Assumed Interest Rate 5.00%
2) Assumed Inflation Rate 2.00%
3) Land Acquisition costs are not applicable for grant.

Table 2. Capital Cost Estimate - Distribution System Improvements

	2007 Cost Estimate						2007 Cost Estimate - Domestic only					
Item	Pipe Diam	Quantity	Unit	Unit cost	Extension	Totals	Pipe Diam	Quantity	Unit	Unit cost	Extension	Totals
Pipeline Looping												
36th Avenue - 36th St. to 37th St.												
Water Main & Accessories	100	160	m	$220	35,200		50	160	m	$180	28,800	
Tie Ins		2	LS		-			2	LS		-	
Hydrant (Supply & Install)		1	LS		-			1	LS		-	
Pavement Restoration		1	LS		-			1	LS		-	
Subtotal						35,200						28,800
36th Avenue - 25th St.												
Pipe	100	140	m	$220	30,800		75	140	m	$190	26,600	
Connections to existing mains		2	LS		-			2	LS		-	
Hydrant (Supply & Install)		1	LS		-			1	LS		-	
Pavement Restoration		1	LS		-			1	LS		-	
Subtotal						30,800						26,600
Easement Lot 6 Plan 3847 - 33rd St. to 39th St.												
Pipe	150	260	m	$255	66,300		75	260	m	$190	49,400	
Connections to 250 mm main + gate valve		1	LS		-			1	LS		-	
Connections to 100 mm main + valves		3	LS		-			3	LS		-	
Fittings		1	LS		-			1	LS		-	
Hydrant (Supply & Install)		1	LS		-			1	LS		-	
Pavement Restoration		1	LS		-			1	LS		-	
Subtotal						66,300						49,400
North End of 37th St.												
Pipe	100	100	m	$220	22,000		50	100	m	$180	18,000	
Connections to existing mains		1	LS		-			1	LS		-	
Hydrant (Supply & Install)		1	LS		-			1	LS		-	
Pavement Restoration		1	LS		-			1	LS		-	
Subtotal						22,000						18,000
Total Construction						154,300						122,800

Unit costs include excavation, installation, fittings, and paving

Table 3-1
OPTION 1
Osoyoos Lake Treated Supply

Component	Size	Quantity	Units	Capital Cost	Initial Annual O&M Cost
<u>Supply System</u>					
Required Looping				$154,300	$772
New Steel Pipeline	400	75	ML	$45,000	$225
Rehab existing to Low Lift Pump station				$250,000	$1,250
New High Lift Treated Water Pumpstation	12	225	kW	$437,500	$53,650
Reservoir	3	1	ML	$500,000	$2,500
Engineering and Contingencies		30%		$416,040	$17,519
WTP Land Acquisition		0.5	ha	$300,000	
Water Meters		180	@ $1000	$180,000	$900
Subtotal				**$2,283,000**	**$76,815**
<u>Water Treatment</u>					
Chemical Coagulation and Mixing	13.3	ML/d		$346,450	
Flocculation				$1,039,350	
Clarification				$2,425,150	
Filtration				$2,944,825	
Primary Disinfection				$519,675	
Secondary Disinfection				$0	
Residuals Management				$692,900	
Subtotal				**$7,968,350**	**$451,210**
TOTAL				**$10,251,350**	**$528,026**

Table 3-2
OPTION 2
Osoyoos Lake Treated Domestic Supply

Component	Size	Quantity	Units	Capital Cost	Initial Annual O&M Cost
Supply System					
Required Looping				$122,800	$614
New Steel Pipeline	400	75	m	$45,000	$225
Urban treated supply pipe	25	300	m	$51,000	$255
	50	200	m	$36,000	$180
	75	250	m	$47,500	$238
	100	1000	m	$220,000	$1,100
Rural treated supply pipe	25	1600	m	$272,000	$1,360
	50	2300	m	$414,000	$2,070
	75	700	m	$133,000	$665
	100	800	m	$176,000	$880
Water Service Connections		140	ea	$140,000	$700
Rehab existing Pumpstation				$250,000	$1,250
New High Lift Treated Water Pumpstation	0.15 ML/day	3	kW	$104,500	$1,702
Reservoir		0.5	ML	$250,000	$1,250
Engineering and Contingencies		30%		$678,540	$3,747
Water Meters		180	@ $1000	$180,000	$900
WTP Land Acquisition		0.5	ha	$300,000	
Subtotal				**$3,420,000**	**$17,000**
Water Treatment					
Chemical Coagulation and Mixing	0.175 ML/day			$15,600	
Flocculation				$46,800	
Clarification				$109,200	
Filtration				$132,600	
Primary Disinfection				$23,400	
Secondary Disinfection					
Residuals Management				$31,200	
Subtotal				**$358,800**	**$18,896**
TOTAL				**$3,778,800**	**$35,896**

Table 3-2a
OPTION 2a
Osoyoos Lake Treated Domestic Supply (POE in Rural Residences)

Component	Size	Quantity	Units	Capital Cost	Initial Annual O&M Cost
Supply System					
Required Looping				$122,800	$614
New Steel Pipeline	400	75	mm	$45,000	$225
Urban treated supply pipe	25	300	m	$51,000	$255
	50	200	m	$36,000	$180
	75	250	m	$47,500	$238
	100	1000	m	$220,000	$1,100
Water Service Connections		140	ea	$140,000	$700
Rehab existing to Low Lift Pumpstation				$250,000	$1,250
New High Lift Treated Water Pumpstation	0.1 ML/day	2	kW	$103,000	$1,468
Reservoir		0.5	ML	$250,000	$1,250
Engineering and Contingencies		30%		$379,590	$2,184
Water Meters		180	@ $1000	$180,000	$900
WTP Land Acquisition		0.5	ha	$300,000	
Subtotal				**$2,125,000**	**$10,000**
Water Treatment					**$18,896**
Chemical Coagulation and Mixing	0.126 ML/day			$15,600	
Flocculation				$46,800	
Clarification				$109,200	
Filtration				$132,600	
Primary Disinfection				$23,400	
Secondary Disinfection				$0	
POE devices for rural systems		40	@$6,600	$264,000	$30,000
Residuals Management				$31,200	
Subtotal				**$622,800**	**$48,896**
TOTAL				**$2,747,800**	**$58,896**

Table 3-3
OPTION 3
Groundwater Domestic Supply

Component	Size	Quantity	Units	Capital Cost	Initial Annual O&M Cost
Supply System					
Required Domestic Looping				$122,800	$614
New Steel Pipeline	400	75	m	$45,000	$225
Urban treated supply pipe	25	300	m	$51,000	$255
	50	200	m	$36,000	$180
	75	250	m	$47,500	$238
	100	1000	m	$220,000	$1,100
Rural treated supply pipe	25	1600	m	$272,000	$1,360
	50	2300	m	$414,000	$2,070
	75	700	m	$133,000	$665
	100	1200	m	$264,000	$1,320
Water Service Connections		180	ea	$180,000	$900
Well Installations		3	ea	$375,000	$3,750
Reservoir		0.5	ML	$250,000	$1,250
Engineering and Contingencies		30%		$723,090	$4,178
Water Meters		180	@ $1000	$180,000	$900
Well Land Acquisition		0.5	ha	$300,000	
Subtotal				**$3,613,000**	**$19,000**
Water Treatment					
Chemical Coagulation and Mixing					
Flocculation					
Clarification					
Filtration					
Primary Disinfection	0.175	ML/day		$23,400	$1,466
Secondary Disinfection					
Residuals Management					
Subtotal				**$23,400**	**$1,466**
TOTAL				**$3,636,400**	**$20,466**

Table 3-3a
OPTION 3a
Groundwater Domestic Supply (POE at rural residences)

Component	Size	Quantity	Units	Capital Cost	Initial Annual O&M Cost
Supply System					
Required Domestic Looping				$122,800	$614
New Steel Pipeline	400	75	m	$45,000	$225
Urban treated supply pipe	25	300	m	$51,000	$255
	50	200	m	$36,000	$180
	75	250	m	$47,500	$238
	100	1200	m	$264,000	$1,320
Water Service Connections		140	ea	$140,000	$700
Well Installations		3	ea	$375,000	$3,750
Reservoir		0.5	ML	$250,000	$1,250
Engineering and Contingencies		30%		$399,390	$2,559
Water Meters		180	@ $1000	$180,000	$900
Pump Station Land Acquisition		0.5	ha	$300,000	
Subtotal				**$2,211,000**	**$12,000**
Water Treatment					
Chemical Coagulation and Mixing					
Flocculation					
Clarification					
Filtration					
Primary Disinfection	0.126 ML/day			$23,400	$1,240
POE devices for rural systems		30	@$6,600	$198,000	$30,000
Secondary Disinfection					
Residuals Management					
Subtotal				**$221,400**	$31,240
TOTAL				**$2,432,400**	**$43,240**

Table 3-4
OPTION 4
Osoyoos Lake Supply with Point of Entry Systems (POE)

Component	Size	Quantity	Units	Capital Cost	Initial Annual O&M Cost
Supply System					
Required Looping				$154,300	$772
New Steel Pipeline	400	75	ML	$45,000	$225
Rehabilitate existing Pump station				$250,000	$1,250
Engineering and Contingencies		30%		$134,790	$674
Water Meters		180	@ $1000	$180,000	$900
Subtotal				**$764,000**	**$3,820**
Water Treatment					
Chemical Coagulation and Mixing					
Flocculation					
Clarification					
Filtration					
Primary Disinfection					
POE devices for all systems		180	@$6,600	$1,188,000	$135,000
Secondary Disinfection					
Residuals Management					
Subtotal				**$1,188,000**	**$135,000**
TOTAL				**$1,952,000**	**$138,820**

Regional District of Okanagan-Similkameen
Osoyoos Irrigation District Water Supply Improvement Options Review
Technical Memorandum No. 1
Table 4
Water Treatment Cost Estimates

TREATMENT OPTION	ESTIMATED COST (See Note 1) Chemical Coagulation and Mixing	Flocculation	Clarification	Filtration	Primary Disinfection	Secondary Disinfection	Residuals Treatment	TOTAL CAPITAL COST	ANNUAL O&M COST	20 YEAR O&M COST	PRESENT VALUE O&M
Option 1 - Osoyoos Lake Treated Supply			13.3	ML/day	2400	ML					3%
DISINFECTION (WITHOUT FILTRATION)											
Chlorination					$519,675			$519,675	$29,823	$ 596,465	$443,694
Ozone/Chlorination					$3,464,500	$519,675		$3,984,175	$247,202	$ 4,944,046	$3,677,746
UV/Chlorination					$1,732,250	$519,675		$2,251,925	$143,792	$ 2,875,841	$2,139,263
FILTRATION											
Direct Filtration/UV	$346,450	$1,039,350		$3,637,725	$1,732,250	$519,675	$692,900	$7,968,350	$451,210	$ 9,024,208	$6,712,872
Conventional Filtration	$346,450	$1,039,350	$2,425,150	$2,944,825	$519,675		$692,900	$7,968,350	$451,210	$ 9,024,208	$6,712,872
Membrane Filtration	$346,450	$1,039,350		$5,543,200	$519,675		$692,900	$8,141,575	$639,846	$ 12,796,913	$9,519,287
Option 2 - Osoyoos Lake Treated Domestic Supply					0.18	ML/day					
DISINFECTION (WITHOUT FILTRATION)											
Chlorination					$23,400			$23,400	$1,466	$ 29,320	$21,810
Ozone/Chlorination					$156,000	$23,400		$179,400	$12,670	$ 253,400	$188,498
UV/Chlorination					$78,000	$23,400		$101,400	$7,475	$ 149,500	$111,209
FILTRATION											
Direct Filtration/UV	$15,600	$46,800		$163,800	$78,000	$23,400	$31,200	$358,800	$22,010	$ 440,200	$327,453
Conventional Filtration	$15,600	$46,800	$109,200	$132,600	$23,400		$31,200	$358,800	$22,010	$ 440,200	$327,453
Membrane Filtration	$15,600	$46,800		$249,600	$23,400		$31,200	$366,600	$30,350	$ 607,000	$451,531
Option 2a - Osoyoos Lake Treated Domestic Supply (POE in Rural Residences)					0.13	ML/day					
DISINFECTION (WITHOUT FILTRATION)											
Chlorination					$23,400			$23,400	$1,240	$ 24,790	$18,441
Ozone/Chlorination					$156,000	$23,400		$179,400	$9,839	$ 196,781	$146,380
UV/Chlorination					$78,000	$23,400		$101,400	$5,635	$ 112,698	$83,833
FILTRATION											
Direct Filtration/UV	$15,600	$46,800		$163,800	$78,000	$23,400	$31,200	$358,800	$18,896	$ 377,919	$281,124
Conventional Filtration	$15,600	$46,800	$109,200	$132,600	$23,400		$31,200	$358,800	$18,896	$ 377,919	$281,124
Membrane Filtration	$15,600	$46,800		$249,600	$23,400		$31,200	$366,600	$27,519	$ 550,381	$409,414

Note 1: Cost estimates for each treatment process include process equipment, all associated ancillary equipment, electrical & instrumentation, associated structures and siteworks, and associated residuals handling plus 30% allowance for engineering and contingencies.

Table 5.
Water Treatment Unit Costs

Process	Larger System Base Cost Per ML/d (1)	Smaller System Base Cost Per ML/d (2)
Chemical Coagulation and Mixing	$26,000	$31,200
Flocculation	$78,000	$93,600
Clarification		
-Conventional Tube or Plate Settler	$182,000	$218,400
Filtration		
-High Rate (12 m/hr)	$273,000	$327,600
-High Rate (18 m/hr)	$221,000	$265,200
-Membrane	$416,000	$499,200
Primary Disinfection		
-Chlorine	$39,000	$46,800
-Ultraviolet	$130,000	$156,000
-Ozone	$260,000	$312,000
Residuals Treatment		
-Plate Settler/Thickener Centrifuge	$52,000	$62,400
Add this when no san sewer available		

Notes
(1) Based on 5 ML/d plant size and larger
(2) Based on 4 ML/d plant size and smaller
(3) All costs include a 30% allowance for engineering & contingencies

Table 6
Unit Costs - Buried Pipe

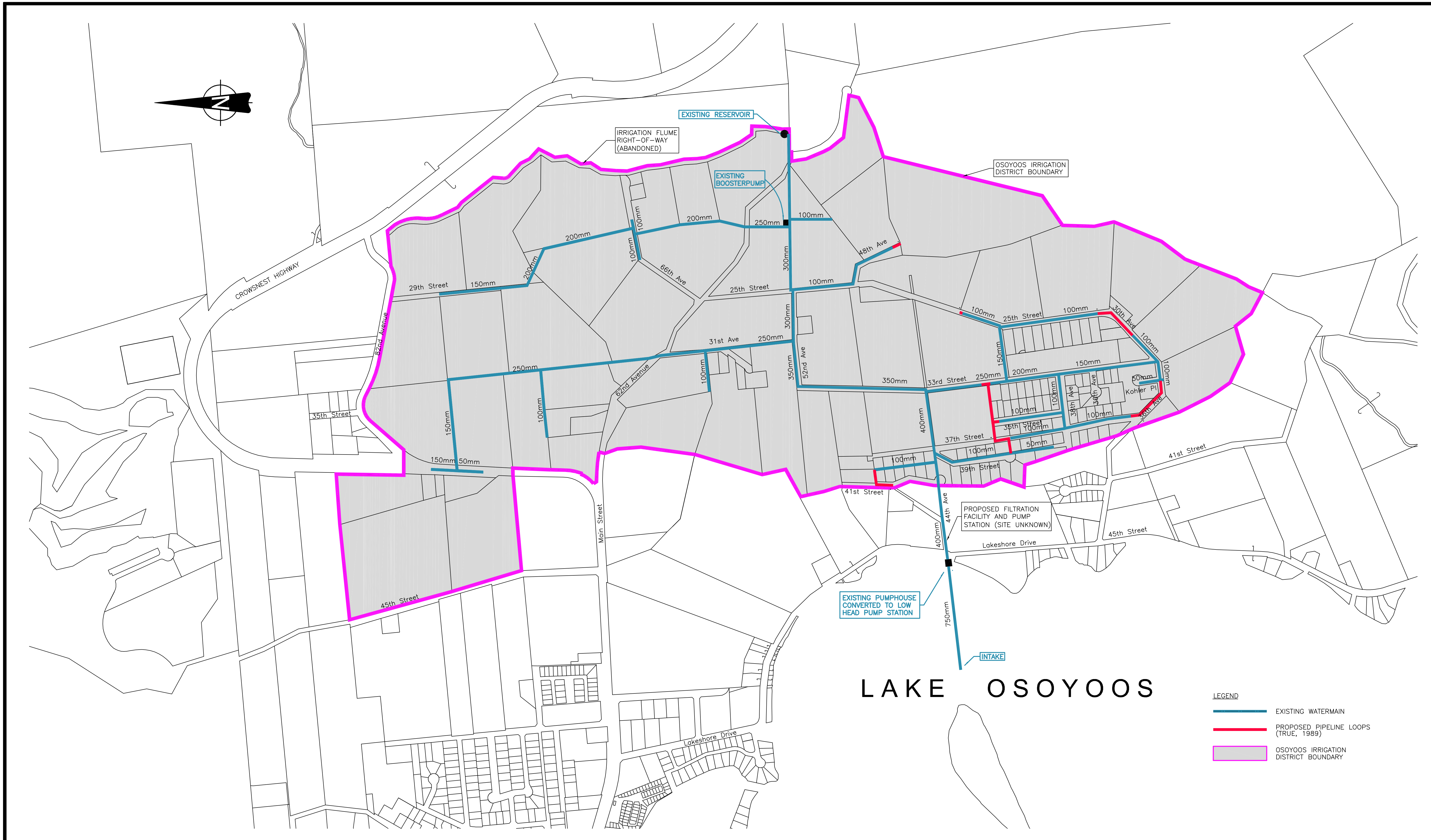
Diameter	Pipe Supply & Install (1)	Hydrants & Valves (2)	Pavement Restoration	Total Excl Pavement	Total Incl Pavement
25	$70	$25	$75	$95	$170
50	$80	$25	$75	$105	$180
75	$90	$25	$75	$115	$190
100	$120	$25	$75	$145	$220
150	$140	$40	$75	$180	$255
200	$190	$45	$75	$235	$310
250	$240	$50	$75	$290	$365
300	$290	$55	$75	$345	$420
350	$340	$60	$90	$400	$490
400	$390	$65	$90	$455	$545
450	$440	$70	$90	$510	$600
600	$590	$75	$100	$665	$765
750	$740	$80	$100	$820	$920
900	$890	$90	$100	$980	$1,080

Notes:

(1) PVC or DI Pipe
(2) Assumes buried line valves, one hydrant per 100m, one air valve assembly per 500m
(3) Costs do not include engineering and contingencies

APPENDIX B - MAPS

This Drawing Is For The Use Of The Client And Project Indicated
No Representations Of Any Kind Are Made To Other Parties



NO.	DATE	ENG.	BY	SUBJECT

REVISIONS

VERIFY SCALES

BAR IS 20mm ON ORIGINAL DRAWING

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IF NOT 20mm ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PRELIMINARY
NOT FOR CONSTRUCTION

Associated Engineering

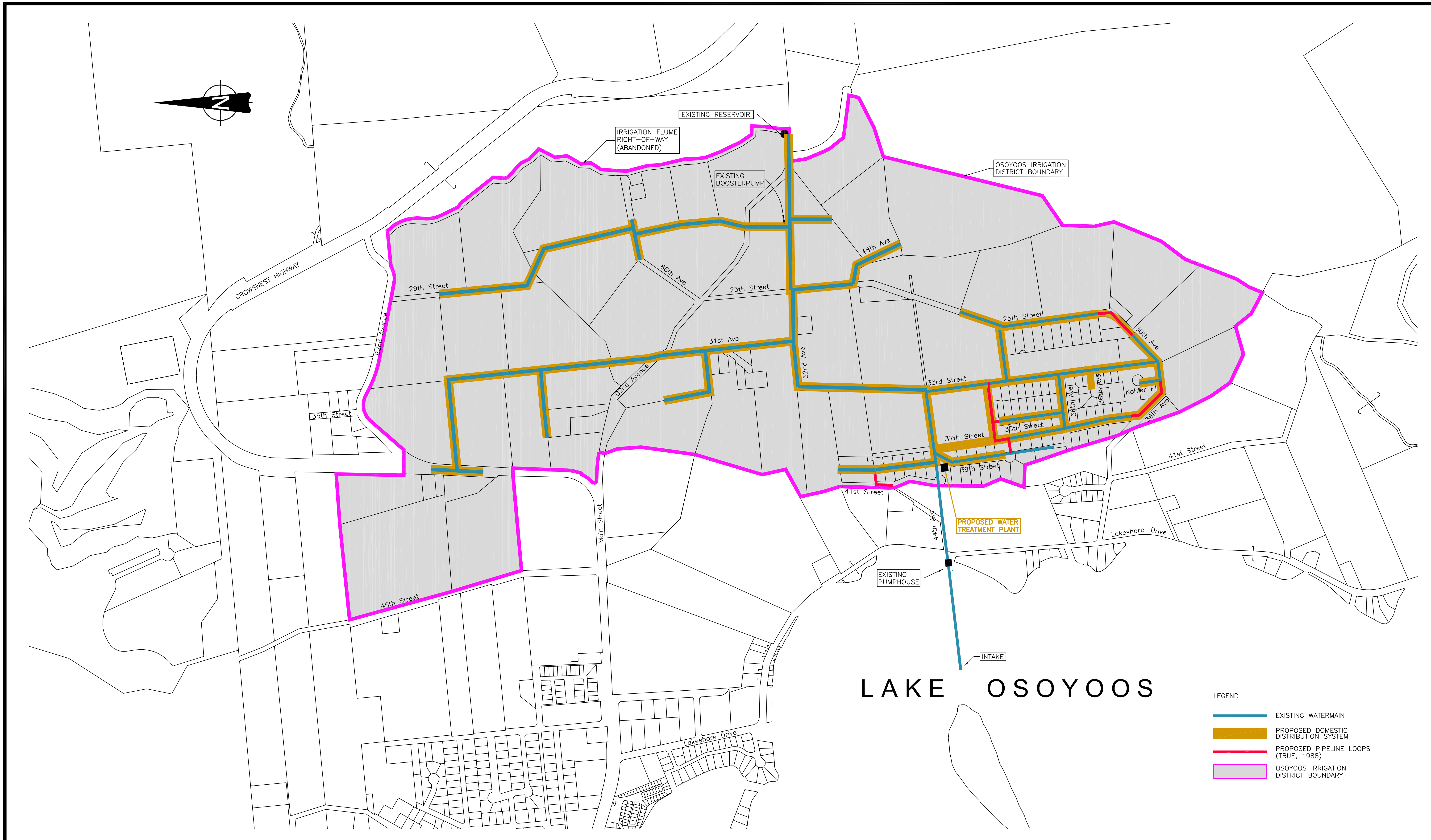
PROJECT No.	2007-2074	
SCALE	1:5000	
DRAWN	K. WADDELL	
DESIGNED	R. MacLEAN	
CHECKED		
APPROVED		
DATE		INITIAL

REGIONAL DISTRICT OF OKANAGAN-SIMILKAMEEN

OPTION 1
OSOYOOS LAKE TREATED SUPPLY

OSOYOOS IRRIGATION DISTRICT
WATER SUPPLY IMPROVEMENTS

DRAWING NUMBER	REV. NO.	SHEET
PLAN 1-1		1 / 5



NO.	DATE	ENG.	BY	SUBJECT
REVISIONS				

VERIFY SCALES

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PRELIMINARY
NOT FOR CONSTRUCTION

Associated Engineering

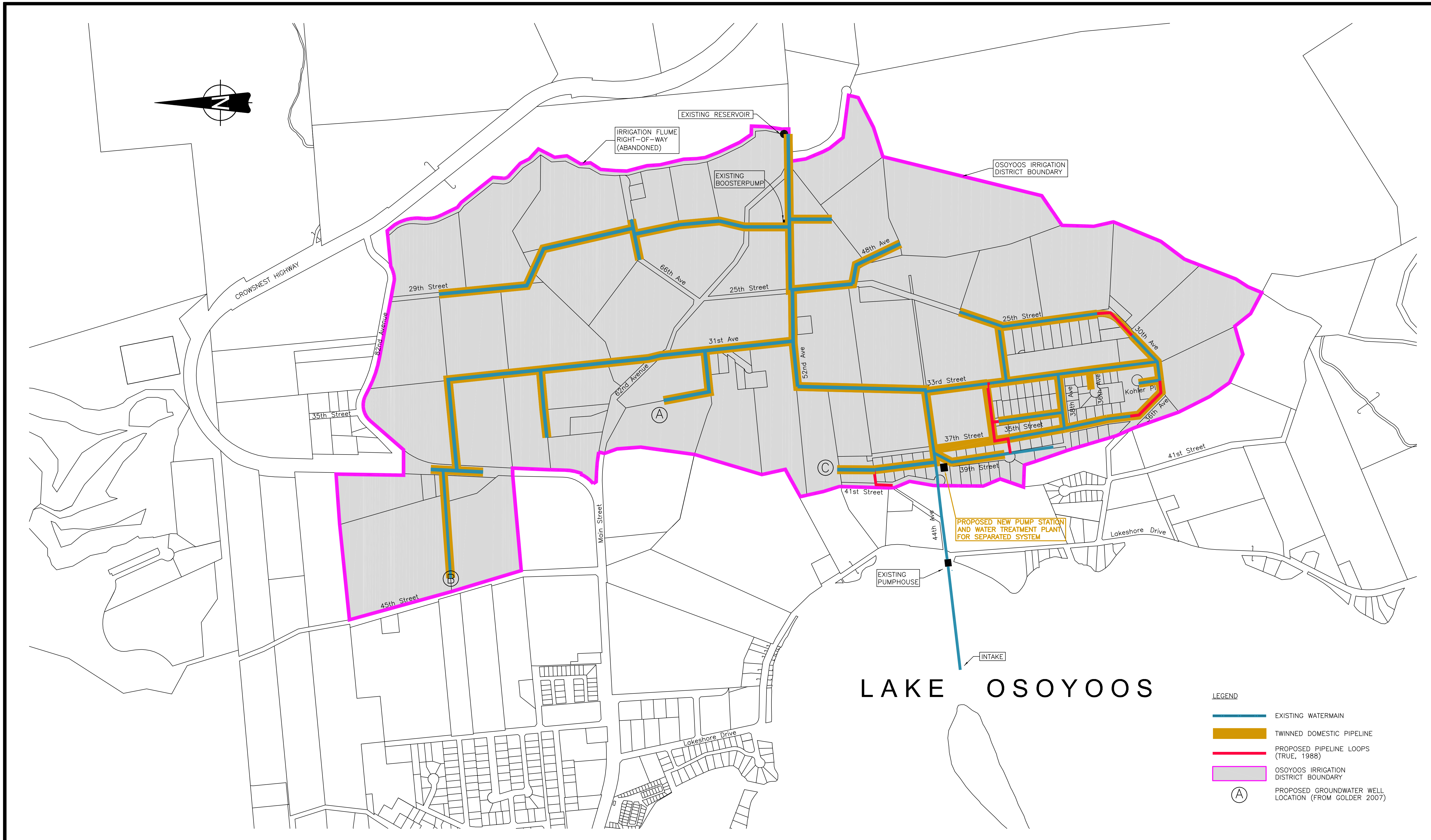
PROJECT No.	2007–2074	
SCALE	1:5000	
DRAWN	K. WADDELL	
DESIGNED	R. MacLEAN	
CHECKED		
APPROVED		
DATE		INITIAL

REGIONAL DISTRICT OF
OKANAGAN-SIMILKAMEEN

OPTION 2
OSOYOOS LAKE TREATED
DOMESTIC SUPPLY

OSOYOOS IRRIGATION DISTRICT
WATER SUPPLY IMPROVEMENTS

DRAWING NUMBER	REV. NO.	SHEET
PLAN 1-2		2/5



NO.	DATE	ENG.	BY	SUBJECT

REVISIONS

VERIFY SCALES

BAR IS 20mm ON ORIGINAL DRAWING

0 20mm

IF NOT 20mm ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PRELIMINARY
NOT FOR CONSTRUCTION

Associated Engineering

PROJECT No.	2007-2074	
SCALE	1:5000	
DRAWN	K. WADDELL	
DESIGNED	R. MacLEAN	
CHECKED		
APPROVED		
DATE		INITIAL

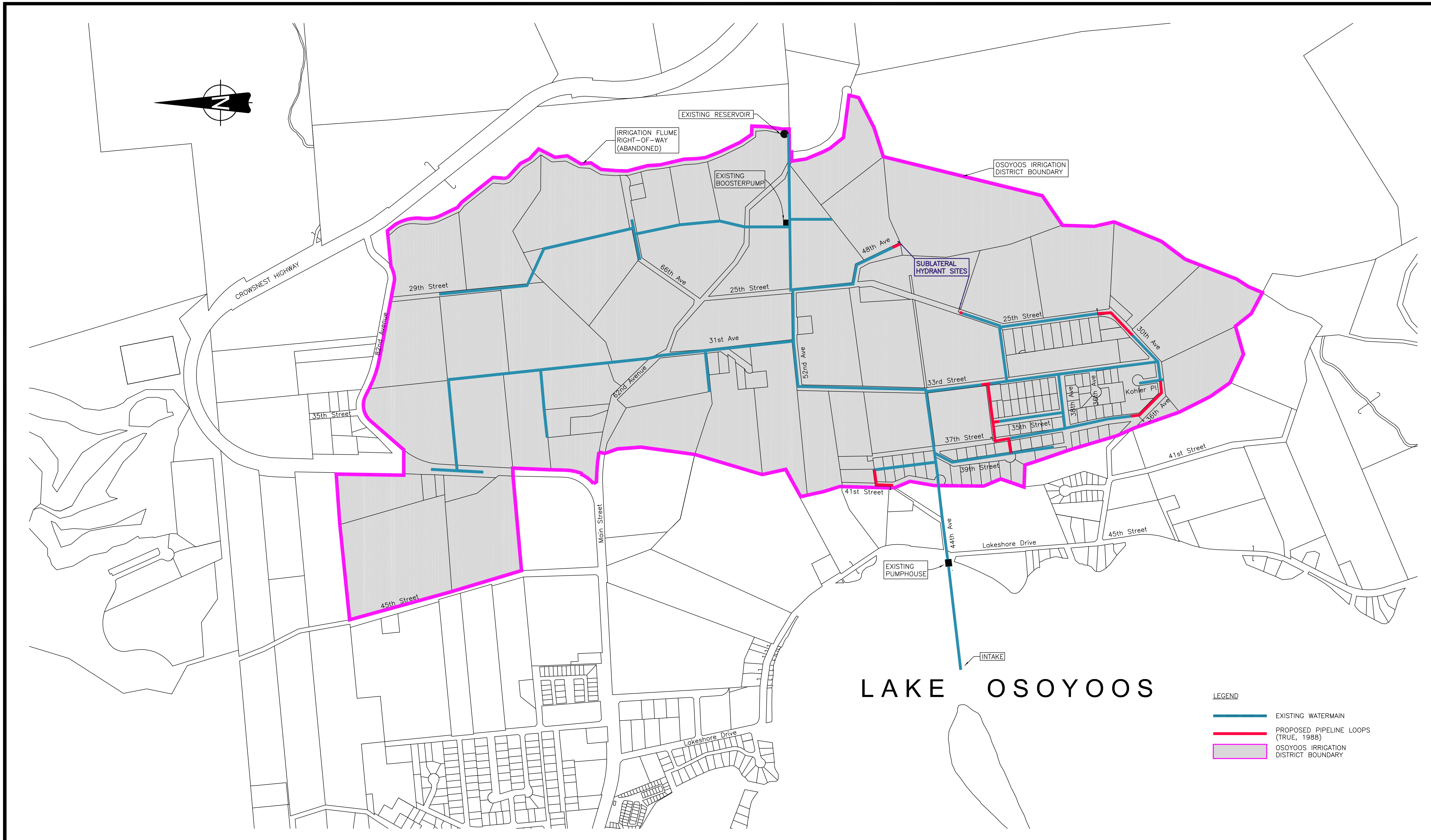
REGIONAL DISTRICT OF OKANAGAN-SIMILKAMEEN

OPTION 3
GROUND WATER DOMESTIC SUPPLY

OSOYOOS IRRIGATION DISTRICT WATER SUPPLY IMPROVEMENTS

DRAWING NUMBER	REV. NO.	SHEET
PLAN 1-3		3/5

This Drawing Is For The Use Of The Client And Project Indicated
No Representations Of Any Kind Are Made To Other Parties



NO.	DATE	ENG.	BY	SUBJECT

REVISIONS

VERIFY SCALES

BAR IS 20mm ON ORIGINAL DRAWING

0 20mm

IF NOT 20mm ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PRELIMINARY
NOT FOR CONSTRUCTION

Associated Engineering

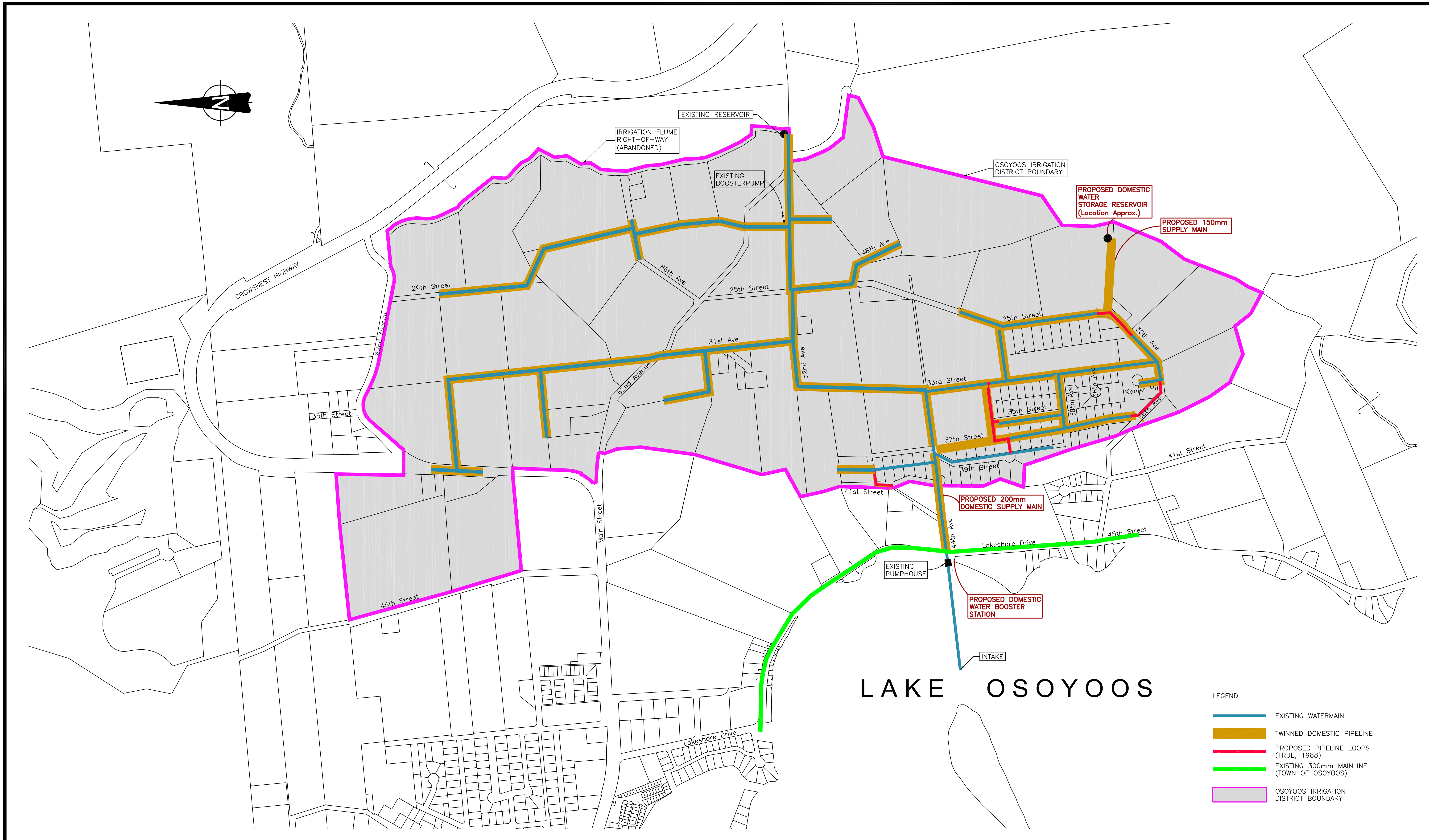
PROJECT No.	2007-2074	
SCALE	1:5000	
DRAWN	K. WADDELL	
DESIGNED	R. MacLEAN	
CHECKED		
APPROVED		
DATE		INITIAL

REGIONAL DISTRICT OF
OKANAGAN-SIMILKAMEEN

OPTION 4
OSOYOOS LAKE WITH POINTS OF ENTRY

OSOYOOS IRRIGATION DISTRICT
WATER SUPPLY IMPROVEMENTS

DRAWING NUMBER	REV. NO.	SHEET
PLAN 1-4		4 / 5



NO.	DATE	ENG.	BY	SUBJECT

REVISIONS

VERIFY SCALES
BAR IS 20mm ON ORIGINAL DRAWING
0 20mm
IF NOT 20mm ON THIS SHEET, ADJUST SCALES ACCORDINGLY

PRELIMINARY
NOT FOR CONSTRUCTION

Associated Engineering

PROJECT No.	2007–2074	
SCALE	1:5000	
DRAWN	K. WADDELL	
DESIGNED	R. MacLEAN	
CHECKED		
APPROVED		
DATE		INITIAL

REGIONAL DISTRICT OF
OKANAGAN-SIMILKAMEEN

OPTION 5
TOWN OF OSOYOOS SUPPLY

OSOYOOS IRRIGATION DISTRICT
WATER SUPPLY IMPROVEMENTS

DRAWING NUMBER	REV. NO.	SHEET
PLAN 1-5		5 / 5

APPENDIX C - LETTER FROM TOWN OF OSOYOOS

June 19, 2008

Mr. Wayne Baldwin, CAO
Regional District Okanagan Similkameen
101 Martin Street, Penticton, BC
V2A 5J9

RE: Town Water Service for the Osoyoos Irrigation District

Dear Wayne:

I am responding to your letter received June 5, 2008 requesting whether or not the Town of Osoyoos would consider providing water to the Osoyoos Irrigation District community and if so under what conditions and costs.

The request went before Council for consideration. The town currently has a permanent seasonal boil water advisory for Water System 8 & 9 to address. The plan is to address the System 8 & 9 boil water advisory by the construction of a twin domestic system supplied by the Town's municipal system. Yet to be determined is whether the overall plan will be approved by IHA and whether or not senior government will support the plan through grants. This solution must be established before it could be considered for areas outside these water servicing areas.

In addition, currently there is no reserve capacity in the Town's municipality water system. Capacity to supply irrigation systems 8 & 9 is proposed to be provided by proposed well no. 7 and/or water conservation i.e. universal metering program. At the present time, water quantity requirements necessary to supply systems 8 & 9 are estimates. It would therefore be appropriate to not commit estimates of future municipal system reserve capacity to others until the System 8 & 9 Twin system are complete and actual demands are known.

At this time, Council is not considering the provision of water supply to the Osoyoos Irrigation District.

Yours truly,

Helen Koning, MPA
Chief Administrative Officer

TOWN OF OSOYOOS, P.O. Box 3010, 8707 Main Street, OSOYOOS, British Columbia, V0H 1V0
Telephone 250.495.6515 Facsimile 250.495.2400 Website www.osoyoos.ca

REGIONAL DISTRICT
RDOS
OKANAGAN-SIMILKAMEEN

101 Martin Street, Penticton, British Columbia V2A 5J9
Tel: 250.492.0237 Fax: 250.492.0063
Toll Free: 877.610.3737
Email: info@rdos.bc.ca

May 29, 2008

File No.: 5330.20

Helen Koning,
Administrator
Town of Osoyoos
PO Box 3010
Osoyoos, BC V0H 1V0

Dear Helen:

Re: Town Water Service for the Osoyoos Irrigation District

The Regional District of Okanagan Similkameen(RDOS) is conducting a feasibility study on behalf of the Osoyoos Irrigation District (OID) in order to determine options to improve their water system to meet current health and engineering standards. To this end we have retained Associated Engineering to review various options to improve the water system and their costs. The community is currently under a permanent Boil Water Advisory. One of the options that the RDOS would like to review is whether or not the Town of Osoyoos would consider providing water to the Osoyoos Irrigation District community and if so under what conditions and costs. It is our intent to review these options with the OID Board and their water users in order to determine the wishes of the community.

We believe there are two main options for water supply from the Town of Osoyoos that the community might consider:

1) Extraterritorial Service
   In this option the residents of the OID would remain part of the Regional District but would connect to the nearby Osoyoos water system. The water system would have to be transferred to the Town. The RDOS would apply for an infrastructure grant to construct a new domestic water system and to construct a new water well for the Town of Osoyoos. The Regional District community would be responsible for any capital costs the grant did not cover. In this option, there may be an opportunity for the Regional District to improve water capacity for the Town of Osoyoos at no cost to the Town's tax payers while providing water to the residents of the OID. The upgrade to the Town of Osoyoos water system would be in lieu of any development cost charges. It would be our preference to undertake these upgrades, as DCC costs can not be covered under Provincial/Federal grant programs.

2) Bulk Purchase of Water
   The ownership, maintenance and management of the OID water system would remain that of the OID or the Regional District. The town would simply sell water at a bulk rate to the community. Should the Town consider this option as the most feasible, would you please identify the cost at which water would be sold.

Should Council agree to any of these options would you please identify any additional conditions or circumstances that we should consider. Should you have any questions, concerns, or would like a presentation to Council, please do not hesitate to call Andrew Reeder, at (250) 490-4142.

Yours truly,

Wayne

Wayne Baldwin, MBA.,
CAO

AR/dk

cc: M. Pendergraft, Area A Director
L. Lobb, Chair OID
A. Reeder, Engineering Services Manager

APPENDIX D - GOLDER GROUNDWATER REPORT

Golder Associates Ltd.

220 - 1755 Springfield Road
Kelowna, British Columbia, Canada V1Y 5V5
Telephone (250) 860-8424
Fax (250) 860-9874

November 2, 2007 07-1440-0116

Associated Engineering (BC) Ltd.
Suite 420, 1628 Dickson Avenue
Kelowna, BC
V1Y 9X1

Attention: Mr. Bill Harvey, P.Eng.

RE: PRELIMINARY ASSESSMENT OF GROUNDWATER AVAILABILITY SOUTHEAST OSOYOOS, BRITISH COLUMBIA

Dear Mr. Harvey:

Golder Associates Ltd. (Golder) is pleased to provide this letter, summarizing the results of our preliminary groundwater availability assessment for the development of groundwater as a potable water supply in southeast Osoyoos, BC (Figure 1). It is understood that this preliminary feasibility study will be included with the results of Associated Engineering (BC) Ltd.'s (Associated's) larger feasibility study regarding possible improvements to the Osoyoos Irrigation District water supply system, which currently provides irrigation and potable water to the area.

1.0 BACKGROUND

The Osoyoos Irrigation District (OID) water system currently services approximately 140 domestic connections and 40 agricultural connections in an area located on the east side of Osoyoos Lake, in Osoyoos, BC, hereafter referred to as the "Study Area". The Study Area is generally bounded by the Town of Osoyoos and Osoyoos Lake to the west, Highway 3 and Osoyoos Indian Band lands to the north, undeveloped land and Anarchist Mountain to the east and undeveloped and agricultural land to the south (Figure 2).

Currently, the OID supplies potable and irrigation water to the Study Area using a single surface water intake in Osoyoos Lake. It is understood that, at times, the OID water supply does not meet the Guidelines for Canadian Drinking Water Quality (GCDWQ) or the Interior Health Authorities 4-3-2-1-0 water quality objectives. As such, the Regional District of Okanagan Similkameen (RDOS) has requested that a feasibility study regarding alternate water supply options for the Study Area be conducted. This letter provides the results of the preliminary groundwater assessment component of the alternate water supply feasibility options for the Study Area.

2.0 SCOPE AND METHODOLOGY

The objective of this assessment was to collect hydrogeological information for the Study Area to provide a preliminary assessment regarding the feasibility of developing a groundwater supply within the Study Area. The scope of work was outlined in our April 20, 2007 proposal entitled *"Workplan and Cost Estimate for Preliminary Assessment of Groundwater Availability, Southeast Osoyoos, British Columbia"*, and included the following:

- Review of groundwater (hydrogeological) and geological reports, databases and maps;

- Preparation of a hydrogeological report, summarizing the information and providing conclusions and recommendations.

3.0 RESULTS

3.1 Site Characterization

The Study Area is located approximately 0.5 km east of Osoyoos Lake, and approximately 1.5 km north of the common Canada/United States border. The topography of the area is moderately sloping towards Osoyoos Lake. The elevation of the area ranges from approximately 290 meters above sea level (masl) along the western portion of the Study Area to 380 masl along the eastern portion of the Study Area (Department of Energy, Mines and Resources, 1975).

Land use in this area is predominantly agricultural with some residential areas throughout.

3.2 Climate

The climate of Osoyoos is characterized as semi-arid desert. Golder reviewed climate data compiled by Environment Canada from the nearest long-term reporting weather station, the Osoyoos West Station (ID#1125865), located at 49°1.800' N latitude and 119° 26.400' W longitude, at an elevation of approximately 297.2 m (Environment Canada, Canadian Climate Data Online). This weather station is located approximately 300 m from the most western boundary of the Study Area, along the eastern shore of Osoyoos Lake. The Osoyoos area experiences hot, dry summers and cool, moderately moist winters, with an average temperature of 10.1°C. Daily mean temperatures range from a minimum of -2.1°C in January to a maximum of 21.7°C in July.

Significant moisture deficits occur in the area due to high evaporation and low precipitation during the summer months. Based on the data provided for the years 1971 to 2000, the mean annual total precipitation for the weather station is approximately 317 mm, with a monthly mean total precipitation ranging from 16 mm in September to 37 mm in May.

3.3 Surficial Geology

The surficial geology of the Okanagan Valley (the Valley) is dominated by glacial and post-glacial deposits derived from the erosion of the bedrock in the Valley and adjacent upland areas, followed by various stages of deposition. The resultant landforms along the edges of, and in the base of, the Valley are complex and include alluvial fans, deltas and associated gullies and stream channels (Nasmith, 1962). The sediment types associated with the landforms include lacustrine silt and clay, glacial and glacial-fluvial deposits of till, clay, silty sand, sand and gravel and more recent fluvial and alluvial sediments.

Nasmith's 1962 publication on the *"Late Glacial History and Surficial Deposits of the Okanagan Valley"* describes the landforms, as well as sediment types, through a sequence of depositional events. The sequence of events is divided into pre-glacial, glacial advance/occupation/retreat and post glacial events, and can generally be described as follows.

Pre-glacial events in the Okanagan area include the deposition of sediments (the White Lake Formation) associated with a large river system which flowed through the Valley. The sediments buried a large portion of the existing volcanic terrain. This was subsequently followed by major tectonic activity including uplift and faulting, which created the Okanagan Fault and the complex bedrock geology of the area.

Additional volcanic activity (basalt flows) occurred after the faulting and uplift. Dissection (downward erosion) of the dominant stream channels along the edge of the Valley also occurred during this period.

Glacial advance and occupation was characterized by the buildup of ice across a large area which completely engulfed the Province of British Columbia. The thickness of ice reached as much as 3,000 m and the weight of the ice caused scouring of the underlying bedrock. Ice movement in the Valley was influenced by gravity, primarily away from accumulation areas, generally from north to south and from higher to lower elevations. Glacial retreat was characterized by "down melting" within the upland areas first and subsequently in the Valley itself. Stagnant ice created blockages, both within the tributaries which drained into the Valley and within the Valley itself, which resulted in the creation of Glacial Lake Penticton.

Melt water from the glaciers, combined with runoff from creeks and streams draining the surrounding plateau, flowed along the margin of the Valley eroding the outwash channels and depositing gravels and sands, sometimes on the edge of the ice and sometimes in ponds blocked in the tributary valleys by the ice.

Lacustrine (lake bottom) deposits associated with Glacial Lake Penticton predominate where the outwash has not cut away, generally between the current lake elevation (275 masl) and the maximum height of the former glacial lake (455 masl).

According to Nasmith, surficial deposits within the Study Area are associated with a period of glacial retreat, with outwash terrace deposits consisting of stratified drift material ranging in texture from fine coarse sand to coarse gravel.

3.4 Bedrock Geology

According to the British Columbia Water Resource Atlas (BCWRA), the bedrock geology in the Osoyoos Area is dominated by Middle Jurassic Granitic intrusions consisting of porphyritic granite, granodiorite and monzonite.

The majority of bedrock within the Study Area is covered by Quaternary (recent) sediments and is therefore not visible. However, bedrock outcrops are present along the eastern portion of and to the east of the Study Area. A major normal fault is present along the center of the Valley, on the north side of Osoyoos Lake, extending in a north-south direction. No faults were noted within the Study Area.

3.5 Aquifer Characterization

Golder reviewed information available from the BC Ministry of Environment (BCMoE) water well database (WELLS), and the on-line geographical interface, the BCWRA. Based on the review of this information, the Study Area is underlain by two aquifers. Aquifer No. 808 is present in the eastern portion of the Study Area, while Aquifer No. 194 is present in the western portion of the Study Area. According to the BCWRA, the central portion of the Study Area is not underlain with an aquifer. A description of the two aquifers identified to underlie the Study Area is as follows:

> *Aquifer No. 808:* Aquifer No. 808 is approximately 1.1 km^2 in area, and is identified as a bedrock aquifer. According to the WRA, this aquifer is reported to have a moderate productivity, moderate water demand, and a moderate vulnerability to surface contamination. There are no wells completed within the bedrock aquifer that are present in the Study Area. However, approximately 50 wells are completed within the bedrock aquifer, with the majority of the wells located to the east of the Study Area.
>
> *Aquifer No. 194:* Aquifer No. 194 is located on the eastern side of Osoyoos Lake, and extends approximately 1 km to the east from the lakeshore. The aquifer covers an area of approximately 4 km^2, and is composed of sand and gravel. According to the BCWRA, the aquifer is identified to have a moderate productivity, a moderate water demand, and a high vulnerability to surface contamination. Approximately 20 to 30 wells are completed within this aquifer within the Study Area. A review of the well logs indicates that the majority of the wells were constructed in the 1950s and 1960s to depths ranging from 3 m to 12 m below ground surface (mbgs). In addition, four wells were extended to greater depths, to a maximum of 21 mbgs. Static water levels at the time of drilling ranged from 1.3 mbgs to 16.8 mbgs. Only one well log, Well Tag Number (WTN) 69182, indicated a driller's well yield of approximately 2.5 L/sec (40 USgpm).

According to the WELLS database, four wells including WTN 17776, 16261, 13944 and 19593, are present in the central portion of the Study Area, between the two aquifers. Information on the well logs indicates that the central portion of the Study Area is underlain mainly by silts and sands to a depth of 9 m, and further underlain with sands and gravels. The deepest of these four wells, WTN 19593, was completed at a depth of approximately 11.6 mbgs and encountered layers of silts and sands, underlain by sands and gravel. The static level of WTN 19593 is approximately 9.1 mbgs.

In addition, a third aquifer is identified in the BCWRA to the west of the Study Area. This aquifer is identified as Aquifer No. 195 and consists of a sand and gravel aquifer located along the shores of Osoyoos Lake. The aquifer is identified to have a moderate productivity, a low water demand and a moderate vulnerability.

The extents of the three aquifers in relation to the Study Area are shown on Figure 3. In addition, all the well logs for wells located within the Study Area are summarized in Table 1.

3.6 Aquifer Recharge

Based on a review of the stratigraphic information, it is understood that a sand and gravel aquifer is present within the western portion of the Study Area. Subsurface stratigraphy consists of fractured bedrock overlain with sand and gravels, which are further overlain with silts and sands towards the east. It can be inferred that the sand and gravel deposits are limited in lateral extent to the east, as they appear to decrease in thickness towards the bedrock outcroppings.

Recharge to the sand and gravel underlying the western portion of the Site likely occurs as a result of the following:

- Rainfall, snowmelt, and irrigation and septic return flows are assumed to represent the largest volume of recharge to the Study Area.

- Upwards recharge of water to the aquifer through the fractured bedrock; this is assumed to represent a relatively small amount of the total recharge.

- Overland surface water flow could contribute to the recharge of the aquifer, with the infiltration of surface water along the bedrock/soil interface zone in the eastern portion of the Study Area.

3.7 Groundwater Flow Direction and Hydraulic Gradient

There is insufficient information available to assess the groundwater flow direction and hydraulic gradient for the Study Area. However, assuming the aquifers are predominantly unconfined and that water levels follow a subdued replica of the surface topography, it is inferred that groundwater flow within the Study Area flows from the east to the west, towards Osoyoos Lake.

3.8 Water Quality

The Study Area is located in a primarily agricultural area with vineyards and orchards. Due to the dry climate, water is used mainly for irrigation. It is unknown whether or not water quality data for the private water wells exists. However, due to the semi-confined/unconfined nature of the aquifer, it is possible that water quality within the aquifer may be adversely impacted by the use of septic systems, pesticides and fertilizers, as well as above ground fuel storage tanks.

3.9 Preliminary GUDI Assessment

As part of the "Drinking Water Quality Improvement Program", the Interior Health Authority has requested that new public water supply wells be subjected to an assessment to determine if the ground water source could potentially be classified as groundwater under the direct influence of surface water (GUDI). The Province of British Columbia does not have a formal regulation with respect to evaluating if groundwater is considered to be GUDI. As such, the Ontario Ministry of Environment (OMoE) protocols were followed as outlined in the Ministry document entitled "Terms of Reference for Hydrogeological Study to Examine Groundwater Sources Potentially Under Direct Influence of Surface Water" dated October 2001. The document states that community wells are "flagged" as potentially under the direct influence of surface water if they:

- Regularly contain Total Coliforms and/or periodically contain E. coli; or,
- Are located within approximately 50 days horizontal saturated travel time from surface water, or are within 100 m (overburden wells) or 500 m (bedrock wells) of surface water (whichever is greater) *and meet one or more* of the following criteria:
    - Wells may be drawing water from an unconfined aquifer;
    - Wells may be drawing water from formations within approximately 15 m of surface;
    - Wells are part of an enhanced recharge/infiltration project;
    - When the well is pumped, water levels in surface water rapidly change or hydraulic gradients beside the surface water significantly increase in a downward direction; and,
    - Chemical water quality parameters are more consistent with nearby surface water than local groundwater and/or they fluctuate significantly and rapidly in response to climatological or surface water conditions.

Our understanding is that a GUDI designation for a ground water source would require that the water from the well receive chemically assisted filtration and disinfection (or an equivalent treatment process).

With respect to GUDI, our review of the hydrogeological settings, surface topography and the location and type of surface water bodies in the area, indicate that the nearest water body is Osoyoos Lake which is located less than 300 m from the western portion of the Study Area. Due to the fact that the fine grained sediments present in the eastern part of the Study Area do not appear to be continuous, the sand and gravel aquifer can be inferred to be semi-confined to unconfined. Furthermore, there is no information regarding the microbiological water quality of wells in the area. Based on the above, there is insufficient information available at this time to confirm whether or not a well drilled within the Study Area could be considered a GUDI well.

4.0 DISCUSSION AND RECOMMENDATIONS

Based on a review of the stratigraphic information, it is understood that a sand and gravel aquifer is present within the western portion of the Study Area. Subsurface stratigraphy consists of fractured bedrock overlain with sand and gravels, which are further overlain with silts and sands towards the east. The sand and gravel deposits are limited in lateral extent to the east, as they appear to decrease in thickness towards the bedrock outcroppings.

Based on the above, it can be inferred that a water supply well could likely be successfully completed within the sand and gravel aquifer present in the Study Area. Although the base of the aquifer was generally not identified within the reviewed well logs, the target depth of the aquifer is estimated to be between approximately 15 mbgs to 30 mbgs. Furthermore, as the available information regarding well yield for the existing wells in the area is limited, it is not possible to estimate the potential sustainable quantity available from a new well. It is likely however, that the yield attainable will be less than the maximum reported yield in the area of 2.5 L/sec (40 USgpm).

The following recommendations are provided:

- As water quality of the aquifer could be a concern, due to its vulnerability to impacts from land uses within the area, it is recommended that water quality testing be completed for a full suite of parameters including metals, fertilizers, pesticides and microbiology be conducted to determine the quality of groundwater before the construction of a test well. It is recommended that two or three water samples be collected from several existing private water wells within the Study Area.

- Should the results of the water sampling program indicate the water quality is acceptable, it is recommended that a test well be drilled at a location yet to be selected. In order to minimize the potential that the test well would be classified as GUDI, the proposed test well location should maximize the distance from Osoyoos Lake (minimum of 100 m from the Lake) and potential sources of contaminant concern.

- Following completion of a test well, it is recommended that a variable-rate pumping test and 72 constant rate pumping test be carried out to assess aquifer properties and the sustainable yield of the well. As part of the well testing, a water sample should be collected and submitted for chemical analyses to verify the water chemistry.

5.0 LIMITATIONS AND USE OF THIS REPORT

This report was prepared for the exclusive use of Associated Engineering (BC) Ltd. and their representatives and is intended to provide a preliminary assessment of the groundwater development potential for the area currently serviced by the Osoyoos Irrigation District. Any use which a third party makes of this report, or any reliance on, or decisions to be made based on it, are the responsibilities of such third parties. Golder accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this report.

The assessment is based on currently available information and does not account for mutual well interference created by additional wells which may be constructed in the future.

The assessment of groundwater conditions presented has been made using historical and technical data collected and information from sources noted in the report. The methodologies used to conduct field investigation, to analyze information and for the preparation of a technical report were performed according to current professional standards and practices in the groundwater field.

Golder has relied in good faith on information provided by third parties noted in this report. We accept no responsibility for any deficiency, misstatements or inaccuracies contained in this report as a result of omissions, misinterpretations or fraudulent acts of others. Furthermore, if new information is discovered during future work, including excavations, borings or other studies, Golder should be requested to provide amendments as required.

6.0 CLOSURE

We trust that this letter provides you with the information you require at this time. Should you have any questions or require additional information, please do not hesitate to contact the undersigned.

Yours very truly,

GOLDER ASSOCIATES LTD.

Remi Allard, M.Eng., P.Eng.
Senior Hydrogeologist, Associate

Jacqueline Foley, M.Sc.
Senior Hydrogeologist

Encl
KF/JF/RA/cfh

http://capws/07144001 16associatedengineeringosoyoosidwatersupplyosoyoos/reports/wp_final/07-1440-0116 groundwater potential osoyoos nov 2-07.doc

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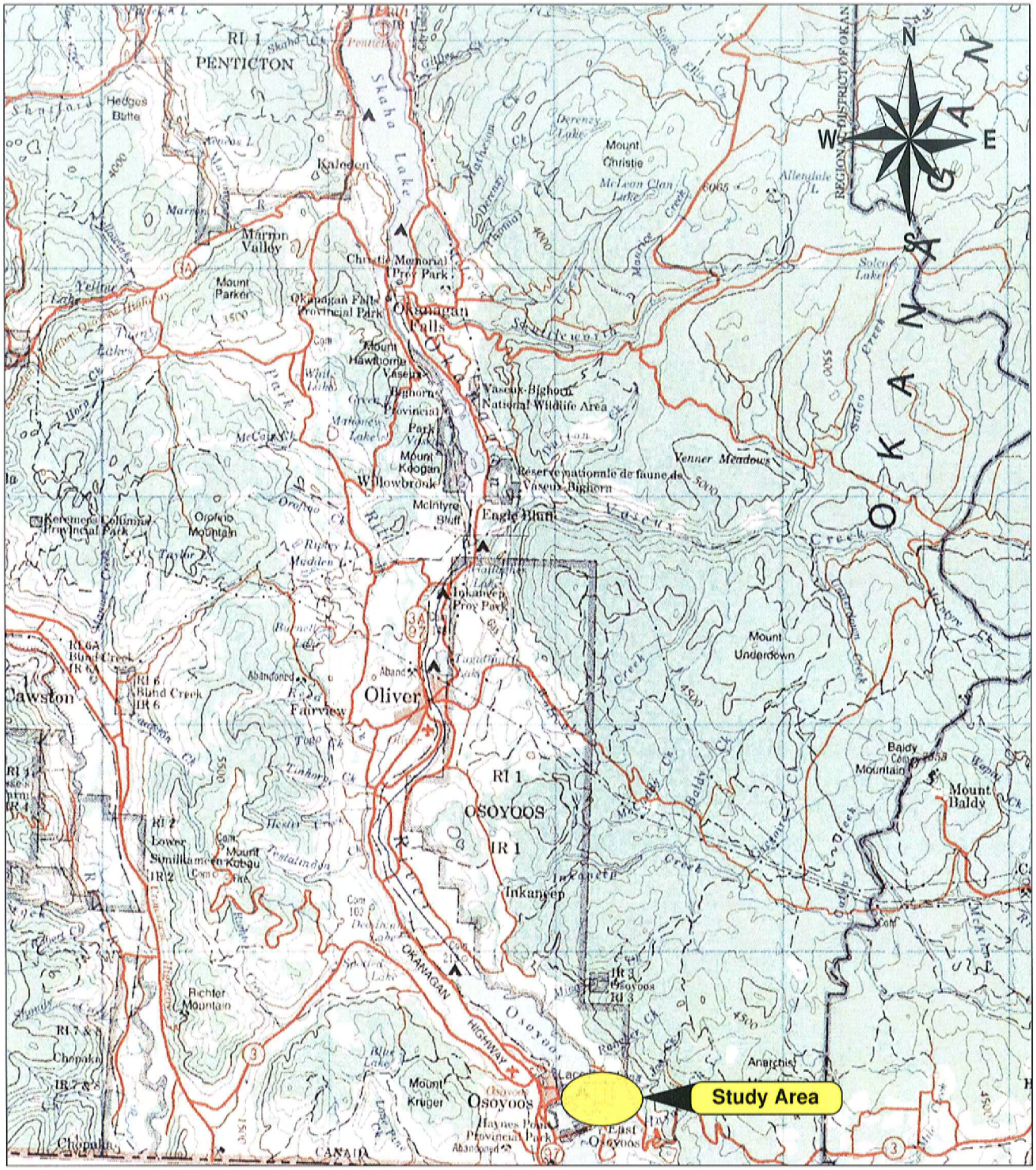
Table 1
BC MoE Water Resource Atlas
Summary of Well Information within Study Area
Osoyoos, British Columbia

Well Tag No.	Construction Date	Well Completion Depth (m)	Water Level (m)	Yield (USgpm)	Stratigraphy/Driller's Comments (depths in metres)
5113	1950-01-01	18.3	-	-	sand
5290	1950-01-01	2.1	-	-	silty fine sand, seems to flow underground through gravel, silt
5319	1950-01-01	1.8	1.2	-	sand, sand and gravel
5322	1950-01-01	0.0	-	-	no log given
13944	1953-01-01	3.7	1.8	-	silty sand and silt
14403	1955-01-01	8.5	1.5	-	sandy silty soil
14595	1956-01-01	4.3	2.4	-	sand and silt
15327	1958-01-01	9.8	9.4	-	yellow clayey silt with compacted layers, sand and silt
15764	1959-01-01	7.0	5.2	-	sand, hard silty layers, hard layers
16261	1960-01-01	2.4	0.9	-	old weathered rock, clay
16263	1960-01-01	9.4	7.9	-	sand and silt
16764	1961-01-01	4.3	3.0	-	silty loam, dark hard layers of silt
17252	1962-01-01	24.4	-	-	sand and silt, compact layers
17562	1962-08-01	3.0	1.8	-	sand and silt
17776	1963-01-01	9.1	4.6	-	sand and silt, sand and gravel at bottom
18227	1963-09-23	10.4	5.8	-	0-7.6 compacted silt rock and gravel, 7.6-10.4 fine sand and gravel
18328	1963-12-05	6.7	5.2	-	0-4.9 Fine sand compact, 4.9-5.2 big rocks, 5.2-6.7 very hard silt, clay-like
18347	1964-01-01	4.6	4.6	-	silty sand, clayey
18348	1964-01-01	15.8	12.8	-	very fine silty sand, silty
18647	1964-03-12	10.4	7.3	-	0-0.3 topsoil, 0.3-8.5 very fine sand, 8.5-9.8 fine sand with few rocks, 9.8-10.4 sand and silty clay
19417	1965-09-01	4.3	0.6	-	0-4.3 mixed fine sand, silt, clay, peat
19593	1966-01-01	11.6	9.1	-	0-3 Hard dry fine sand, 3-3.7 hardpan seam w rocks, 3.7-6.1 fine sand, 6.1-7.3 hardpan seam w rocks, 7.3-9.1 fine sand, 9.1-11.6 sand with rocks and gravel
19612	1966-01-01	21.3	16.8	-	0-1.8 Fine hard pack sand, 1.8-3.7 hard clay, 3.7-9.1 silty sand, 9.1-10.4 silt, 10.4-21.3 grey-blue-brown clay
20383	1967-01-01	7.3	5.8	-	0-0.9 topsoil, 0.9-5.8 coarse sand, 5.8-7.3 gravel
69182	1995-01-10	13.4	2.7	40	0-1.2 silty sand, 1.2-2.1 brown fine sand, 2.1-3.7 brown fine sand and traces of clay, 3.7-5.5 Grey wet silty sand, 5.5-5.8 dry till, 5.8-11.9 Water Producing fine silty sand, 11.9-13.7 water bearing sand and gravel, 45-47 clay,



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SCALE KILOMETRES

PROJECT	ASSOCIATED ENGINEERING OSOYOOS WATER SUPPLY OSOYOOS, B.C.
TITLE	**KEY PLAN**

REFERENCES

1.) **COORDINATE REFERENCE: UTM ZONE 11n, NAD83**
MAP REFERENCE: PRODUCED UNDER LICENSES GRANTED BY HER MAJESTY THE QUEEN IN RIGHT OF CANADA, REPRESENTED BY THE DEPARTMENT OF NATURAL RESOURCES, AND BY SOFTMAP TECHNOLOGIES INC.

Golder Associates
Kelowna, BC

PROJECT No. 07-1440-0116(2000)			FILE No. 0714400116_2000_1.dwg
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CADD	SWD	02/NOV/07	
CHECK	JF	02/NOV/07	**FIGURE: 1**
REVIEW	JF	02/NOV/07	

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LEGEND

OSOYOOS IRRIGATION DISTRICT BOUNDARY (STUDY AREA)

REFERENCES

1.) **COORDINATE REFERENCE: UTM ZONE 11n, NAD83**
MAP REFERENCE: OBTAINED FROM INTEGRATED LAND MANAGEMENT BUREAU, GOVERNMENT OF BRITISH COLUMBIA

PROJECT

ASSOCIATED ENGINEERING
OSOYOOS WATER SUPPLY
OSOYOOS, B.C.

TITLE

STUDY AREA PLAN

Golder Associates
Kelowna, BC

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REVIEW	JF	02/NOV/07		

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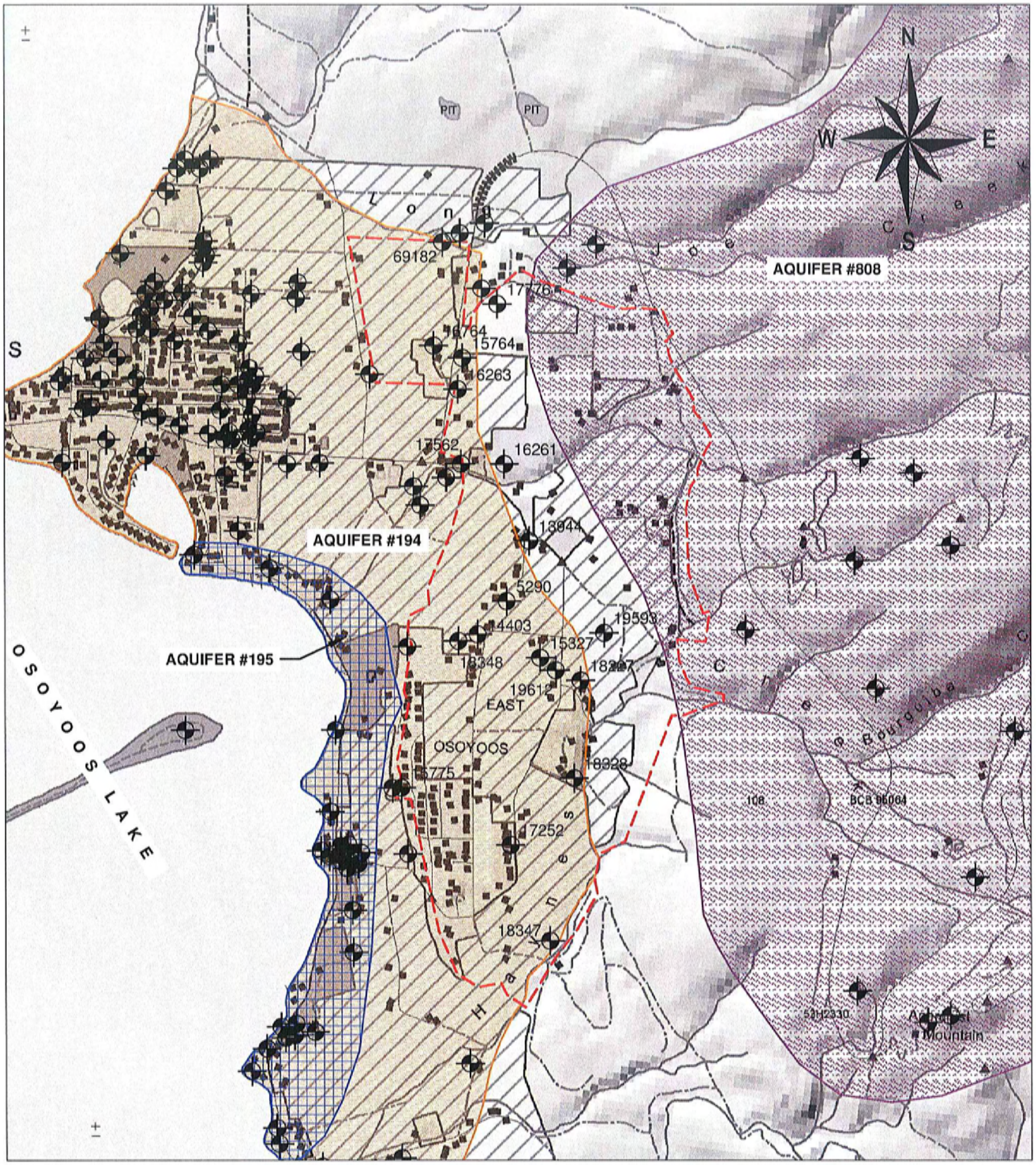

LEGEND

OSOYOOS IRRIGATION DISTRICT BOUNDARY (STUDY AREA)

AQUIFER #194

AQUIFER #195

AQUIFER #808

BC MOE WELL

REFERENCES

1.) **COORDINATE REFERENCE:** UTM ZONE 11n, NAD83
MAP REFERENCE: OBTAINED FROM INTEGRATED LAND MANAGEMENT BUREAU, GOVERNMENT OF BRITISH COLUMBIA

PROJECT

ASSOCIATED ENGINEERING
OSOYOOS WATER SUPPLY
OSOYOOS, B.C.

TITLE

AQUIFER LOCATION PLAN

Golder Associates
Kelowna, BC

PROJECT	No. 07-1440-0116(2000)		FILE No. 0714400116_2000_3.dwg
DESIGN	JF	02/NOV/07	SCALE AS SHOWN REV. 0
CADD	SWD	02/NOV/07	**FIGURE: 3**
CHECK	JF	02/NOV/07	
REVIEW	JF	02/NOV/07	

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