Regional District of
Okanagan-Similkameen

Okanagan Falls Sewage Treatment Plant – Strategic Review

Prepared for:
Regional District of Okanagan-Similkameen
101 Martin Street
Penticton, B.C.

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EarthTech
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DEFINITIONS AND ACRONYMS

AAF	Average Annual Flow
ALR	Agricultural Land Reserve
CCME	Canadian Council of Ministers of the Environment
DCC	Development Cost Charges
EDC	Endocrine Disruptor Compound
LWMP	Liquid Waste Management Plan
ML	Mega Litres (1,000,000 litres or 1,000 m^3)
NDMA	N-nitrosodimethylamine
OC	Operating Certificate
OCP	Official Community Plan
OMRR	Organic Matter Recycling Regulation
OWQC	Okanagan Water Quality Control
RBC	Rotating Biological Contactor
RDOS	Regional District of Okanagan Similkameen
RI	Rapid Infiltration
STP	Sewage Treatment Plant
WLAP	Water Land and Air Protection (Ministry of)

EXECUTIVE SUMMARY

A strategic plan for upgrade and financing of upgrades to the Okanagan Falls Sewage Treatment Plant is presented.

Upgrades to the treatment plant will require updates to the Liquid Waste Management Plan and amendments to the Operating Certificate and Official Community Plan

Consideration of expansion of the existing sewerage area was undertaken. Unit parcel costs for the Kaleden and Skaha Estates area were updated. The unit parcel costs for the Kaleden lakeshore area are higher than Skaha Estates due to the lower density - $22,250 versus $16,990. Additional costs for common conveyance infrastructure would add an additional $1,830 if both communities were sewered together. The unit costs for Kaleden are less favourable if the entire community is sewered.

Given the high cost of sewering Kaleden and Skaha Estates, monitoring is recommended to assess the impacts of septic fields on the water quality of Skaha Lake. The monitoring would involve flourimetry testing, water quality sampling and underwater observations where increased spikes in the detection rate are observed. In addition, phosphorus loading models developed as part of the Okanagan Water Quality Control Project should be updated. The data acquired from the testing and phosphorus modeling will allow the Regional District of Okanagan-Similkameen (RDOS) to monitor and record phosphorus impacts. These findings would provide the means for educating the public and supporting construction of a sewer system.

Based on a detailed assessment of various upgrade options for the Okanagan Falls Sewage Treatment Plant, the preferred option is to construct a new treatment plant located downstream of the existing plant near the feed-lot. However, the impact of funding the preferred option with no grant funding could have a significant impact on the annual single family tax rate. The single family tax bill would rise by up to $345 per annum. The cost would rise by $82 if 2/3 capital funding were obtained. To minimize tax increases, the RDOS should delay implementing a full upgrade until the amount of grant funding can be established.

Short-term upgrades will provide sufficient time to complete planning updates and establish grant funding. Once financing has been secured, either a staged or full upgrade can be initiated.

Based on the foregoing considerations, analyses and conclusions, the following recommendations are made:

1. The RDOS should undertake a treatment plant upgrade which involves constructing a new BNR facility downstream of the existing plant.

2. The Liquid Waste Management Plan will need to be updated. A review of the Official Community Plan should be undertaken concurrent with or subsequent to the Liquid Waste Management Plan update.

3. After the Liquid Waste Management Plan is updated and approved, the Operational Certificate should be amended.

4. A monitoring program should be undertaken for Skaha Lake to assess the impact of septic tank effluent from Skaha Estates and Kaleden. The monitoring should consist of fluorimetry testing and water quality sampling where detection is confirmed. Visual observation of the lake bottom should be made to corroborate points of detection.

5. As a second phase to the lake monitoring program, the original phosphorus loading calculations for Skaha Estates and Kaleden should be updated to account for new development. A comparison of the calculations would complement the lake monitoring program.

6. The RDOS should work with the Okanagan Falls Irrigation District to implement a water conservation strategy for the Okanagan Falls sewerage area. The program should include bylaws to require new development to install low flow fixtures. An education campaign could target existing users.

1.0 INTRODUCTION

In anticipation of continued population and economic growth in the south Okanagan, the Regional District of Okanagan-Similkameen has undertaken a strategic study of the Okanagan Falls sewerage area. The objective of the current strategic plan is to provide recommendations for upgrades to the Okanagan Falls Sewage Treatment Plant (STP) to accommodate near-term and long-term growth. In order to achieve this end, issues surrounding the existing treatment plant site and sewerage area expansion must be considered.

1.1 SCOPE OF WORK

Earth Tech has collected and reviewed documents relevant to the Strategic Review including

- *Feasibility Study of a Sanitary Sewerage System* (1975) by UMA Ltd.
- *East Skaha, Vaseux Official Community Plan* (2001)
- *Waste Management Plan for Electoral Areas A, C & D - Stage Three Report Summary* (1989) by True Engineering;
- *Okanagan Falls Area Sewerage Study* (1998) by Urban Systems Ltd.
- *Okanagan Falls Sewage Treatment Plant Capacity Assessment* (2004) by Urban Systems Ltd.

Preparation of the Strategic Plan has the following specific tasks:

- Assessment of current and future wastewater loading projections
- Assessment of the regulatory requirements for upgrades to the STP
- Development of a short-list of servicing options and assessment criteria
- Undertake a brainstorming sessions with the Okanagan Falls Public Advisory Commission (PAC) to gain feed-back on servicing options
- Prepare a decision matrix with and use PAC to weight the assessment criteria
- Recommend an upgrade option
- Prepare life-cycle cost estimates for the treatment options

- Develop a servicing concept for Kaleden and Skaha Estates
- Develop a monitoring program for Skaha Lake

2.0 BACKGROUND

The Okanagan Falls Sewage Treatment Plant (STP) is an oxidation ditch process, constructed in the late 1970's along with a piped sewer system. The Okanagan Falls STP is located near the confluence of Shuttleworth Creek and the Okanagan River (Figure 2-1). The treatment plant consists of a bar screen, oxidation ditch, clarifier and sludge drying beds. Clarified effluent from the plant is pumped to rapid infiltration basins located approximately 2.7 km from the STP.

Figure 2-2: Rapid Infiltration Basins (Foreground)

In 1989, the RDOS undertook a Liquid Waste Management Plan (LWMP) for Rural Osoyoos, Rural Oliver and Rural Okanagan Falls / Kaleden. The LWMP was completed by T.R. Underwood Engineering and determined that the Okanagan Falls STP was providing an adequate level of phosphorus removal. However, the Kaleden Lakeshore and Skaha Estates areas which area serviced by septic fields could potentially have an impact on Skaha Lake as the treatment systems began to age. The LWMP suggested a time frame of 1999-2004 for addressing phosphorus loading from Skaha Estates and Kaleden through sewering.

In the early 1990's, a multi-family development was permitted for construction adjacent to the existing treatment plant. The original sludge management system was not designed for odour control. As a result, the encroachment of development and loss of a buffer has increased the frequency of odour and noise complaints received to the RDOS.

Recent studies have highlighted the need to upgrade the existing sewage treatment plant. In a 1998 report by Urban Systems, it was reported that the capacity of the plant was constrained by the clarifier capacity. The clarifier was estimated in the report to have a capacity of 750 m^3/day, based on a surface loading rate of 10 – 13 m^3/day/m^2. A more recent report by Earth Tech suggests that the clarifier capacity is 850 m^3/day based on a surface overflow rate of 40 m^3/day/m and raw wastewater instantaneous peaking factor of 3. The difference does not change the recommendation that an upgrade is required. Even in 1997, maximum daily flows exceeding 900 m^3/day were recorded.

Effluent from the oxidation ditch process is pumped to a set of infiltration basins on Oliver Ranch Road, an elevation difference of approximately 65 metres. The most recent Urban Systems report (August, 2004) concludes that the maximum infiltration rate is limited to 800 m^3/day because of clogging or mounding in one of the basins. Since the basins are used sequentially, the reduced capacity of one basin results in a "bottleneck" in the effluent disposal operation. As a further complexity, the discharge of effluent has resulted in the formation of a small pond in a kettle located down-gradient of the basins. The pond, now referred to as Johnson Lake, provides habitat for indigenous aquatic species.

As a result of the limited disposal capacity and habitat issues, consideration needs to be given for the future long term disposal of effluent from the Okanagan Falls STP.

Figure 2-3: Johnson Lake

The three key issues that need to be addressed as part of a strategic review of long-term upgrade options are:

1. Existing Plant Capacity - the existing flows regularly exceed the theoretical capacity of the STP;

2. Future Growth – any treatment plant upgrades must allow for future growth in Okanagan Falls, as well as an expanded sewerage area which includes Kaleden and Skaha Estates; and

3. Local Impacts – treatment upgrades must be sensitive to the presence of local residents.

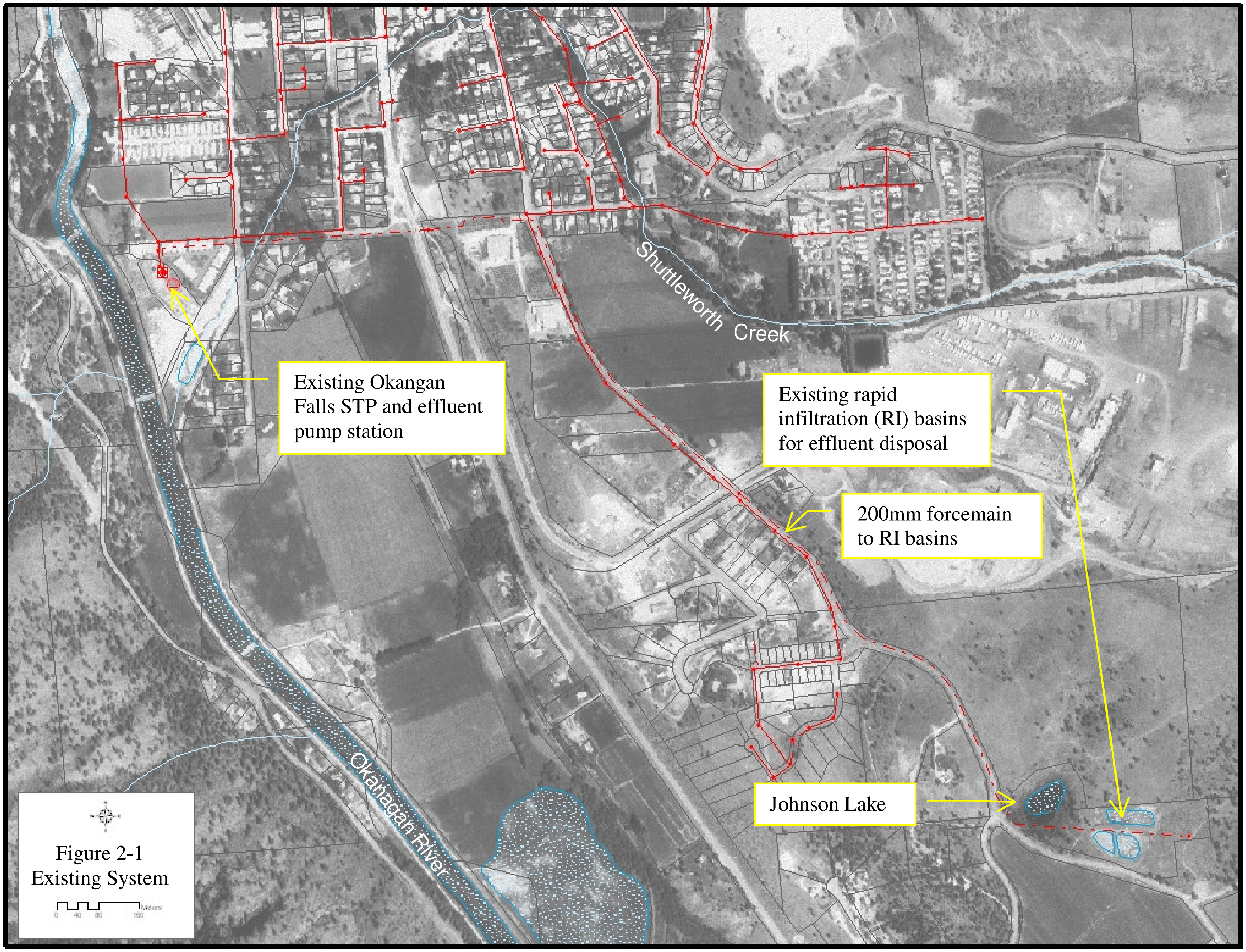


Figure 2-1
Existing System

2.1 POPULATION GROWTH ASSUMPTIONS

Okanagan Falls

Population growth projections from the East Skaha, Vaseux Official Community Plan (Bylaw No. 1708) indicate a low to medium annual residential growth rate to 2016. The current population of Okanagan Falls is estimated to be 1,380 people.

A low to medium growth rate corresponds to an annual population increase of 1.5% to 2.5%. Previous sewer studies have adopted a population growth rate of 2.0% for the Okanagan Falls sewerage area. For the purposes of projecting future flow rates and in the absence of any updated population growth figures, a 2.0% growth rate is adopted for this report.

There are currently 1,212 sanitary service connections within the Okanagan Falls sewerage area which includes both residential and commercial units.

While the average long-term growth rate target is 1.5 to 2.5%, short-term population growth can be substantially larger. Currently, development proposals being considered by the RDOS may result in an increase of up to 300 residential, multi-family and recreational units. It is assumed that the these new units are included in the 2.0% growth assumption.

Skaha Estates

Skaha Estates is an established community on the east shore of Skaha Lake. The current estimated population of Skaha Estates is 550 people. The community consists of a core area of single family residential lots, surrounded by larger agricultural or Crown Land holdings. The higher density single family area which is targeted for sewering is largely built-out and there is little opportunity for growth. As a result, a nominal 1.0% annual growth rate is assumed to account for densification after sewers are installed.

Kaleden

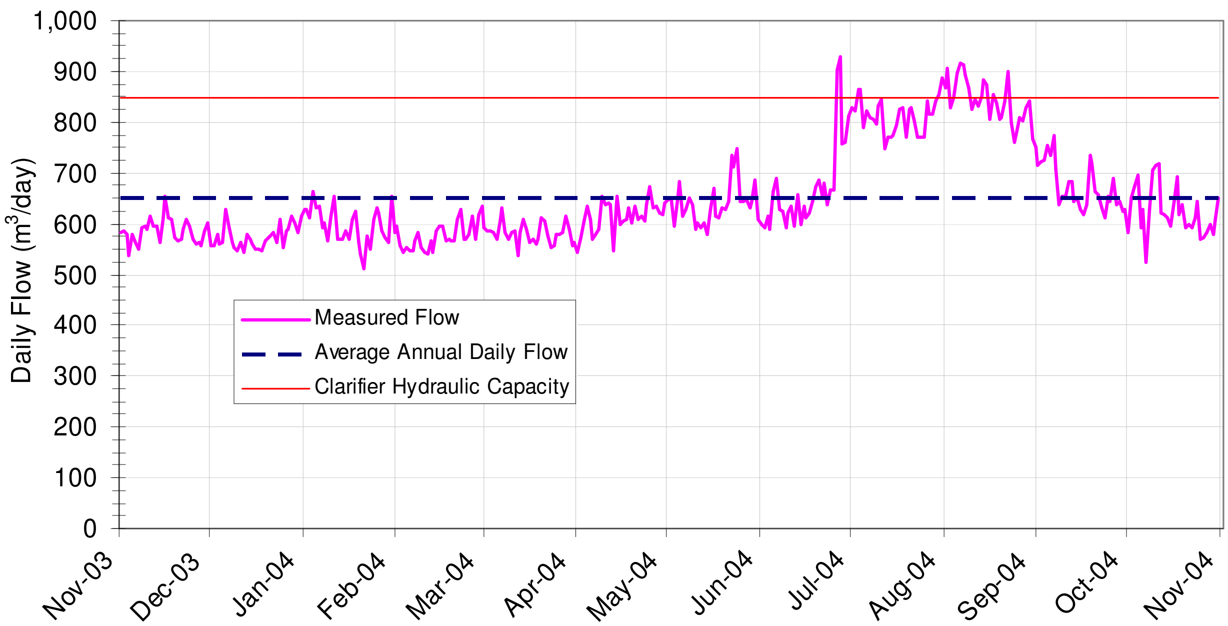
Kaleden can be characterized as a predominately rural community interspersed with areas of higher density single family development. The total population of the community is estimated to be 1,300 people. A relatively large proportion of the parcels occur along the lakeshore which is associated with the historical core of the community. Most of the existing parcels are built-out and subdivision of the larger, agricultural parcels is constrained by the Agricultural Land Reserve (ALR). As a result, a low population growth is assumed for Kaleden to take into account nominal densification.

An uncertain aspect of the future growth of the community relates to its proximity to the Penticton Indian Band and former site of the Okanagan Game Farm. The former Okanagan Game Farm which is no longer operational consists of a large parcel of relatively flat land at the western boundary of Kaleden, adjacent to Highway 97. The land is suitable for a residential subdivision or golf course development. There are no current plans for the site, however, the RDOS should anticipate some development in the long-term.

2.2 CURRENT INFLUENT WASTEWATER FLOW

Based on flow measurement data collected from November, 2003 to October 2004, the Average Annual Flow (AAF) to the facility is 650 m^3/day. The peak daily flow into the treatment plant was 930 m^3/day on June 27, 2004.

Figure 2-4: Measured Wastewater Flows to the Okanagan Falls STP



The daily flow to the STP is characterized by higher flows in the summer months from late June to early September. The flow characteristics to the STP for the period of November 2003 to November 2004 are summarized as follows:

- Average Annual Flow (AAF): 650 m^3/day
- Maximum Average Month Flow (August): 840 m^3/day

- Maximum Day Flow (June 27): 930 m^3/day
- Maximum Day Flow / AAF: 1.43
- Peak Hour Flow / Average Day Flow: 3.0 (assumed)

Although RDOS does not record peak instantaneous flows to the STP, the data available suggests that the STP is at approximately 80% of its theoretical capacity during AAF.

Based on the average annual flow of 650 m^3/day and existing population 1,380 people, the per capital wastewater contribution is 470 L/day. This calculated per capita flow rate in Okanagan Falls is at the high end of rates found in other areas of the Okanagan:

Penticton:	Average Day Flow (July, 2003) =	15.1 ML/day
	Residential Units Served =	13,500
	Total Population Served =	32,000
	Per Capita Flow =	472 L/capita/day
Vernon:	Average Day Flow (July, 2003) =	13.3 ML/day
	Population Served =	36,500
	Per Capita Flow =	363 L/capita/day
Kelowna:	Average Day Flow (July, 2003) =	30.8 ML/day
	Population Served =	70,500
	Per Capita Flow =	437 L/capita/day

The relatively high per capita wastewater flow rate in Okanagan Falls can be partially explained by the additional population associated with summer tourism. However, the data also suggest that water consumption in Okanagan Falls is higher than average. Therefore, a water conservation strategy in Okanagan Falls will have good potential for reducing wastewater flow rates to the treatment plant. The RDOS should work with the Okanagan Falls Irrigation District to implement a water conservation strategy for the Okanagan Falls sewerage area. The program should include bylaws to require new development to install low flow fixtures. An education campaign could target existing users.

For the purposes of sizing treatment components and projecting flows, an average per capita wastewater rate of 470 L/day will be used.

2.3 FUTURE INFLUENT FLOWRATE

Based on the above estimates of average unit per capita flow rates and populations, future wastewater flowrates can be projected. Table 2-1 provides an estimate of future populations and wastewater flow rates for Kaleden, Skaha Estates and Okanagan Falls. Based on these estimates, the maximum day wastewater flow into the treatment plant will be 2.2 ML/day in 2030, if the sewerage area is expanded to include both Skaha Estates and Kaleden. Based on the existing sewerage area which includes only Okanagan Falls, the future maximum day flow into the plant in 2030 is estimated to be 1.4 ML/day.

Table 2-1 – Projected Population and Wastewater Flow Rates

Year		Projected Population			Projected Flow (ML/day)			
		Okanagan Falls	Skaha Estates	Kaleden Lakeshore	Okanagan Falls, Kaleden & Skaha Estates		Okanagan Falls	
					Average Annual Daily Flow (ML/day)	Maximum Day Flow (ML/day)	Average Annual Daily Flow (ML/day)	Maximum Day Flow (ML/day)
2005	0	1,380	550	426	1.11	1.58	0.65	0.93
2006	1	1,480	556	430	1.16	1.66	0.70	0.99
2007	2	1,580	561	435	1.21	1.73	0.74	1.06
2008	3	1,680	567	439	1.26	1.80	0.79	1.13
2009	4	1,698	572	443	1.28	1.82	0.80	1.14
2010	5	1,715	578	447	1.29	1.84	0.81	1.15
2011	6	1,733	583	452	1.30	1.86	0.81	1.16
2012	7	1,751	589	456	1.31	1.88	0.82	1.18
2013	8	1,769	594	460	1.33	1.90	0.83	1.19
2014	9	1,786	600	464	1.34	1.92	0.84	1.20
2015	10	1,804	605	469	1.35	1.93	0.85	1.21
2016	11	1,822	611	473	1.37	1.95	0.86	1.22
2017	12	1,840	616	477	1.38	1.97	0.86	1.24
2018	13	1,857	622	482	1.39	1.99	0.87	1.25
2019	14	1,875	628	486	1.40	2.01	0.88	1.26
2020	15	1,893	634	491	1.42	2.03	0.89	1.27
2021	16	1,910	640	496	1.43	2.05	0.90	1.28
2022	17	1,928	646	500	1.44	2.07	0.91	1.30
2023	18	1,946	652	505	1.46	2.09	0.91	1.31
2024	19	1,964	658	509	1.47	2.10	0.92	1.32
2025	20	1,981	664	514	1.48	2.12	0.93	1.33
2026	21	1,999	669	519	1.50	2.14	0.94	1.34
2027	22	2,017	675	523	1.51	2.16	0.95	1.36
2028	23	2,035	681	528	1.52	2.18	0.96	1.37
2029	24	2,052	687	532	1.54	2.20	0.96	1.38
2030	25	2,070	693	537	1.55	2.22	0.97	1.39

2.4 REGULATORY ASESSMENT

The Operational Certificate (OC) for the Okanagan Falls STP was issued on January 12, 1999 in conformance with the Waste Management Act, which was the enabling legislation at that time. The OC was issued in accordance with the Approved Liquid Waste Management Plan (LWMP). The LWMP was submitted on Aug 24, 1989 and received Ministerial Approval on May 22, 1990.

A Liquid Waste Management Plan (LWMP) describes the strategy by which a community manages its liquid waste to ensure it meets MWLAP long-term objectives. The LWMP provides an implementation schedule and includes measures to accommodate future development. A LWMP authorizes the local government to discharge wastewater effluent in accordance with its OC. The Operational Certificate is a document that provides the conditions under which the discharge is to occur. Therefore, a LWMP and OC must be consistent.

A LWMP and an Official Community Plan (OCP) must also be in accord with one another. It is often good policy to review the OCP, either prior to or during the LWMP process to ensure that both reflect current conditions and the wishes of the community. The current Okanagan Falls OCP was last amended in 1996. Consideration should be given for updating this document, simultaneously with the LWMP review. While there is no legal requirement for a fixed timeframe, review of a LWMP should be updated every 5 years. Since the LWMP for the Okanagan Falls area was completed in 1989 – 16 years ago – a review is warranted.

Currently, there is an active sewer Public Advisory Committee (PAC) in the community and it is strongly recommended that this committee be consulted prior to commencing with the amendment to the existing LWMP. The existence of a PAC, while common when a LWMP is under development or amendment, indicates high level of interest in the community with respect to their sewage issues. This will likely make the LWMP process much smoother since some of the issues will already be known to the community.

Once the scope of the upgrades has been determined, it will be necessary to meet with Ministry of WLAP staff since it is a decision of the Regional Waste Manager that will allow for the use of a 2 stage process over a three stage process.

The LWMP can be updated to allow for a relocation of the Okanagan Falls STP. Long term expansion or relocation plans need to be formulated and confirmed in the LWMP and the needed land for future expansion into the foreseeable future acquired as soon as possible. If the strategic review determines that the entire plant should be relocated off the current site, the decision to require a 2 stage process over a 3 stage process will need to be discussed with Ministry of WLAP staff and the Regional Waste Manager. The 3 stage process includes a public consultation component and the public open house and the information bulletins that were sent out as part of this strategic plan could be considered as being part of the LWMP process. It is strongly recommended that the Senior Environmental Protection Officer in Penticton be consulted, so the MWLAP is aware of what is being planned, and can advise how the strategic review project could best be dovetailed into the LWMP update.

Sewage issues were discussed in a report prepared by Urban Systems entitled "Okanagan Falls Area Sewerage Study", issued in December 1998. The report discusses flows, treatment options and a collection area expansion to include Skaha Estates and Kaleden. This report was never utilized as a basis for an LWMP upgrade. The report bears some resemblance to the August 9, 2004, report by Urban Systems entitled "Okanagan Falls Sewage Treatment Plant Capacity Assessment". These earlier studies indicate a concern about sewering issues on the part of the Regional District and should be brought to the public's attention during the next LWMP amendment process.

The current site is very close to a nearby seniors' complex and will likely continue to generate complaints regardless of how well managed and high tech the operation should become. There is very little that can be done to ameliorate this proximity problem, short of moving the operation off-site. The issue of impacts to local residents and operation of future upgrades should be addressed as part of the LWMP amendment process.

A water conservation programme will be an essential component of the LWMP. Reducing water consumption can reduce the hydraulic loading on the sewage treatment plant. A public information program could also remind the public that garburators which are under the sink devices that turn waste food into organic slurry that adds to the biological load on the already taxed STP are prohibited in the current OC.

The Operational Certificate will need to be amended after the Minister approves the updated Liquid Waste Management Plan. New flow information, STP location, STP details and details regarding the disposition (Reuse and or disposal) of the effluent produced and reference to current legislation and regulations (specifically the Organic Matter Recycling Regulation) will need to be included. It is recommended that the RDOS or its consultant provide the first draft of the proposed Operational Certificate for review by the Ministry and the Regional District as Ministry staff have little time for such activities at present with their current level of staffing.

The current Okanagan Falls OC makes reference to the Waste Management Act, which has been superseded by the Environmental Management Act. Any such references will need to be updated in the amended OC that would be issued after the amended or updated LWMP has been approved by the Minister. Due to Ministry of WLAP staffing constraints it is recommended that the RDOS or its consultant prepare a "First Draft" of an amended OC. This draft OC would be based on an update of the old OC. It would be reviewed and suggestions for changes made by both Ministry and RDOS staff, a negotiation process that can take several weeks. The amended OC should contain estimated annual flows for at least 10 years into the future, and all the necessary constraints and monitoring requirements contained within the current OC but amended for current and future conditions as spelled out in the amended LWMP.

The current Operational Certificate contains a requirement for a "Sludge Management Plan" and such a report was prepared by Urban Systems, for the RDOS, dated April 2000, entitled "*OK Falls STP Sludge Management Plan*". Sludge management would be covered under the *Organic Matter Recycling Regulation* (OMRR). However, since there has been a LWMP developed and approved for Okanagan Falls it is preferable to include a sludge management plan in the updated LWMP. The siting and operational requirements should be consistent with the OMRR. Details of the sludge management plan could be brought to the attention of the public during the LWMP process when the sewage issues are raised. While issues of sludge management and the production of compost or biosolids could be included in the OC it is not recommended due to the unnecessary effort required and this issue would be better covered under the OMRR as part of the LWMP.

2.5 EMERGING ISSUES AND UNCERTAINTIES

As our understanding of the water environment improves and population densities increase, the trend towards more stringent discharge limits and the identification of more priority pollutants is likely to continue.

In addition to the normal domestic waste, sanitary flows can carry disease-causing pathogens and toxic substances such as motor oil, heavy metals, paint thinner, pesticide residues, and solvents. Most of these substances are known to have negative human and environmental impacts and are addressed through source controls and education. However, emerging research is uncovering new classes of compounds with toxic effects. The most potentially significant compounds included endocrine disruptors, NDMA and trace metals.

Endocrine Disruptor Compounds (EDC's) are substances that are capable of affecting the endocrine systems of biological organisms resulting in reproductive and immune system dysfunction, neurological, behavioural and developmental disorders, and possibly certain forms of cancer. Sources of EDC's include natural estrogens, animal hormones, alkylphenols (used in the manufacture of plastics), phytoestrogens (natural plant excretions), pharmaceuticals (therapeutic compounds and birth control pills) and detergents. Interest in this class of compounds started in the late 1990's with the advent of equipment able to detect the chemicals at extremely low levels in the environment. Research has been directed towards understanding the risks posed by these compounds, their fate in the environment and development of wastewater treatment processes to remove EDC's.

NDMA (N-nitrosodimethylamine) is a by-product of municipal wastewater disinfection of wastewater effluent and results from the reaction of monochloramine and organic nitrogen containing compounds. NDMA is a probable human carcinogen. On-going research is being conducted to correlate various factors with NDMA levels. Possible influences on NDMA production includes plant operation, pH levels, nutrient levels, TSS levels, the extent of nitrification / denitrification and the concentration of possible precursors.

Pharmaceuticals include a variety of drugs which are not fully metabolized and enter the sanitary sewer system. Research is being undertaken to determine possible links of some of these medications to morphological anomalies in aquatic species.

Trace Metals Toxicity results from ingestion of elements such as lead, mercury, cadmium, arsenic and copper which occur naturally in the water, sediment, and biota. Elevated levels are frequently found in sediments around sources of municipal effluent but are usually in a form that is not readily taken up by organisms and so pose little direct threat to aquatic life. However, under some circumstances not fully understood, heavy metals can change into forms available to organisms, making them highly toxic. Contaminated sediments may persist as sources of metals, particularly to bottom-dwelling organisms and their predators, causing a deterioration in the water environment quality.

The impacts of climate change introduce additional uncertainties. Recently, Environment Canada released a report summarizing research on climate change within the Okanagan Basin (*Expanding the Dialogue on Climate Change and Water Management in the Okanagan Basin*, 2004). The report concludes that climate change within the Okanagan will result in less precipitation and a longer growing season in the future. The increasing demand for irrigation water due to a longer growing season will further strain dwindling water resources.

In order to promote inter-jurisdictional cooperation and coordination on environmental issues, the Canadian Council of Ministers of the Environment (CCME) was established. The CCME is a collection of federal, provincial and territorial ministers. A technical steering committee works with the CCME to provide on-going advice. In this way, member governments can respond quickly to emerging issues, set national environmental strategies and develop long-term plans. Currently, the CCME is working on a Canada-wide strategy for managing wastewater effluent discharges. In addition to development of a harmonized national regulatory framework, the CCME will prepare action plans on emerging issues and develop a risk management model for various pollutants. The work being undertaken by the CCME will provide important tools for future management of wastewater effluent discharges.

In the short-term, the CCME task force has identified chlorine and ammonia as priority pollutants in wastewater effluent discharges to receiving waters and we expect national standards will be set. In the Okanagan Basin, the Municipal Sewage Regulation requires removal of both ammonia and phosphorus. Therefore, any consideration of surface water discharges should provide for UV disinfection to address future national standards.

3.0 SEWERAGE AREA EXPANSION

The Okanagan Falls sewerage area could be expanded to include Kaleden and Skaha Estates (Figure 3-1). The original LWMP Stage 1 Report dated March 1988, prepared by TRUE for the RDOS notes that "… the Skaha Estates area is constructed on mapping polygons having moderate to Very High phosphorus transmission classifications. Recognizing that the entire Skaha Estates area has a phosphorus transmission rate of Moderate or higher, the objective of an alternative sewerage system will be to service the entire area." The high water table along the Kaleden Lakeshore coupled with 'High' to 'Very High' phosphorus transmission classifications make the Kaleden Lakeshore area a concern, as well.

The Stage 2 report suggested that the costs did not justify sewering Kaleden and Skaha Estates at that time and the project was given a low action priority. The Skaha Estates and Kaleden portions of the project could eventually proceed and it was suggested that the appropriate easements be procured in the meantime.

In 1998, Urban Systems assessed the costs to include Skaha Estates and the Kaleden Lakeshore area into the Okanagan Falls Sewerage Area.

To address the potential inclusion of Kaleden and Skaha Estates in the Okanagan Falls Sewerage Area a servicing plan is proposed. The servicing plan presented builds on the Urban Systems report (1998).

For Kaleden, the option of sewering the bench area, in addition to the lakeshore area is investigated to determine whether servicing the entire community would reduce the unit cost of servicing only the Lakeshore area. Construction cost estimates for each of the communities were based on similar work carried out recently in the Okanagan.

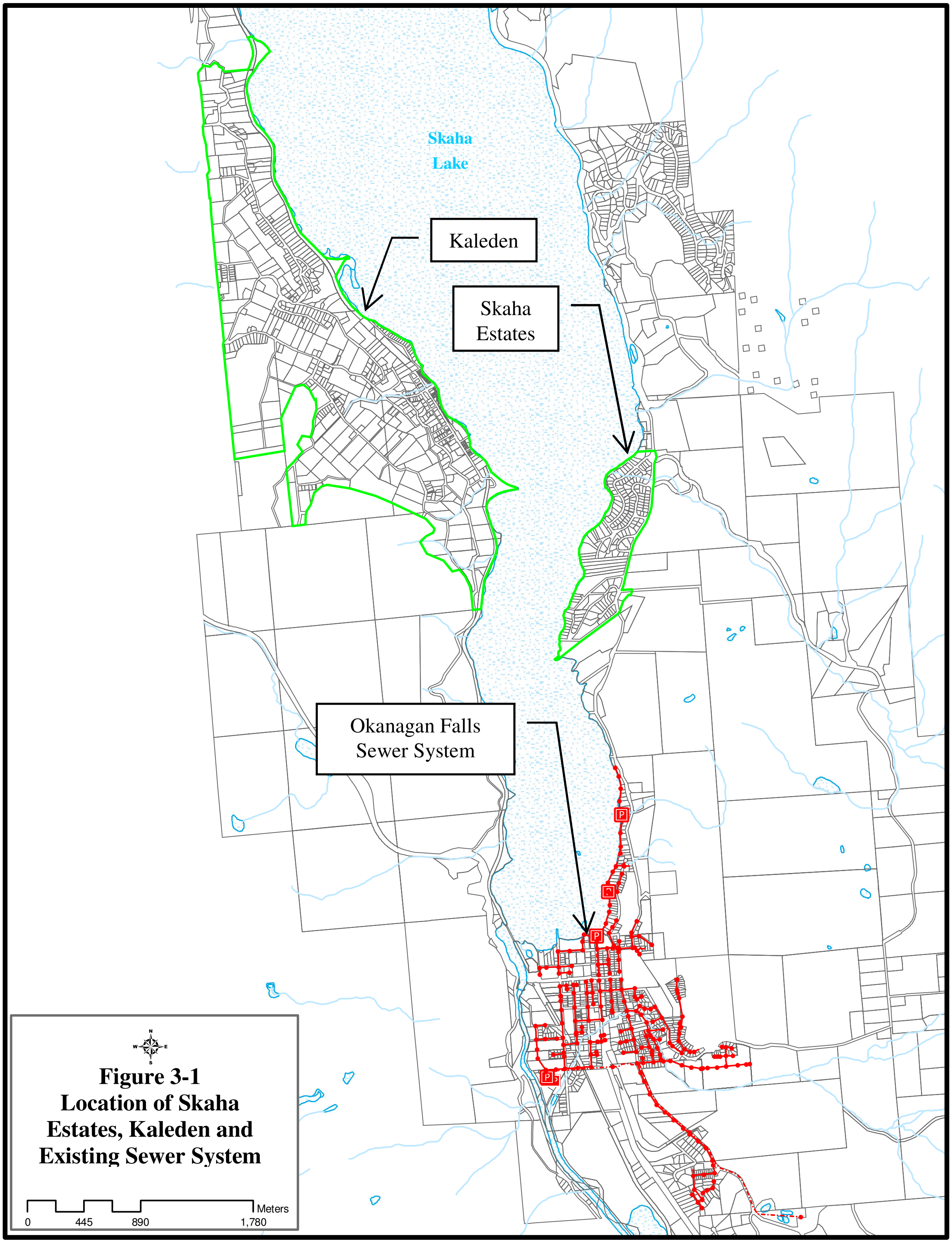


Figure 3-1
Location of Skaha Estates, Kaleden and Existing Sewer System

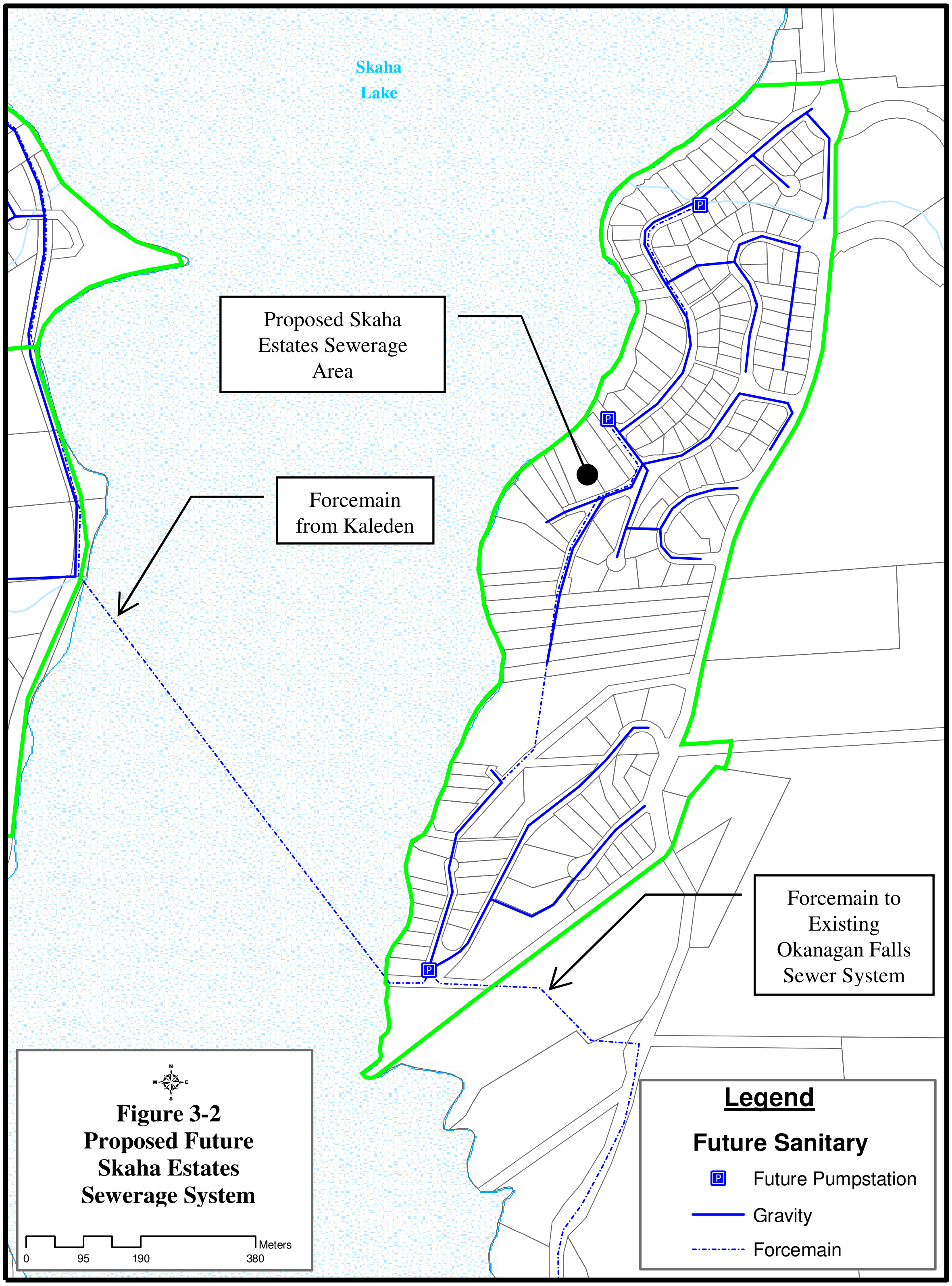


Figure 3-2
Proposed Future Skaha Estates Sewerage System

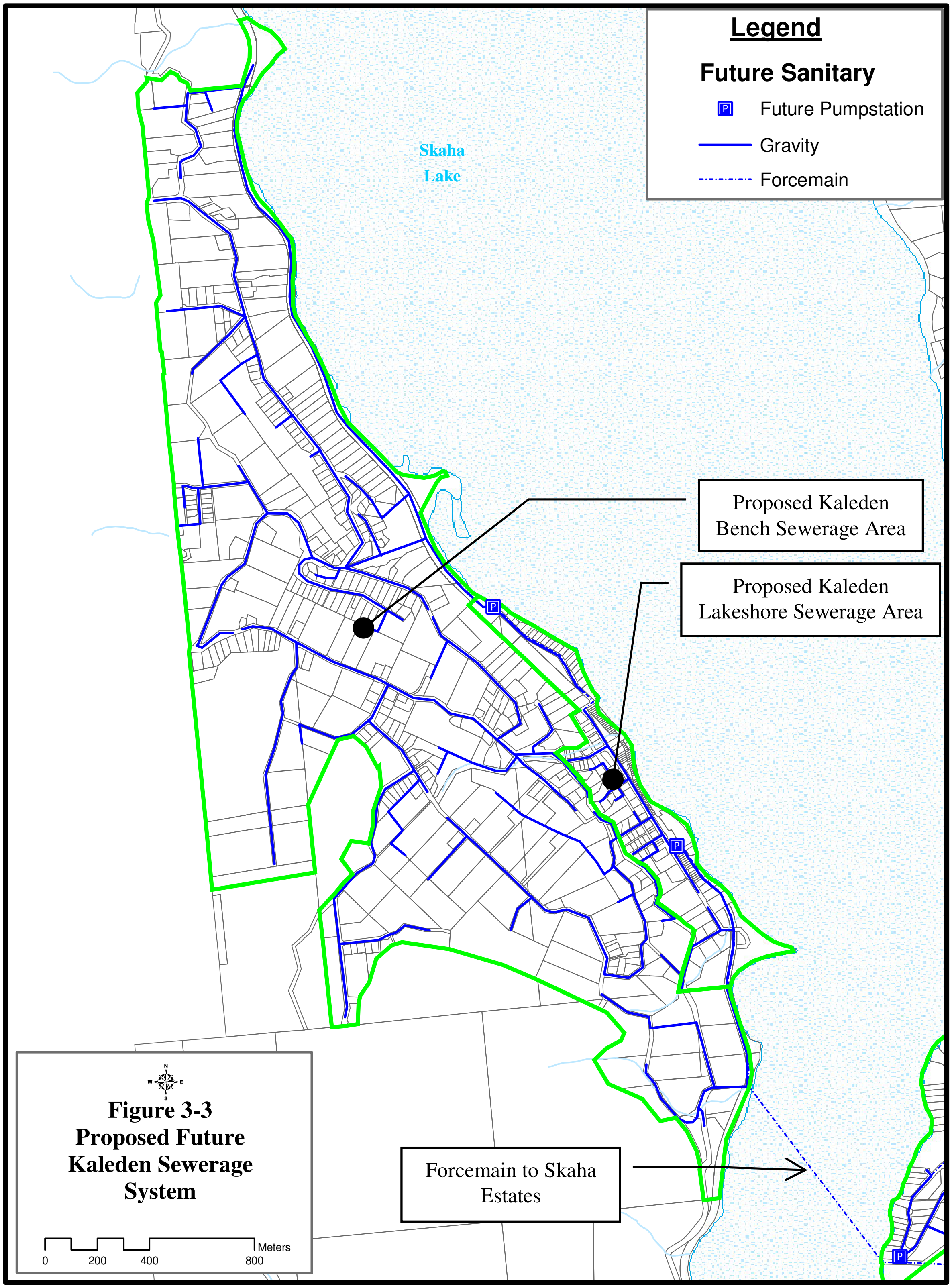


Figure 3-3
Proposed Future
Kaleden Sewerage
System

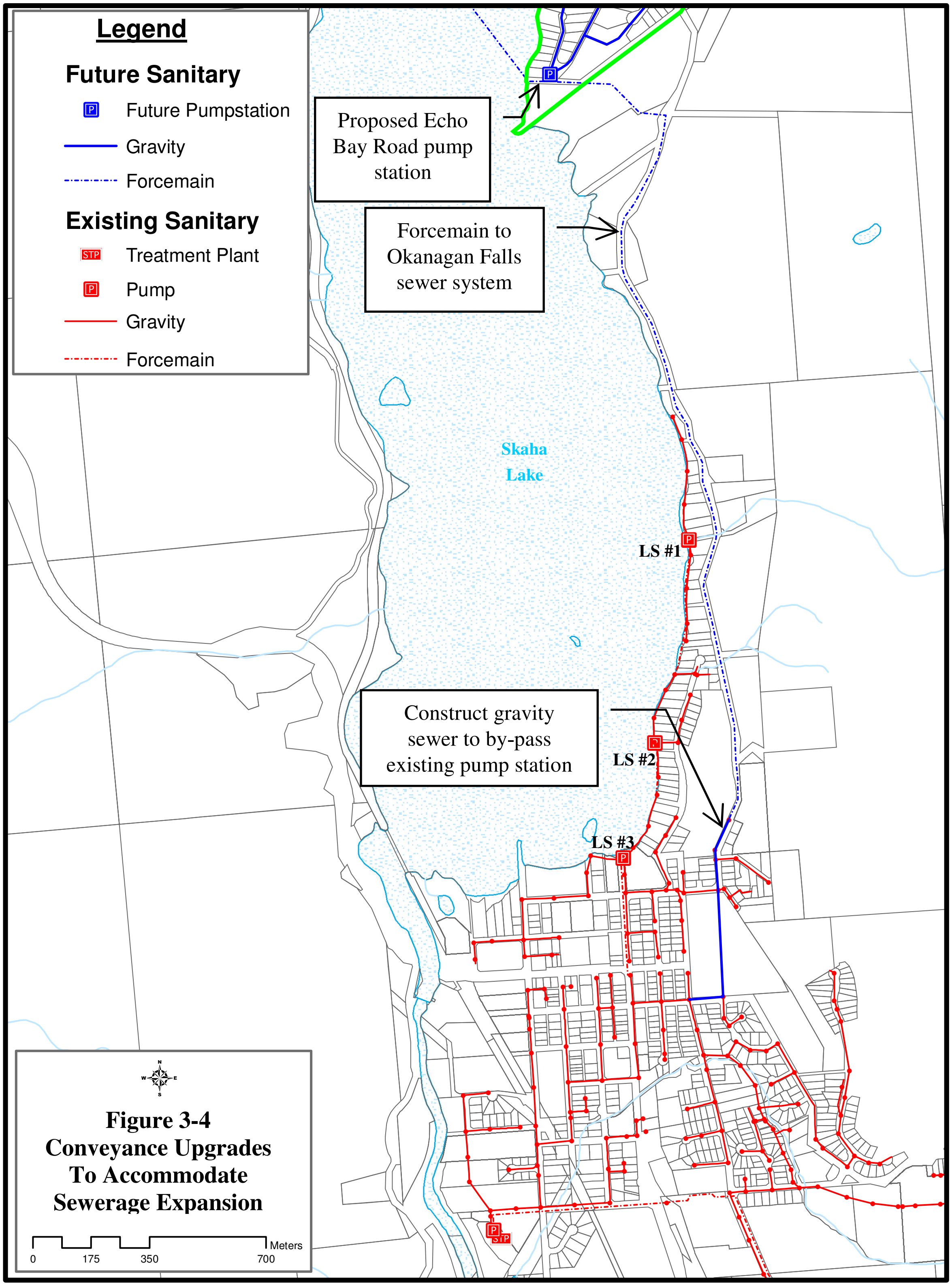


Figure 3-4
Conveyance Upgrades
To Accommodate
Sewerage Expansion

3.1 SKAHA ESTATES

Capital costs were estimated for constructing a sewer system in Skaha Estates to service a 54 hectare area along Skaha Lake. Figure 3-2 provides a map showing proposed pipe alignments and sewerage area extents. The estimated capital cost of providing sanitary services for the Skaha Estates sewerage area is $3,110,000 (Table 3-1).

There are a total of 183 lots that would be serviced in the Skaha Estates sewerage area. Based on the estimated construction cost in Table 3-1, the cost of sewering Skaha Estates on a per parcel basis is $16,990.

Table 3-1: Capital Cost Estimates for Sewering Skaha Estates

Item	Unit	Quantity	Cost/Unit	Cost Estimate ($)
1.) Gravity sewer (incl. manholes, services, road/ROW restoration, dewatering)	m	4,390	390	1,712,100
2.) Devon Drive Pump Station	LS	1	165,000	165,000
3.) Devon Drive Forcemain (common trench)	m	250	155	38,750
4.) Laguna Lane Pump Station	LS	1	165,000	165,000
5.) Camberly Cove Forcemain (common trench)	m	695	155	107,725
Sub-Total				*2,188,575*
Engineering & Contingency (35%)				766,001
Taxes (7%)				153,200
TOTAL (Rounded)				***3,110,000***

3.2 KALEDEN

Capital costs were estimated for constructing a sewer system in Kaleden to service only the high-priority area along the lakeshore. Figure 3-3 provides a map showing proposed pipe alignments. The servicing concept was extended to include the remainder of Kaleden (i.e. the bench area). The Kaleden Bench is not rated as 'high' for phosphorus transmissivity, and therefore, does not constitute a high priority for sewering. However, cost estimates were developed for the purposes of determining whether the cost of sewering the entire community would lower the overall parcel cost.

Kaleden Lakeshore

The Kaleden Lakeshore area has been defined as a 32 hectare area fronting Skaha Lake between Ponderosa Point and the end of Alder Avenue. Concern about the older age of septic systems in this area, coupled with a high groundwater table has made this a priority area for sewering.

Estimated costs for sewering this area are presented in Table 3-2. The total cost is estimated to be $3,160,000.

There are a total of 142 lots serviced in the Kaleden Lakeshore sewerage area. Based on the estimated construction cost in Table 3-2, the parcel cost of sewering the Lakeshore Area is $22,250.

Table 3-2: Cost Estimates for Sewering the Kaleden Lakeshore Area

Item	Unit	Quantity	Cost/Unit	Cost Estimate ($)
1.) Gravity sewer (incl. manholes, services, road/ROW restoration, dewatering)	m	3,170	370	1,172,900
2.) Alder Ave. Pump Station	LS	1	165,000	165,000
3.) Alder Ave. Forcemain	m	585	155	90,675
4.) Pioneer Park Pump Station	LS	1	245,000	245,000
5.) Skaha Lake Forcemain (common trench)	m	980	155	151,900
6.) Skaha Lake Forcemain (submerged)	m	960	420	403,200
Sub-Total				2,228,675
Engineering & Contingency (35%)				780,036
Taxes (7%)				156,007
TOTAL (Rounded)				***3,160,000***

Kaleden Bench

The Kaleden Bench sewerage area encompasses a 349 hectare area and includes most of the community of Kaleden. A preliminary sewer pipe layout is provided in Figure 3-3. Based on the proposed pipe layout, the total capital cost of sewering the bench area is $11,900,000.

Table 3-3: Cost Estimates for Sewering the Kaleden Bench Area

Item	Unit	Units	Cost/unit	Cost Estimate ($)
1.) Gravity sewer	m	22,515	370	8,330,550
2.) Alder Ave. Pump Station Upgrade	LS	1	12,000	12,000
3.) Pioneer Park Pump Station Upgrade	LS	1	25,000	25,000
Sub-Total				*8,367,550*
Engineering & Contingency (35%)				2,928,643
Taxes (7%)				585,729
TOTAL (Rounded)				***11,900,000***

There are a total of 438 lots serviced in the Kaleden Bench sewerage area. Based on the estimated construction cost in Table 3-3, the parcel cost of sewering the Bench Area is $27,170.

On a per parcel basis, the cost of sewering the Bench Area is significantly higher than the Lakeshore Area. A large proportion of the Bench Area is made up of relatively large agricultural parcels. This makes for a low parcel density which requires longer lengths of sewer pipe.

If the Lakeshore Area and Bench Area were combined into a single sewerage area the total capital cost of sewering Kaleden would be $15,060,000. The combined capital cost averaged over the 580 parcels amounts to $25,970 per property. Therefore, compared to a local sewering of the Lakeshore Area, undertaking a full sewering of the Kaleden area would increase the cost to the residents in Lakeshore Area.

3.3 COMMON CONVEYANCE UPGRADES

Upgrades and new construction of facilities for conveying wastewater from Kaleden and Skaha Estates to Okanagan Falls were assessed. These are common facilities, required for both communities. As a result, the cost of implementation would be shared by both Kaleden and Skaha Estates. Table 3-4 provides summary of the estimated costs for the conveyance upgrades.

The pumpstation at the south end of Skaha Estates would accommodate wastewater from both Kaleden and Skaha Estates. From here, the wastewater would be pumped to Okanagan Falls through a forcemain on Eastside Road. An upgrade to the existing sewer system in Okanagan Falls is proposed which would allow by-pass of the liftstation at the north end of Main Street, on Skaha Lake (LS #3).

Table 3-4: Cost Estimates for Common Conveyance Upgrades

Item	Unit	Quantity	Cost/Unit	Cost Estimate ($)
1.) Gravity by-pass sewer (incl. manholes, services, road/ROW restoration, dewatering)	m	624	370	230,880
2.) Echo Bay Road Pump Station	LS	1	165,000	165,000
3.) Eastside Road Forcemain (road restoration)	m	2,615	225	588,375
			Sub-Total	*984,255*
			Engineering & Contingency (35%)	344,489
			Taxes (7%)	68,898
			TOTAL (Rounded)	***1,400,000***

The cost of constructing the common conveyance facilities would be recovered through a parcel charge, in addition to the sewering cost. If the Kaleden Lakeshore and Skaha Estates area were serviced, the common conveyance facilities would add $4,310 to each property connected to the sewer. If all of Kaleden and Skaha Estates were sewered the additional per parcel cost would be $1,830.

3.4 SKAHA LAKE WATER QUALITY MONITORING PROGRAM

The issue of monitoring lake water quality to determine the impact of a small subdivision on a lake is one that has been attempted on many occasions. The challenge is measuring what is essentially a diffuse source of pollution and characterizing its impact on a large, dynamic water body.

Skaha Lake is approximately 15 km long by 2 km wide (Figure 3-5). Most of the flow enters the north end of Skaha Lake via the Okanagan River Channel, and leaves the lake at the south end through the Okanagan River Channel. Based on the total lake volume and average inflow, the retention time in the lake is less than 2 years. However, the lake has a tapered shape in a north-south direction with the narrower end at Okanagan Falls. The physical shape suggests that the flushing rate is higher at its narrowest sections, beginning at the south end of Kaleden and Skaha Estates.

On average, the annual per capita contribution of phosphorus is 1.0 - 1.6 kg (dry weight). The phosphorus is discharged to the wastewater stream in the form of wash water, food processing wastes, urine, and feces. The amount of phosphorous that each person contributes to a septic tank on a daily basis is relatively small. The actual concentration of phosphorous entering a septic tank, given an average consumption of 470 L/capita/day would be in the 6 to 9 mg/L range. Phosphorous is removed in a septic system by soils and further dilution by groundwater. The actual concentration of phosphorous entering the lake will be much lower still. The amount of phosphorus that makes it to the lake will depend on the septic system's proximity to the lake, groundwater level and soil conditions. The phosphorus concentration entering the lake may not be different from its natural or background concentration. The background concentration of phosphorus for Skaha Lake is approximately 0.025 mg/L.

As part of the Okanagan Water Quality Control Project (OWQC Project) (1986 to 1995) considerable effort was expended attempting to determine the impact of subdivisions located along the shorelines of Okanagan valley lakes. The team found that it was possible to detect what were believed to be inflows from houses in the subdivisions into the lake using a device called a "Fluorimeter". The device monitored the water and showed noticeable spikes when towed behind a boat past houses that were situated along the lake shoreline. Unfortunately, subsequent sampling efforts rarely showed levels that differed appreciable from background. It was determined that the devices were probably responding to the whiteners in laundry soap.

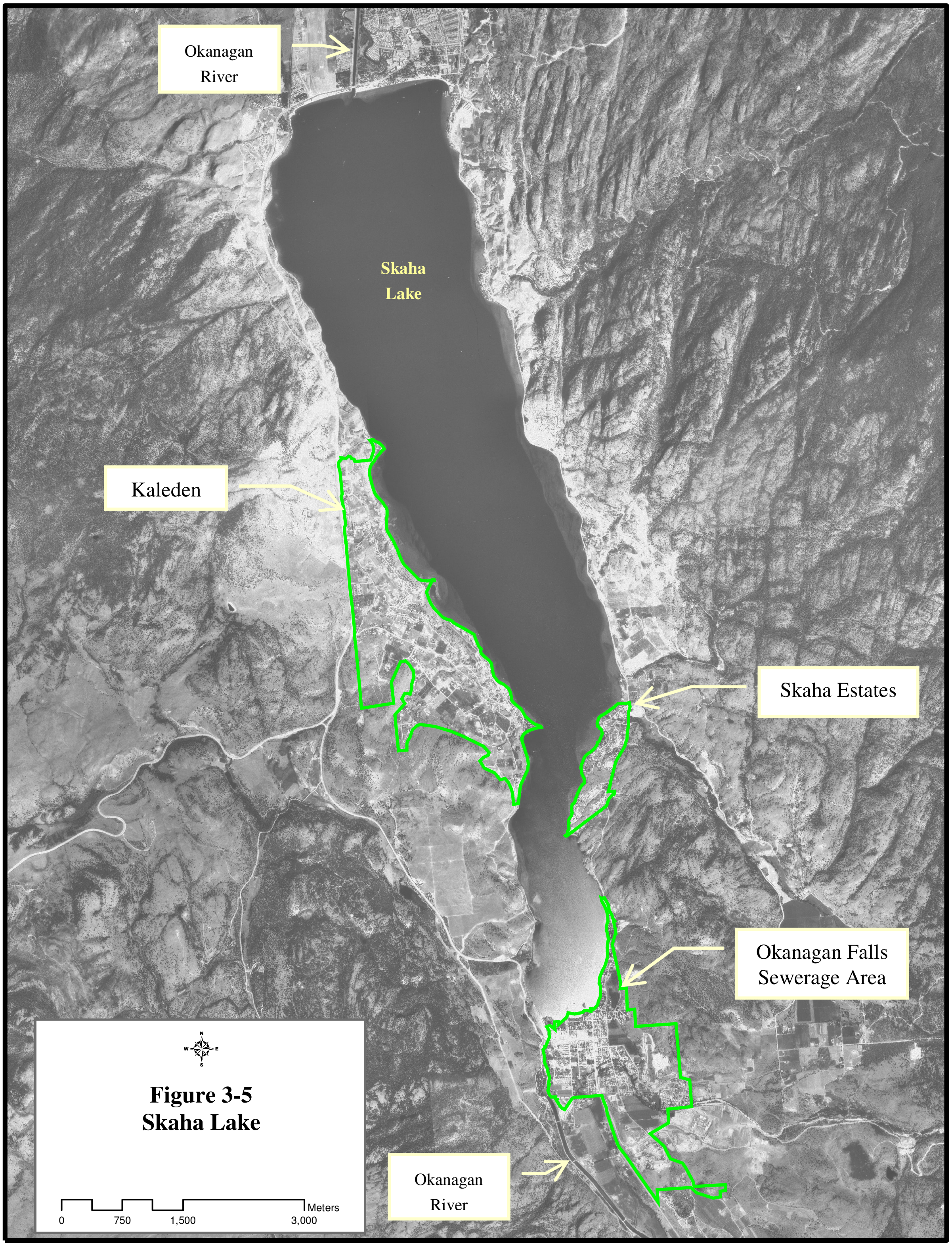


Figure 3-5
Skaha Lake

The mandate of the OWQC Project was to identify and prioritize areas that were contributing phosphorous to the lakes so that the appropriate remedial measures could be initiated. The method selected was to utilize the existing detailed soils mapping information and prepare a series of phosphorous transmission polygons on a series of maps that covered the entire Okanagan basin. The houses were counted on each polygon, a standard occupancy rate of 2.5 persons per household was applied and the computer generated the raw phosphorous input information. The computer also generated the required phosphorous loading information for all the communities around the lakes in the Okanagan using the phosphorous transmission polygons. This was done for the Kaleden and Skaha Estates areas and the information was presented in the original Liquid Waste Management Plan Stage 1 Report dated March 1988. This report was entitled "Waste Management Plan for Electoral Areas A, C & D Stage One Report Part 2 Analysis of Alternatives" prepared by TRUE for the RDOS.

The report recognized that the Skaha Estates area has a phosphorus transmission rate of moderate or higher. It also noted that there was a high water table along the Kaledan Lakeshore which coupled with High to Very High Phosphorus Transmission classifications made the Kaledan area a concern.

Considerable time has past since the 1988 report and some additional houses have been built both along the lakeshore in Kaleden and Skaha Estates.

Waste flows from the septic fields through the ground to the lake have been occurring for a relatively long period of time. Therefore, noticeable attached algae growth would be established where any significant phosphorus inputs were occurring (Vic Jensen, Ministry's Environmental Section). Dye testing and visual sub-surface surveys of the lakeshore for algae growths would indicate a phosphorus loading condition.

It is recommended that a lake monitoring program attempting to determine the impact of septic tank effluent from Skaha Estates and from Kaleden should consist of the following:

1. Fluorimetry testing of the Skaha lakeshore, with water samples being taken where there was increased fluorimeter detection; and

2. Visual observations of the condition of the attached algae on the lake bottom should be made at the same time and digital camera pictures taken - while this part of the lake monitoring program may or may not produce hard data, the spikes coupled with the recorded visual observations and pictures will be of great value in explaining to the public the nature of the problem.

Furthermore, it is recommended that as a second phase of the lake monitoring program should consist of updating the original phosphorous loading calculations. It will be necessary to obtain copies of the phosphorous transmission polygon maps for the Skaha Estates and Kaleden areas from the Ministry of Water Land and Air Protection and update the house count on each polygon and then enter the information on a spreadsheet. The original count was done from airphotos and current airphotos could be used. A comparison of the previous loading to the current loading would complement the information gathered in the physical lake monitoring program and be a useful tool to assist the public to understand the current situation in their area.

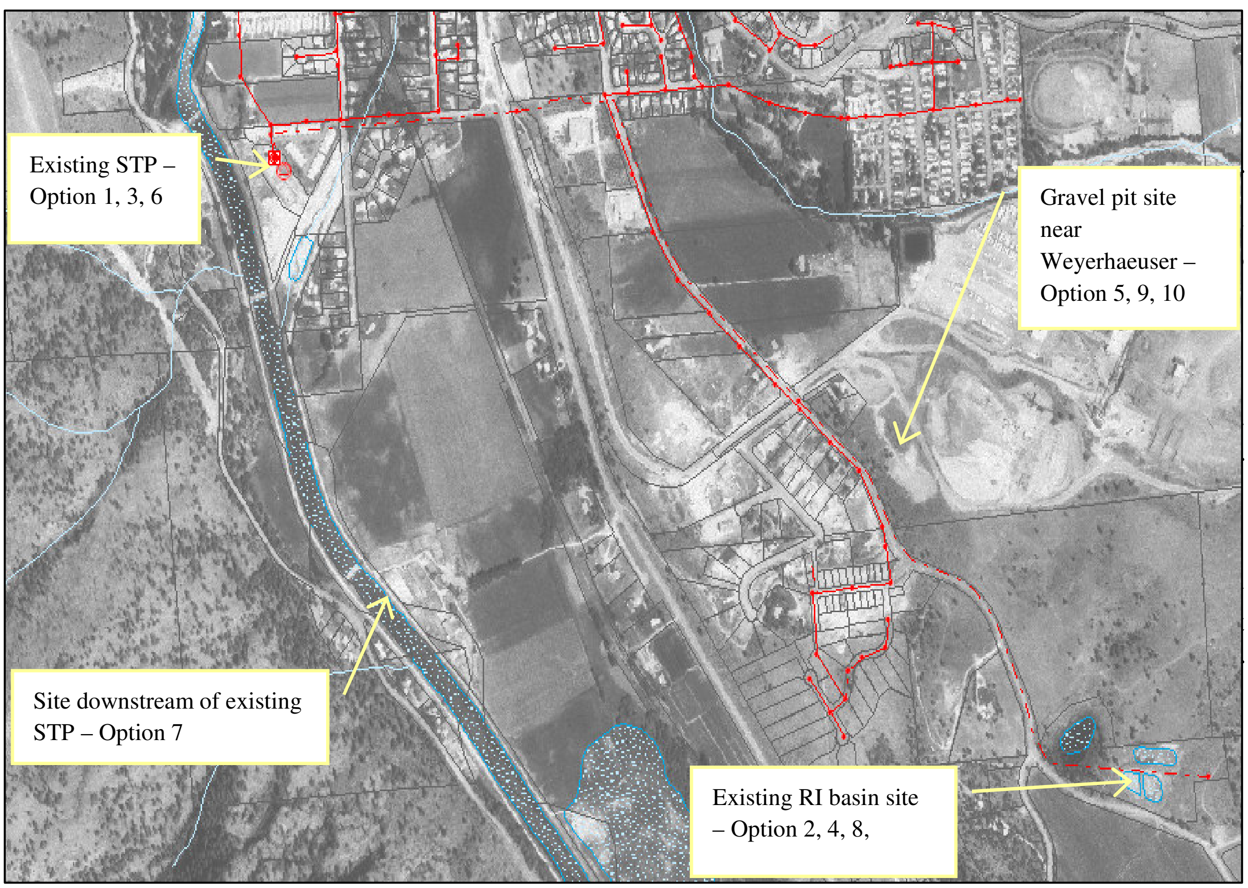
4.0 SEWAGE TREATMENT PLANT UPGRADE OPTIONS

The approach for selecting the preferred upgrade option incorporated a public input workshop to develop criteria and weightings for comparison of various STP upgrades. From the screening list 10 options were selected and a preliminary list of criteria tabulated (Appendix I). The criteria were refined as part of a Public Advisory Committee (PAC) workshop. Feed-back from the PAC was also used to assign priorities or weightings to the criteria. The final results support an upgrade scenario which involves construction of a biological nutrient removal (BNR) treatment plant at a new site downstream of the existing facility.

4.1 COMPARATIVE ASSESSMENT

Based on the Servicing Matrix for the Okanagan Falls Sewage Treatment Plant (STP), ten short-listed options were advanced for more detailed consideration. A description of each of the options and their advantages and disadvantages is provided below.

Figure 4-1: Location of Various Treatment Options



Since the existing site is owned by the RDOS, there would be no additional costs associated with land purchase.

Disadvantages: The oxidation ditch process requires a relatively large area – approximately two times the space of an activated sludge process. The larger surface area of the oxidation ditch would make advanced odour control more expensive.

Although the existing site could accommodate an oxidation ditch process designed to treat wastewater loadings to 2030 (i.e. the 25-year time horizon), it may be a challenge to provide for longer term servicing (i.e. 25 – 75 years).

Even if the treated wastewater is reused as irrigation water, effluent disposal would require continued use of the pumpstation and RI basins during the winter.

Any trucking of residuals for disposal would require passing through residential and commercial areas of town.

Option #2: Oxidation Ditch at RI Site

Description: An oxidation ditch could be constructed at the existing rapid infiltration (RI) basin to provide for the 25 year servicing horizon. The existing wastewater treatment plant would be de-commissioned and the effluent pumpstation converted to a wastewater liftstation. Wastewater would be pumped through the existing forcemain to the RI basins. Effluent would be disposed of at the RI basins.

The new oxidation ditch process would be designed with a mechanical sludge thickener and de-watering facility. Residuals from the plant would be trucked to the Campbell Mountain composting facility. Since the site can provide for a buffer zone, the facility could be designed with moderate odour control and noise attenuation.

Advantages: The close proximity of the RI basins to the plant would reduce maintenance requirements.

The RI site is located in an agricultural area (grapes) with a low population density, suggesting a low public impact.

With disinfection, treated wastewater could be used as irrigation water to grow animal fodder.

Since the existing site is owned by the RDOS, there would be no additional costs associated with land purchase.

Disadvantages: An oxidation ditch located at the RI site will rely on the uninterrupted operation of the wastewater liftstation. Back-up power and pumping redundancy increase the reliability of the liftstation, however, a forcemain rupture would result in sewage overflows unless emergency storage is provided. Therefore, emergency storage should be provided.

Wastewater pumps are designed with an open impeller to handle the high solids content – this feature reduces the pump efficiency. Pumping wastewater to a plant near the RI basins would have an increased power and maintenance cost over existing pumping. In addition, substantial upgrades to the existing pumps (or construction of a booster pump station) are required to provide for a high-lift wastewater station.

Currently, there are no developed fields nearby that could be supplied with effluent for irrigation water.

Vineyards are located adjacent to the RI basins. The presence of a wastewater treatment facility may be perceived as a land-use conflict.

Option #3: Conventional Activated Sludge (Secondary) at Existing STP Site

Description: A conventional activated sludge process could be constructed at the existing treatment plant site to provide for the 25 year servicing horizon. The process would consist of concrete bio-reactor tanks designed to minimize the vertical profile. A digester would be incorporated into the facility to stabilize waste sludge and mechanical equipment would be used for dewatering. The dewatered sludge would be trucked to the Campbell Mountain composting facility.

The facility would be designed with advanced odour control and noise attenuation to minimize impacts on nearby residents.

The effluent pump station would be retained to allow disposal of effluent at the RI site. The amount of pumping could be reduced during the growing season by supplying effluent for irrigation water.

Advantages: Treated wastewater could be used as irrigation water in nearby fields to grow animal fodder.

Since the existing site is owned by the RDOS, there would be no additional costs associated with land purchase.

Disadvantages: The capital cost of an activated sludge process is higher than an oxidation ditch process.

Any trucking of residuals for composting would require passing through residential and commercial areas of town.

Even if the treated wastewater is reused as irrigation water, effluent disposal would require continued use of RI basins during the winter.

Option #4: Conventional Activated Sludge (Secondary) at the RI Site

Description: A conventional activated sludge process could be constructed at the RI site to provide for the 25 year servicing horizon. The process would consist of concrete bio-reactor tanks designed. A digester would be incorporated into the facility to stabilize waste sludge. Mechanical equipment would be used to dewater the sludge. Residuals from the plant would be trucked to the Campbell Mountain composting facility. Since the site can provide for a buffer zone, the facility could be designed with moderate odour control and noise attenuation. Effluent would be disposed of at the RI basins.

The effluent pumpstation at existing STP site would need to be converted to a wastewater liftstation. Wastewater would be pumped through the existing forcemain to the RI basin site.

Advantages: Treated wastewater could be used as irrigation water in nearby fields to grow animal fodder.

The close proximity of the RI basins to the plant will consolidate maintenance requirements and lower operational costs.

The RI site is located in an agricultural area (grapes) with a low population density, suggesting a low public impact.

Since the existing site is owned by the RDOS, there would be no additional costs associated with land purchase.

Disadvantages: Wastewater pumps are designed with an open impeller to handle the high solids content – this feature reduces the pump efficiency. Pumping wastewater to a plant near the RI basins would have an increased power and maintenance cost over existing pumping. In addition, substantial upgrades to the existing pumps (or construction of a booster pump station) are required to provide for a high-lift wastewater station.

A treatment plant located at the RI site will rely on the uninterrupted operation of the wastewater liftstation. Back-up power and pumping redundancy increase the reliability of the liftstation, however, a forcemain rupture would result in sewage overflows unless emergency storage is provided. Therefore, emergency storage should be provided.

Vineyards are located adjacent to the RI basins. The presence of a wastewater treatment facility may be perceived as a land-use conflict.

Option #5: Conventional Activated Sludge (Secondary) Near Weyerhaeuser

Description: A conventional activated sludge process could be constructed near the Weyerhaeuser mill sit to provide for the 25 year servicing horizon. The existing wastewater treatment plant would be de-commissioned and the effluent pumpstation converted to a wastewater liftstation. Wastewater would be pumped through the existing forcemain to the new site. The process would consist of concrete bio-reactor tanks, a digester to stabilize waste sludge, and mechanical equipment to dewater the sludge. The dewatered sludge would be trucked to the Campbell Mountain composting facility. Effluent would be pumped to RI basins for disposal.

Since the area is zoned industrial and can provide for a buffer zone, the facility could be designed with moderate odour control and noise attenuation.

Advantages: The plant would be located in an industrial area with a low risk of public impact.

Treated wastewater could be used as irrigation water in nearby fields to grow animal fodder.

The close proximity of the RI basins to the plant would reduce maintenance requirements.

Disadvantages: Wastewater pumps are designed with an open impeller to handle the high solids content – this feature reduces the pump efficiency. Pumping wastewater to a plant near the Weyerhaeuser site would have an increased power and maintenance cost over existing pumping. In addition, substantial upgrades to the existing pumps (or construction of a booster pump station) are required to provide for a high-lift wastewater station.

A treatment plant located near the Weyerhaeuser site will rely on the uninterrupted operation of the wastewater liftstation. Back-up power and pumping redundancy increase the reliability of the liftstation, however, a forcemain rupture would result in sewage overflows unless emergency storage is provided. Therefore, emergency storage should be provided.

There are limited existing fields in the vicinity currently being used to grow animal fodder – additional agricultural fields would need to be developed to use all the effluent for irrigation.

A community water supply well which is located approximately 300 metres from the site will create a potential or perceived conflict of use.

This option would require purchase or lease of property.

Option #6: Biological Nutrient Removal (Tertiary) at Existing Plant Site

Description: A biological nutrient removal (BNR) plant could be constructed at the existing treatment plant site to provide for the 25 year servicing horizon. The process would consist of concrete bio-reactor tanks, a volatile fatty acid (VFA) fermenter, and mechanical equipment to dewater the sludge. The dewatered sludge would be transported to the Campbell Mountain composting facility for final stabilization of the residuals. Since the site cannot provide for a buffer zone, the facility would be designed with advanced odour control and noise attenuation.

The effluent pump station would be retained to allow disposal of effluent at the RI site. The amount of pumping could be reduced during the growing season by supplying effluent for irrigation water.

Since the existing site is owned by the RDOS, there would be no additional costs associated with land purchase.

Advantages: Treated tertiary wastewater could be used as irrigation water in nearby fields to grow animal fodder or for high public use areas such as a golf course. The effluent could also be discharged to the river or a constructed wetland during the winter period.

The BNR process is a modified activated sludge process which could be configured to operate as either a conventional activated sludge or BNR process. This would allow production of tertiary or secondary effluent, depending on the use.

Since the existing site is owned by the RDOS, there would be no additional costs associated with land purchase.

Disadvantages: The capital and maintenance cost of the BNR process is slightly more than an activated sludge process.

Any trucking of residuals for composting would require passing through residential and commercial areas of town. The frequency of trucking would be similar to other processes.

Option #7: Nutrient Removal (Tertiary) Downstream of Existing STP

Description: A biological nutrient removal (BNR) plant could be constructed downstream of the existing treatment plant site, near the cattle feed-lot. The process would consist of concrete bioreactor tanks and mechanical equipment to dewater the sludge. The dewatered sludge would be transported to the Campbell Mountain composting facility for final stabilization. Since the area can provide for a buffer zone, the facility could be designed with moderate odour control and noise attenuation.

Treated wastewater could be used as irrigation water in nearby fields to grow animal fodder. As a contingency measure, the effluent forcemain alignment could be reconfigured to allow use of the RI basins for disposal.

Advantages: The high quality effluent produced by the BNR plant will provide for flexibility in terms of reuse and reduce (or eliminate) reliance on disposal via the RI basins.

An access road from Highway 97 would need to be provided, reducing impacts on residential and commercial areas from truck traffic.

Disadvantages: This option would require purchase or lease of the property, application for possible exclusion under the Agricultural Land Reserve and an OCP amendment.

The existing gravity trunk would need to be extended to the new facility.

Option #8: Fixed Film RBC at Existing RI Site

Description: A Rotating Biological Contactor (RBC) plant could be constructed at the existing RI site to provide for the 25 year servicing horizon. A RBC consists of a series of plates mounted on a rotor. The biological film which grows on the plates as they are cycled through the wastewater consumes carbonaceous BOD_5. Sludge can usually be mechanically de-watered without further stabilization and trucked to a composting or landfill facility. Effluent would be disposed of at the RI basins.

The effluent pumpstation at the existing STP site would need to be converted to a wastewater liftstation. Wastewater would be pumped through the existing forcemain to the RI basin site.

Advantages: Treated wastewater could be used as irrigation water in nearby fields to grow animal fodder.

RBC's have relatively low power consumption.

Since the existing site is owned by the RDOS, there would be no additional costs associated with land purchase.

Disadvantages: Wastewater pumps are designed with an open impeller to handle the high solids content – this feature reduces the pump efficiency. Pumping wastewater to a plant near the RI basins would have an increased power and maintenance cost over existing pumping. In addition, substantial upgrades to the existing pumps (or construction of a booster pump station) are required to provide for a high-lift wastewater station.

A treatment plant located at the RI site will rely on the uninterrupted operation of the wastewater liftstation. Back-up power and pumping redundancy increase the reliability of the liftstation, however, a forcemain rupture would result in sewage overflows unless emergency storage is provided. Therefore, emergency storage should be provided.

RBC's are sensitive to overloading and low temperature conditions (i.e., not as robust as other treatment processes).

Vineyards are located adjacent to the RI basins. The presence of a wastewater treatment facility may be perceived as a land-use conflict.

Option #9: Fixed Film RBC at Site Near Weyerhaeuser

Description: A Rotating Biological Contactor (RBC) plant could be constructed at a site near the Weyerhaeuser mill to provide for the 25 year servicing horizon. A RBC consists of a series of plates mounted on a rotor. The biological film which grows on the plates as they are cycled through the wastewater consumes carbonaceous BOD_5. Sludge can be mechanically de-watered without stabilization and trucked to a composting or landfill facility. Effluent would be pumped and disposed of at the RI basins.

The effluent pumpstation at the existing STP site would need to be converted to a wastewater liftstation. Wastewater would be pumped through the existing forcemain to the RI basin site.

Advantages: Treated wastewater could be used as irrigation water in nearby fields to grow animal fodder

RBC's have relatively low power consumption.

Disadvantages: Wastewater pumps are designed with an open impeller to handle the high solids content – this feature reduces the pump efficiency. Pumping wastewater to a plant near the Weyerhaeuser site would have an increased power and maintenance cost over existing pumping. In addition, substantial upgrades to the existing pumps (or construction of a booster pump station) are required to provide for a high-lift wastewater station.

A treatment plant located near the Weyerhaeuser site will rely on the uninterrupted operation of the wastewater liftstation. Back-up power and pumping redundancy increase the reliability of the liftstation, however, a forcemain rupture would result in sewage overflows unless emergency storage is provided. Therefore, emergency storage should be provided.

RBC's are sensitive to overloading and low temperature conditions (i.e., not as robust as other treatment processes).

A community water supply well which is located approximately 300 metres from the site may create a potential or perceived conflict of use.

This option would require purchase or lease of property.

Option #10: Primary at Existing STP Site and Secondary at RI Site

Description: The treatment process could be split and located at two separate locations. The existing oxidation ditch could be converted to a primary treatment facility. Residuals from the primary treatment system could be dewatered and composted. Due to the close proximity of residential units, the primary process would need to be designed with advanced odour control and noise attenuation.

Primary effluent would be pumped to a oxidation ditch (secondary) treatment facility located at the RI site.

The new oxidation ditch at the RI site would be designed with a mechanical sludge thickener and de-watering facility. Residuals from the plant would be trucked to the Campbell Mountain composting facility. The facility would require moderate odour control and noise attenuation.

Advantages: The close proximity of the RI basins to the plant would reduce maintenance requirements.

Due to the lower solids content, pumping primary effluent to the RI basins would require only one lift compared to 2 lifts for raw wastewater.

The RI site is located in an agricultural area (grapes) with a low population density, suggesting a low public impact for the oxidation ditch.

With disinfection, treated wastewater could be used as irrigation water to grow animal fodder.

Since both sites are owned by the RDOS, there would be no additional costs associated with land purchase.

Disadvantages: An oxidation ditch located at the RI site will rely on the uninterrupted operation of the wastewater liftstation to pump primary effluent. Back-up power and pumping redundancy increase the reliability of the liftstation, however, a forcemain rupture would result in primary effluent overflows unless emergency storage is provided. Therefore, emergency storage should be provided.

Currently, there are no developed fields nearby that could be supplied with effluent for irrigation water.

Trucking residuals from the primary treatment site for disposal would require passing through residential and commercial areas of town.

Vineyards are located adjacent to the RI basins. The presence of a wastewater treatment facility may be perceived as a conflict.

4.2 DECISION ANALYSIS & RECOMMENDED UPGRADE OPTION

On March 2, 2005 a Workshop with the Okanagan Falls Wastewater Public Advisory Committee (PAC) was undertaken to provide decision-making direction for an upgrade of the treatment plant. The purpose of the meeting was to assign group and criteria weighting to a decision matrix. The decision matrix provides the basis for selection of the ultimate wastewater treatment plant upgrade.

The preliminary criteria were refined to include four categories and 17 criteria. The criteria are listed and described in Table 4-1.

Ten treatment plant options were short-listed and described above. The ten upgrade options provide wastewater treatment for the community of Okanagan Falls to the end of the study period (2030). Based on the growth and per capita wastewater rate assumption, the upgrade would be sized for a maximum day flowrate of 1.4 ML/day.

Additional capacity to accommodate Kaleden and Skaha Estates was not included in the treatment plant expansion. The cost of sewering these communities is considered to be relatively high and should be addressed as a separate issue once funding is established. The will of these communities to be sewered and the availability of grant funding will determine the timing of the sewerage expansion. Without this commitment, establishing a proper timing and determining the treatment requirements are difficult. Rather, the RDOS should allow for provision to expand the any future upgrades to accommodate Kaleden and Skaha Estates.

Each of the options were assessed by Earth Tech staff according to the criteria developed in Table 4-1. The results of the rating are provided as Table 4-2.

As part of Workshop #1 with the Okanagan Falls PAC, group and criteria weightings were developed. The PAC provided the basis for weighting of the financial, environmental and social criteria. The technical criteria were weighted by Earth Tech staff. The weightings were applied to the criteria table and a decision score was calculated for each of the ten options (Table 4-2).

Based on the criteria assessment in Table 4-2, the top two options in order of preference are:

1. **Option 7** – construct a new Biological Nutrient Removal (BNR) treatment plant at a site downstream of the existing plant, and

2. **Option 6** - upgrade the existing oxidation ditch process to a BNR process at the existing site.

Table 4-1 - Decision Criteria for Selection of the Okanagan Falls STP Upgrade

Category	Decision Criteria	Description
Fianancial	Life-Cycle Costs	The total lifetime cost of the upgrade including financing, design/construction, operating and maintenance costs.
Technical	Reliability	How reliable is the treatment option? Are there any components that would result in a high consequence failure?
	Future Flexibility/Expansion Provision	Does the site provide room for future expansion and is there flexibility in the treatment process to adapt to a changing regulatory environment?
	Effluent Quality	What level of treatment is provided by the option? A higher level of treatment (tertiary) is more desirable.
	Water Re-Use Potential	Are there sites that would allow reuse of the effluent? Reuse sites are more feasible, the closer they are to the STP.
	Operational Ease (Required Staff)	How complex is the treatment plant operation, i.e. how many people would be required to operate the plant?
	Method for Residuals Disposal	How would the waste sludge be disposed? A composted residual is best because it does not add to the landfill volume.
	Site Access	Are there any constraints associated with site access because of surrounding land-use? Is there more than one route available to access the site?
Environmental	Habitat Impacts	Are there any habitat losses or potential enhancements that could result from the plant upgrade?
	Emissions	Does the process increase emission of pollutants or greenhouse gases?
Social	Health Risks	What degree of human health risk does the treatment plant pose?
	Odour Levels	Does the process generate nuisance odours? With odour control facilities in-place, how often will odours be emitted?
	Potential for Public Conflicts (Risk)	What is the risk that a conflict will arise because of the plant site, perceived conflicts or day-to-day exposure of operational activities (i.e. maintenance vehicles regularly passing through a residential area)?
	Economic Diversification	What is the potential that a specific upgrade will increase economic diversification by promoting the start-up of a new industry/business or helping an existing business?
	Noise Levels	Does the process generate noise that could be a nuisance? How often would they occur?
	Aesthetics	Would an industrial-type building at the site have a negative or positive impact on aesthetics?
	Compatibility with Surroundings	How does a treatment plant fit-in to the existing, surrounding land-use? Is there sufficient buffer with incompatible uses like residential areas and agriculture for human consumption (i.e. vineyards)

Insert Table 4-2 Here

Table 4-2: Decision Matrix Table with Decision Criteria

Category	Decision Criteria	Weighting		Option 1: Oxidation Ditch at Existing STP	Option 2: Oxidation Ditch at RI Site	Option 3: Activated Sludge at Existing STP	Option 4: Activated Sludge at RI Site	Option 5: Activated Sludge Nr Weyerhauser	Option 6: BNR (Tertiary) Plant at Existing STP	Option 7: BNR (Tertiary) D/S of Existing STP	Option 8: Fixed Film (RBC) at RI Site	Option 9: Fixed Film (RBC) Nr Weyerhaeuser	Option 10: Primary at Existing STP & Secondary at RI Site	Scale[1]	
		By Group	By Criteria											Verbal (Best – Worse)	Numerical
Financial	Life-Cycle Costs	0.250	1.00	7.4	7.7	8.7	9.1	9.2	9.1	9.7	8.1	8.3	8.8	7.0 – 10.0	10 - 0
Technical	Reliability	0.263	0.28	99.9	99.9	99.99	99.9	99.9	99.999	99.999	99.9	99.9	99.9	100/99.999/99.99/ 99.9/99	4- 0
	Future Flexibility/Expansion Provision		0.25	Adequate	Good	Good	Good	Good	Very Good	Very Good	Adequate	Adequate	Adequate	Very Good/Good/ Adequate/None	3 - 0
	Effluent Quality		0.12	2ndary	2ndary	2ndary	2ndary	2ndary	Tertiary	Tertiary	2ndary	2ndary	2ndary	Tertiary/Secondary/ Primary	2 - 0
	Water Re-Use Potential		0.11	Yes	Limited	Yes	Yes	Yes	Yes	Yes	Limited	Yes	Limited	Yes/Limited/No	2 - 0
	Operational Ease (Required Staff)		0.10	1 PT	1 PT	1 FT	1 FT	1 FT	1 FT	1 FT	1 PT	1 PT	1 PT	1 PT/2 FT/3 FT/4 FT	4 - 0
	Method for Residuals Disposal		0.0081	Compost	Compost	Compost	Compost	Compost	Compost	Compost	Compost	Compost	Compost	Compost/Landfill/ Beds	2 - 0
	Site Access		0.050	Constrained	Good	Constrained	Good	Good	Constrained	Good	Good	Good	Constrained	Good/Constrained/ Poor	2 - 0
Environmental	Habitat Impacts	0.188	0.50	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral	Positive	Neutral	Neutral	Neutral	Pos./Neutral/Neg.	2 - 0
	Emissions		0.50	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral	Positive	Neutral	Neutral	Neutral	Pos./Neutral/Neg.	2 - 0
Social	Health Risks	0.300	0.22	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low/Moderate/High	2 - 0
	Odour Levels		0.22	Frequent	Frequent	Rare	Rare	Rare	Rare	Rare	Occasional	Occasional	Occasional	Rare/Occasional/ Frequent	2 - 0
	Potential for Public Conflicts (Risk)		0.19	High	Moderate	High	Moderate	Moderate	High	Low	Moderate	Moderate	High	Low/Moderate/High	2 - 0
	Economic Diversification		0.15	Neutral	Neutral	Neutral	Neutral	Neutral	Good	Good	Neutral	Neutral	Neutral	Good/Neutral/None	2 - 0
	Noise Levels		0.11	Frequent	Frequent	Occasional	Occasional	Occasional	Occasional	Occasional	Occasional	Occasional	Occasional	Rare/Occasional/Frequent	2 - 0
	Compatibility with Surroundings		0.074	Negative	Negative	Negative	Negative	Neutral	Neutral	Neutral	Negative	Neutral	Negative	Very Pos. – Very Neg.	4 - 0
	Aesthetics		0.037	Negative	Neutral	Negative	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral	Very Pos. – Very Neg.	4 - 0
			DECISION SCORE	**0.102**	**0.108**	**0.093**	**0.090**	**0.090**	**0.110**	**0.116**	**0.102**	**0.101**	**0.088**		
			SCORING RANK		**3**				**2**	**1**	**4**				

[1] Note that the numerical scale correlates directly to the verbal scale. For example, a Low/ML/M/MH/High verbal scoring corresponds to a numerical scoring of 10/7.5/5.0/2.5/0, respectively.

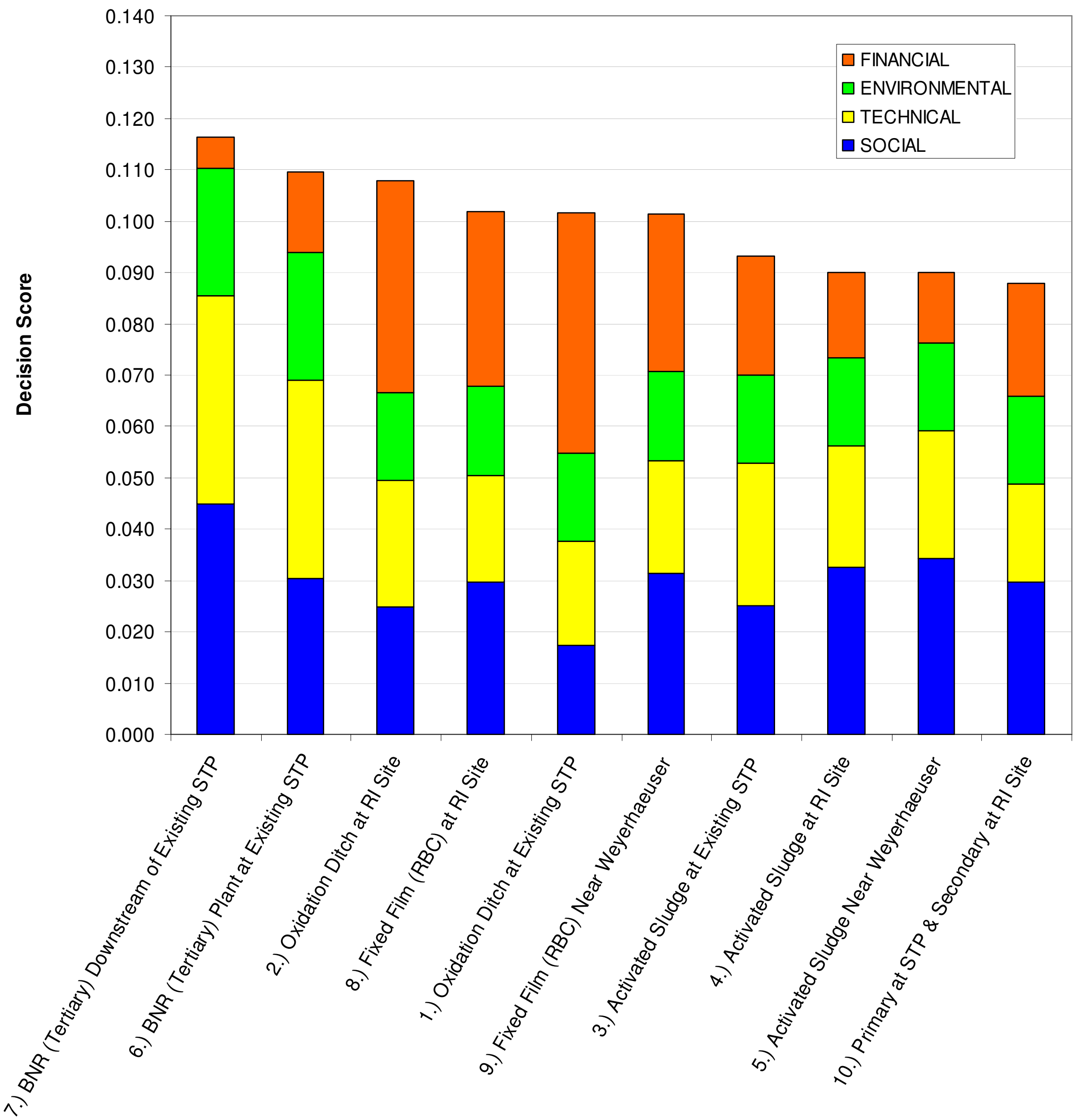
Table 4-3: Life-Cycle Costs for Okanagan Falls STP Upgrade Options

Option	Capital Cost (2005 $)	Annualized O&M Cost (2005$)	Life-Cycle Cost		Decision Score	
			(2005 $)	Rank	Score	Rank
Option 1: Oxidation Ditch at Existing STP	3,530,000	$240,000	$7,400,000	10	0.102	5
Option 2: Oxidation Ditch at RI Site	3,880,000	$240,000	$7,700,000	9	0.108	3
Option 3: Activated Sludge at Existing STP	4,040,000	$294,000	$8,700,000	6	0.093	7
Option 4: Activated Sludge at RI Site	4,380,000	$294,000	$9,000,000	4	0.090	8
Option 5: Activated Sludge Near Weyerhaeuser	4,640,000	$294,000	$9,200,000	2	0.090	9
Option 6: BNR (Tertiary) Plant at Existing STP	4,620,000	$294,000	$9,100,000	3	0.110	2
Option 7: BNR (Tertiary) Downstream of Existing STP	5,230,000	$294,000	$9,700,000	1	0.116	1
Option 8: Fixed Film (RBC) at RI Site	4,350,000	$240,000	$8,100,000	8	0.102	4
Option 9: Fixed Film (RBC) Near Weyerhaeuser	4,560,000	$240,000	$8,300,000	7	0.101	6
Option 10: Primary at Existing STP & Secondary at RI Site	3,980,000	$300,000	$8,800,000	5	0.088	10

The two BNR options are among the highest life-cycle cost options (Table 4-3). However, the options rate very high in the Social and Technical groups. The BNR treatment options trade-off relatively high capital and operating costs for low public impacts, high flexibility and good reliability.

Figure 4-2 shows the relative group criteria scoring for each of the ten options.

Figure 4-2: Decision Scores by Group



Recommendation

Based on the feed-back from the PAC and decision analyses, the preferred option is to construct a BNR facility downstream of the existing site. We recommend that the Regional District advance Option 7 as the preferred upgrade option to take advantage of the high social benefits.

The decision score for Option 6 and Option 7 is relatively sensitive to cost. Any cost increases to the preferred option resulting from higher than expected land acquisition costs could shift the preference in favour of Option 6. That is, if the land purchase cost or leasing arrangement is not favourable then the Regional District should re-consider the strategy and pursue an option which involves upgrading the existing facility to a BNR process (i.e. Option 6).

4.3 STP UPGRADE FINANCING AND IMPACT ON SEWER RATES

In order to assess the cost to users, a financial model was prepared to calculate the service connection cost under two funding scenarios. The cost per service connection for Option 6 and 7 was calculated assuming a 0% and 67% funding grant. The results are presented in Table 4-4.

The single family housing tax calculation in Table 4-4 assumes:

1. DCC's will finance 1/3 of the capital cost; and
2. Capital costs will be financed over 20 years at the current Municipal Finance Authority interest rate of 5.0%;

Table 4-4: Tax Implications to Finance STP Upgrades for Option 7

Option	Tax Rate Increase			Annual Totals with Increases
	Ave. Single Family Home Parcel Tax Increase/ Annum	Ave. Single Family Home User Fee Increase	Total Annual Combined Increase	
Option 7 - No Grant	$276	$68	$345	$630
Option 7 - 2/3 Infrastructure Grant	$13	$68	$82	$367

The impact of funding Option 7 with no grant funding could have a significant impact on the annual single family tax rate. The single family tax bill would rise by up to $345 per annum. The cost would rise by $82 if 2/3 capital funding were obtained. To minimize impacts to tax increase, the RDOS should delay implementing a full upgrade until the amount of grant funding can be established.

4.4 STAGING OF PREFERRED UPGRADE

If less than 2/3 capital grant funding is achieved, the RDOS should consider staging the preferred upgrade option. Staging of the upgrades will allow the capital costs to be spread out, reducing the financing costs and required tax increases.

A staged approach for construction of a new BNR facility downstream of the existing site where no capital grants have been provided could consist of the following:

Interim Measures: A fine-screen filter and sludge thickener could be incorporated into the existing oxidation ditch process to address odour issues and clarifier over-loading. The interim measures would extend the life of the existing plant and allow additional upgrades to be deferred until planning work is complete. This process is currently being undertaken.

Stage I : Add Initial Bioreactor Stage at New Site (2008). This stage would involve constructing a small-sized bioreactor and clarifier at the new site. The existing oxidation ditch would be used for equalization to allow for a smaller-sized facility. Installation of disinfection equipment would allow for reuse of effluent as irrigation water on the surrounding fields.

Stage II: Expand Clarifier (~2012). A new clarifier installed as part of Stage II would increase over-all capacity of the new plant

Stage III: Upgrade Bioreactor & Solids Handling (~2020). For this stage, the bioreactor would be upgraded to allow for nutrient removal. Upgraded solids handling equipment would allow de-watering and composting of the waste sludge.

Stage IV : Add Tertiary Filter. Stage IV would be undertaken when the debt from Stage I is retired in 2028. Addition of a tertiary filter would allow the effluent to be discharged to an engineering wetland or Okanagan River.

5.0 CONCLUSIONS & RECOMMENDATIONS

A strategic plan for upgrade and financing of upgrades to the Okanagan Falls Sewage Treatment Plant is presented.

Upgrades to the treatment plant will require updates to the Liquid Waste Management Plan and amendments to the Operating Certificate and Official Community Plan

Consideration of expansion of the existing sewerage area was undertaken. Unit parcel costs for the Kaleden and Skaha Estates area were updated. The unit parcel costs for the Kaleden lakeshore area are higher than Skaha Estates due to the lower density - $22,250 versus $16,990. Additional costs for common conveyance infrastructure would add an additional $1,830 if both communities were sewered together. The unit costs for Kaleden are less favourable if the entire community is sewered.

Given the high cost of sewering Kaleden and Skaha Estates, monitoring is recommended to assess the impacts of septic fields on the water quality of Skaha Lake. The monitoring would involve flourimetry testing, water quality sampling and underwater observations where increased spikes in the detection rate are observed. In addition, phosphorus loading models developed as part of the Okanagan Water Quality Control Project should be updated. The data acquired from the testing and phosphorus modeling will allow the RDOS to monitor and record phosphorus impacts. These findings would provide the means for educating the public and supporting construction of a sewer system.

Based on a detailed assessment of various upgrade options for the Okanagan Falls Sewage Treatment Plant, the preferred option is to construct a new treatment plant located downstream of the existing plant. However, undertaking the preferred option with no grant funding could have a significant impact on the annual single family tax rate. The single family tax bill would rise by up to $345 per annum under a zero grant scenario. The cost would rise by $82 if 2/3 capital funding were obtained. To minimize tax increases, the RDOS should delay implementing a full upgrade until the amount of grant funding can be established.

Short-term upgrades will provide sufficient time to complete planning updates and establish grant funding. Once financing has been secured, either a staged or full upgrade can be initiated.

Based on the foregoing considerations, analyses and conclusions, the following recommendations are made:

1. The RDOS should undertake a treatment plant upgrade which involves constructing a new BNR facility downstream of the existing plant.

2. The Liquid Waste Management Plan will need to be updated. A review of the Official Community Plan should be undertaken concurrent with or subsequent to the Liquid Waste Management Plan update.

3. After the Liquid Waste Management Plan is updated and approved, the Operational Certificate should be amended.

4. A monitoring program should be undertaken for Skaha Lake to assess the impact of septic tank effluent from Skaha Estates and Kaleden. The monitoring should consist of fluorimetry testing and water quality sampling where detection is confirmed. Visual observation of the lake bottom should be made to corroborate points of detection.

5. As a second phase to the lake monitoring program, the original phosphorus loading calculations for Skaha Estates and Kaleden should be updated to account for new development. A comparison of the calculations would complement the lake monitoring program.

6. The RDOS should work with the Okanagan Falls Irrigation District to implement a water conservation strategy for the Okanagan Falls sewerage area. The program should include bylaws to require new development to install low flow fixtures. An education campaign could target existing users.

Appendix I –

Screening Table

WWTP Servicing Matrix – shaded cells indicate options for further consideration

	Technologies Considered	Sites	Mitigative Measures/Considerations
PHASE I			
Liquid Train	Oxidation Ditch	Existing STP Site	Requires advanced odour/noise control
		Existing RI Site	Requires pumping raw sewage to plant
		Near Gravel Pit (Weyerhauser)	Requires pumping raw sewage to plant and purchase of land. Site is close to water supply wells.
		Downstream of Existing Site	Requires land purchase and pumping effluent to RI basins. Provides good buffer with residential area
	Facultative Lagoon	Existing RI Site	Insufficient land available.
		Near Gravel Pit (Weyerhauser)	Requires pumping raw sewage to plant and large land purchase. Site is close to water supply wells.
	Conventional Activated Sludge	Existing STP Site	Requires advanced odour/noise control
		Existing RI Site	Requires pumping raw sewage to plant
		Near Gravel Pit (Weyerhauser)	Requires pumping raw sewage to plant and purchase of land. Site is close to water supply wells.
		Downstream of Existing Site	Requires land purchase and pumping effluent to RI basins. Provides good buffer with residential area.
	Biological Nutrient Removal	Existing STP Site	Requires advanced odour/noise control.
		Existing RI Site	Requires pumping raw sewage to plant. Effluent exceeds RI basin requirements.
		Near Gravel Pit (Weyerhauser)	Requires pumping raw sewage to plant and purchase of land. Site is close to water supply wells.
		Downstream of Existing Site	Requires land purchase and extension of trunk.
	Fixed Film	Existing STP Site	Negative visual impacts of trickling filter and RBC.
		Existing RI Site	Requires pumping raw sewage to plant.
		Near Gravel Pit (Weyerhauser)	Requires pumping raw sewage to plant and purchase of land. Site is close to water supply wells.
		Downstream of Existing Site	Requires pumping effluent to RI basins for disposal.
Solids Train	Thickening	Existing STP Site	Requires advanced odour control
		Existing RI Site	
		Near Gravel Pit (Weyerhauser)	
		Downstream of Existing Site	
	Dewatering	Existing STP Site	Requires advanced odour control
		Existing RI Site	
		Near Gravel Pit (Weyerhauser)	
		Downstream of Existing Site	
	Composting	Existing STP Site	Not appropriate
		Existing RI Site	Not appropriate
		Near Gravel Pit (Weyerhauser)	Not appropriate
		Downstream of Existing Site	Not appropriate
		Campbell Mtn. Facility	Requires additional trucking costs.
		New OK Falls Facility	Requires development of new composting facility.
	Landfilling	Campbell Mtn. Facility	Requires significant trucking and disposal costs.
		OK Falls Facility	Doe not currently accept organics
Effluent Disposal	Rapid Infiltration	Existing RI Site	Secondary treatment is adequate
	Wetland Discharge	Existing STP Site	Requires tertiary treatment. No land available nearby to construct wetland.
		Downstream of Existing Site	Requires tertiary treatment
	River Discharge	Existing STP Site	Requires tertiary treatment
		Downstream of Existing Site	Requires tertiary treatment
	Re-use	Existing STP Site	Agricultural reuse potential. Requires effluent disposal to RI site during winter.
		Existing RI Site	Agricultural land is available but not developed. Requires effluent disposal to RI site during winter period.
		Near Gravel Pit (Weyerhauser)	Agricultural and industrial reuse potential. Requires effluent disposal to RI site during winter period.
		Downstream of Existing Site	Agricultural reuse potential. Requires river discharge or effluent storage during winter period.

Appendix II –
Life-cycle Cost Estimates of Options

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Option 1: Oxidation Ditch at Existing Site

Year	Maintenance Costs			Capital Cost
	Labour	High-Lift Pumping	Expenses (chemicals, disposal, insurance, etc.)	
2005	80,000	3,650	142,000	0
2006	81,600	3,920	144,840	0
2007	83,200	4,200	147,680	0
2008	84,800	4,480	150,520	3,530,000
2009	86,400	4,530	153,360	0
2010	88,000	4,570	156,200	0
2011	89,600	4,620	159,040	0
2012	91,200	4,670	161,880	0
2013	92,800	4,720	164,720	0
2014	94,400	4,770	167,560	0
2015	96,000	4,820	170,400	0
2016	97,600	4,870	173,240	0
2017	99,200	4,920	176,080	0
2018	100,800	4,970	178,920	0
2019	102,400	5,020	181,760	0
2020	104,000	5,070	184,600	0
2021	105,600	5,120	187,440	0
2022	107,200	5,170	190,280	0
2023	108,800	5,220	193,120	0
2024	110,400	5,270	195,960	0
2025	112,000	5,320	198,800	0
2026	113,600	5,370	201,640	0
2027	115,200	5,420	204,480	0
2028	116,800	5,470	207,320	0
2029	118,400	5,520	210,160	0
2030	120,000	5,570	213,000	0

Present Worth = $7,370,000

Capital Cost Estimate

Phase I (Interim Measures)

Item	Cost Estimate
1 Interim treatment upgrade	120,000
2 Building & misc. piping	85,000
Sub-Total	205,000
E&C (35%)	71,750
TOTAL	277,000

Phase II (Capacity Replacement)

Item	Cost Estimate
1 Oxidation ditch replacement	
site prep., concrete	470,000
rotor, pumps, steel fab.	100,000
misc. piping & fabrication	80,000
2 Electrical & controls	500,000
3 Clarifier	850,000
4 Influent screen	120,000
5 Sludge thickener	85,000
6 Sludge press/dewatering	210,000
7 Odour control	100,000
8 Buildings, asphalt, misc.	100,000
Sub-Total	2,615,000
E&C (35%)	915,250
TOTAL	3,530,000

Option 2: Oxidation Ditch at RI Site

Year	Maintenance Costs			Capital Cost
	Labour	High-Lift Pumping	Expenses (chemicals, disposal, insurance, etc.)	
2005	80,000	3,650	142,000	0
2006	81,600	3,920	144,840	0
2007	83,200	4,200	147,680	0
2008	84,800	4,480	150,520	3,880,000
2009	86,400	4,530	153,360	0
2010	88,000	4,570	156,200	0
2011	89,600	4,620	159,040	0
2012	91,200	4,670	161,880	0
2013	92,800	4,720	164,720	0
2014	94,400	6,070	167,560	0
2015	96,000	6,140	170,400	0
2016	97,600	6,200	173,240	0
2017	99,200	6,260	176,080	0
2018	100,800	6,330	178,920	0
2019	102,400	6,390	181,760	0
2020	104,000	6,450	184,600	0
2021	105,600	6,520	187,440	0
2022	107,200	6,580	190,280	0
2023	108,800	6,640	193,120	0
2024	110,400	6,710	195,960	0
2025	112,000	6,770	198,800	0
2026	113,600	6,840	201,640	0
2027	115,200	6,900	204,480	0
2028	116,800	6,960	207,320	0
2029	118,400	7,030	210,160	0
2030	120,000	7,090	213,000	0

Present Worth = $7,690,000

Capital Cost Estimate

Phase I (Interim Measures)

Item	Cost Estimate
1 Interim treatment upgrade	120,000
2 Building & misc. piping	85,000
Sub-Total	205,000
E&C (35%)	71,750
TOTAL	277,000

Phase II (Capacity Replacement)

Item	Cost Estimate
1 New oxidation ditch	
site prep., concrete	470,000
rotor, pumps, steel fab.	100,000
misc. piping & fabrication	80,000
2 Electrical & controls	500,000
3 Clarifier	850,000
3 Influent screen	120,000
4 Sludge thickener	85,000
5 Sludge press/dewatering	210,000
6 Odour control	60,000
7 Buildings, asphalt, misc.	160,000
8 Upgrade pump facility	240,000
Sub-Total	2,875,000
E&C (35%)	1,006,250
TOTAL	3,880,000

Option 3: Activated Sludge at Existing STP

Year	Maintenance Costs			Capital Cost
	Labour	High-Lift Pumping	Expenses (chemicals, disposal, insurance, etc.)	
2005	80,000	3,650	142,000	0
2006	81,600	3,920	144,840	0
2007	83,200	4,200	147,680	0
2008	120,000	4,480	170,000	4,040,000
2009	122,400	4,530	173,400	0
2010	124,800	4,570	176,800	0
2011	127,200	4,620	180,200	0
2012	129,600	4,670	183,600	0
2013	132,000	4,720	187,000	0
2014	134,400	4,770	190,400	0
2015	136,800	4,820	193,800	0
2016	139,200	4,870	197,200	0
2017	141,600	4,920	200,600	0
2018	144,000	4,970	204,000	0
2019	146,400	5,020	207,400	0
2020	148,800	5,070	210,800	0
2021	151,200	5,120	214,200	0
2022	153,600	5,170	217,600	0
2023	156,000	5,220	221,000	0
2024	158,400	5,270	224,400	0
2025	160,800	5,320	227,800	0
2026	163,200	5,370	231,200	0
2027	165,600	5,420	234,600	0
2028	168,000	5,470	238,000	0
2029	170,400	5,520	241,400	0
2030	172,800	5,570	244,800	0

Present Worth = $8,700,000

Capital Cost Estimate

Phase I (Interim Measures)

Item	Cost Estimate
1 Interim treatment upgrade	120,000
2 Building & misc. piping	85,000
Sub-Total	205,000
E&C (35%)	71,750
TOTAL	277,000

Phase II (Capacity Replacement)

Item	Cost Estimate
1 New bioreactor	
site prep., concrete	450,000
pumps & aeration	340,000
misc. piping & fabrication	130,000
2 Electrical & controls	570,000
3 Clarifier	850,000
3 Influent screen	120,000
4 Sludge thickener	85,000
5 Sludge press/dewatering	210,000
6 Odour control	100,000
7 Buildings, asphalt, misc.	140,000
Sub-Total	2,995,000
E&C (35%)	1,048,250
TOTAL	4,040,000

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Option 4: Activated Sludge at RI Site

Year	Maintenance Costs			Capital Cost
	Labour	High-Lift Pumping	Expenses (chemicals, disposal, insurance, etc.)	
2005	80,000	3,650	142,000	0
2006	81,600	3,920	144,840	0
2007	83,200	4,200	147,680	0
2008	120,000	4,480	170,000	4,380,000
2009	122,400	4,530	173,400	0
2010	124,800	4,570	176,800	0
2011	127,200	4,620	180,200	0
2012	129,600	4,670	183,600	0
2013	132,000	6,010	187,000	0
2014	134,400	6,070	190,400	0
2015	136,800	6,140	193,800	0
2016	139,200	6,200	197,200	0
2017	141,600	6,260	200,600	0
2018	144,000	6,330	204,000	0
2019	146,400	6,390	207,400	0
2020	148,800	6,450	210,800	0
2021	151,200	6,520	214,200	0
2022	153,600	6,580	217,600	0
2023	156,000	6,640	221,000	0
2024	158,400	6,710	224,400	0
2025	160,800	6,770	227,800	0
2026	163,200	6,840	231,200	0
2027	165,600	6,900	234,600	0
2028	168,000	6,960	238,000	0
2029	170,400	7,030	241,400	0
2030	172,800	7,090	244,800	0

Present Worth = $9,000,000

Capital Cost Estimate

Phase I (Interim Measures)

Item	Cost Estimate
1 Interim treatment upgrade	120,000
2 Building & misc. piping	85,000
Sub-Total	205,000
E&C (35%)	71,750
TOTAL	277,000

Phase II (Capacity Replacement)

Item	Cost Estimate
1 New bioreactor	
site prep., concrete	450,000
pumps & aeration	340,000
misc. piping & fabrication	130,000
2 Electrical & controls	600,000
3 Clarifier	850,000
3 Influent screen	120,000
4 Sludge thickener	85,000
5 Sludge press/dewatering	210,000
6 Odour control	60,000
7 Buildings, asphalt, misc.	160,000
8 Upgrade pump facility	240,000
Sub-Total	3,245,000
E&C (35%)	1,135,750
TOTAL	4,380,000

Option 5: Activated Sludge Nr Weyerhaeuser

Year	Maintenance Costs			Capital Cost
	Labour	High-Lift Pumping	Expenses (chemicals, disposal, insurance, etc.)	
2005	80,000	3,650	142,000	0
2006	81,600	3,920	144,840	0
2007	83,200	4,200	147,680	0
2008	120,000	4,480	170,000	4,640,000
2009	122,400	4,530	173,400	0
2010	124,800	4,570	176,800	0
2011	127,200	4,620	180,200	0
2012	129,600	4,670	183,600	0
2013	132,000	6,010	187,000	0
2014	134,400	6,070	190,400	0
2015	136,800	6,140	193,800	0
2016	139,200	6,200	197,200	0
2017	141,600	6,260	200,600	0
2018	144,000	6,330	204,000	0
2019	146,400	6,390	207,400	0
2020	148,800	6,450	210,800	0
2021	151,200	6,520	214,200	0
2022	153,600	6,580	217,600	0
2023	156,000	6,640	221,000	0
2024	158,400	6,710	224,400	0
2025	160,800	6,770	227,800	0
2026	163,200	6,840	231,200	0
2027	165,600	6,900	234,600	0
2028	168,000	6,960	238,000	0
2029	170,400	7,030	241,400	0
2030	172,800	7,090	244,800	0

Present Worth = $9,230,000

Capital Cost Estimate

Phase I (Interim Measures)

Item	Cost Estimate
1 Interim treatment upgrade	120,000
2 Building & misc. piping	85,000
Sub-Total	205,000
E&C (35%)	71,750
TOTAL	277,000

Phase II (Capacity Replacement)

Item	Cost Estimate
1 New bioreactor	
site prep., concrete	450,000
pumps & aeration	340,000
misc. piping & fabrication	130,000
2 Electrical & controls	600,000
3 Clarifier	850,000
4 Influent screen	120,000
5 Sludge thickener	85,000
6 Sludge press/dewatering	210,000
7 Odour control	100,000
8 Buildings, asphalt, misc.	160,000
9 Upgrade pump facility	240,000
10 Land acquisition	150,000
Sub-Total	3,435,000
E&C (35%)	1,202,250
TOTAL	4,640,000

Option 6: BNR (Tertiary) Plant at Existing STP

Year	Maintenance Costs			Capital Cost
	Labour	High-Lift Pumping	Expenses (chemicals, disposal, insurance, etc.)	
2005	80,000	3,650	142,000	0
2006	81,600	3,920	144,840	0
2007	83,200	4,200	147,680	0
2008	120,000	4,480	170,000	4,620,000
2009	122,400	0	173,400	0
2010	124,800	0	176,800	0
2011	127,200	0	180,200	0
2012	129,600	0	183,600	0
2013	132,000	0	187,000	0
2014	134,400	0	190,400	0
2015	136,800	0	193,800	0
2016	139,200	0	197,200	0
2017	141,600	0	200,600	0
2018	144,000	0	204,000	0
2019	146,400	0	207,400	0
2020	148,800	0	210,800	0
2021	151,200	0	214,200	0
2022	153,600	0	217,600	0
2023	156,000	0	221,000	0
2024	158,400	0	224,400	0
2025	160,800	0	227,800	0
2026	163,200	0	231,200	0
2027	165,600	0	234,600	0
2028	168,000	0	238,000	0
2029	170,400	0	241,400	0
2030	172,800	0	244,800	0

Present Worth = $9,130,000

Capital Cost Estimate

Phase I (Interim Measures)

Item	Cost Estimate
1 Interim treatment upgrade	120,000
2 Building & misc. piping	85,000
Sub-Total	205,000
E&C (35%)	71,750
TOTAL	277,000

Phase II (Capacity Replacement)

Item	Cost Estimate
1 New bioreactor	
site prep., concrete	450,000
pumps & aeration	340,000
misc. piping & fabrication	130,000
2 Electrical & controls	600,000
3 Clarifier	850,000
4 Influent screen	120,000
5 Sludge thickener	85,000
6 Sludge press/dewatering	210,000
7 Odour control	100,000
8 Buildings, asphalt, misc.	140,000
9 Filter	300,000
10 UV Disinfection	100,000
Sub-Total	3,425,000
E&C (35%)	1,198,750
TOTAL	4,620,000

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Option 7: BNR (Tertiary) D/S of Existing STP

Year	Maintenance Costs			Capital Cost
	Labour	High-Lift Pumping	Expenses (chemicals, disposal, insurance, etc.)	
2005	80,000	3,650	142,000	0
2006	81,600	3,920	144,840	0
2007	83,200	4,200	147,680	0
2008	120,000	4,480	170,000	5,230,000
2009	122,400	0	173,400	0
2010	124,800	0	176,800	0
2011	127,200	0	180,200	0
2012	129,600	0	183,600	0
2013	132,000	0	187,000	0
2014	134,400	0	190,400	0
2015	136,800	0	193,800	0
2016	139,200	0	197,200	0
2017	141,600	0	200,600	0
2018	144,000	0	204,000	0
2019	146,400	0	207,400	0
2020	148,800	0	210,800	0
2021	151,200	0	214,200	0
2022	153,600	0	217,600	0
2023	156,000	0	221,000	0
2024	158,400	0	224,400	0
2025	160,800	0	227,800	0
2026	163,200	0	231,200	0
2027	165,600	0	234,600	0
2028	168,000	0	238,000	0
2029	170,400	0	241,400	0
2030	172,800	0	244,800	0

Present Worth = $9,660,000

Capital Cost Estimate

Phase I (Interim Measures)

Item	Cost Estimate
1 Interim treatment upgrade	120,000
2 Building & misc. piping	85,000
Sub-Total	205,000
E&C (35%)	71,750
TOTAL	277,000

Phase II (Capacity Replacement)

Item	Cost Estimate
1 New bioreactor	
site prep., concrete	450,000
pumps & aeration	340,000
misc. piping & fabrication	130,000
2 Electrical & controls	750,000
3 Clarifier	850,000
4 Influent screen	120,000
5 Sludge thickener	85,000
6 Sludge press/dewatering	210,000
7 Odour control	100,000
8 Buildings, asphalt, misc.	160,000
9 Filter	300,000
10 UV Disinfection	100,000
11 Extend gravity trunk (730m)	180,000
12 Land acquisition	100,000
Sub-Total	3,875,000
E&C (35%)	1,356,250
TOTAL	5,230,000

Option 8: Fixed Film (RBC) at RI Site

Year	Maintenance Costs			Capital Cost
	Labour	High-Lift Pumping	Expenses (chemicals, disposal, insurance, etc.)	
2005	80,000	3,650	142,000	0
2006	81,600	3,920	144,840	0
2007	83,200	4,200	147,680	0
2008	84,800	4,480	150,520	4,350,000
2009	86,400	4,530	153,530	0
2010	88,000	4,570	156,541	0
2011	89,600	4,620	159,551	0
2012	91,200	4,670	162,562	0
2013	92,800	6,010	165,572	0
2014	94,400	6,070	168,582	0
2015	96,000	6,140	171,593	0
2016	97,600	6,200	174,603	0
2017	99,200	6,260	177,614	0
2018	100,800	6,330	180,624	0
2019	102,400	6,390	183,634	0
2020	104,000	6,450	186,645	0
2021	105,600	6,520	189,655	0
2022	107,200	6,580	192,666	0
2023	108,800	6,640	195,676	0
2024	110,400	6,710	198,686	0
2025	112,000	6,770	201,697	0
2026	113,600	6,840	204,707	0
2027	115,200	6,900	207,718	0
2028	116,800	6,960	210,728	0
2029	118,400	7,030	213,738	0
2030	120,000	7,090	216,749	0

Present Worth = $8,110,000

Capital Cost Estimate

Phase I (Interim Measures)

Item	Cost Estimate
1 Interim treatment upgrade	120,000
2 Building & misc. piping	85,000
Sub-Total	205,000
E&C (35%)	71,750
TOTAL	277,000

Phase II (Capacity Replacement)

Item	Cost Estimate
1 New RBC	
site prep., concrete	310,000
RBC rotors	650,000
misc. piping & fabrication	90,000
2 Electrical & controls	470,000
3 Clarifier	850,000
4 Influent screen	120,000
5 Sludge thickener	85,000
6 Sludge press/dewatering	210,000
7 Odour control	60,000
8 Buildings, asphalt, misc.	140,000
9 Upgrade pump facility	240,000
Sub-Total	3,225,000
E&C (35%)	1,128,750
TOTAL	4,350,000

Option 9: Fixed Film (RBC) Nr Weyerhaeuser

Year	Maintenance Costs			Capital Cost
	Labour	High-Lift Pumping	Expenses (chemicals, disposal, insurance, etc.)	
2005	80,000	3,650	142,000	0
2006	81,600	3,920	144,840	0
2007	83,200	4,200	147,680	0
2008	84,800	4,480	150,520	4,560,000
2009	86,400	4,530	153,530	0
2010	88,000	4,570	156,541	0
2011	89,600	4,620	159,551	0
2012	91,200	4,670	162,562	0
2013	92,800	6,010	165,572	0
2014	94,400	6,070	168,582	0
2015	96,000	6,140	171,593	0
2016	97,600	6,200	174,603	0
2017	99,200	6,260	177,614	0
2018	100,800	6,330	180,624	0
2019	102,400	6,390	183,634	0
2020	104,000	6,450	186,645	0
2021	105,600	6,520	189,655	0
2022	107,200	6,580	192,666	0
2023	108,800	6,640	195,676	0
2024	110,400	6,710	198,686	0
2025	112,000	6,770	201,697	0
2026	113,600	6,840	204,707	0
2027	115,200	6,900	207,718	0
2028	116,800	6,960	210,728	0
2029	118,400	7,030	213,738	0
2030	120,000	7,090	216,749	0

Present Worth = $8,290,000

Capital Cost Estimate

Phase I (Interim Measures)

Item	Cost Estimate
1 Interim treatment upgrade	120,000
2 Building & misc. piping	85,000
Sub-Total	205,000
E&C (35%)	71,750
TOTAL	277,000

Phase II (Capacity Replacement)

Item	Cost Estimate
1 New RBC	
site prep., concrete	310,000
RBC rotors	650,000
misc. piping & fabrication	90,000
2 Electrical & controls	470,000
3 Clarifier	850,000
4 Influent screen	120,000
5 Sludge thickener	85,000
6 Sludge press/dewatering	210,000
7 Odour control	60,000
8 Buildings, asphalt, misc.	140,000
9 Upgrade pump facility	240,000
10 Land acquisition	150,000
Sub-Total	3,375,000
E&C (35%)	1,181,250
TOTAL	4,560,000

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Option 10: Primary at Existing STP & Secondary at RI Site

Year	Maintenance Costs			Capital Cost
	Labour	High-Lift Pumping	Expenses (chemicals, disposal, insurance, etc.)	
2005	80,000	3,650	142,000	0
2006	81,600	3,920	144,840	0
2007	83,200	4,200	147,680	0
2008	145,000	4,480	150,520	3,980,000
2009	147,900	4,530	153,360	0
2010	150,858	4,570	156,370	0
2011	153,875	4,620	159,381	0
2012	156,953	4,670	162,391	0
2013	160,092	4,720	165,402	0
2014	163,294	4,770	168,412	0
2015	166,559	4,820	171,422	0
2016	169,891	4,870	174,433	0
2017	173,288	4,920	177,443	0
2018	176,754	4,970	180,454	0
2019	180,289	5,020	183,464	0
2020	183,895	5,070	186,474	0
2021	187,573	5,120	189,485	0
2022	191,324	5,170	192,495	0
2023	195,151	5,220	195,506	0
2024	199,054	5,270	198,516	0
2025	203,035	5,320	201,526	0
2026	207,096	5,370	204,537	0
2027	211,238	5,420	207,547	0
2028	215,462	5,470	210,558	0
2029	219,772	5,520	213,568	0
2030	224,167	5,570	216,578	0

Present Worth = $8,780,000

Capital Cost Estimate

Phase I (Interim Measures)

Item	Cost Estimate
1 Interim treatment upgrade	120,000
2 Building & misc. piping	85,000
Sub-Total	205,000
E&C (35%)	71,750
TOTAL	277,000

Phase II (Capacity Replacement)

Item	Cost Estimate
1 New secondary at RI site	
site prep., concrete	525,000
rotor, pumps, steel fab.	135,000
misc. piping & fabrication	120,000
2 Electrical & controls	600,000
3 Clarifier	850,000
4 Influent screen	120,000
4 Sludge thickener	85,000
5 Sludge press/dewatering	210,000
6 Odour control	60,000
7 Buildings, asphalt, misc.	140,000
8 Upgrade pump facility	100,000
Sub-Total	2,945,000
E&C (35%)	1,030,750
TOTAL	3,980,000

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