TECHNICAL MEMORANDUM NO. 1

REGIONAL DISTRICT OF KITIMAT-STIKINE
LAKELSE LAKE/JACKPINE FLATS

Stage 1 Liquid Waste Management Plan (LWMP)
Summary of Background Studies

March 2004
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1 BACKGROUND

Lakelse Lake is located south of Terrace, on the eastern margin of the Coast Range Mountains. The lake is fed by thirteen small creeks. Some of the larger tributary streams are Williams Creek, Hatchery Creek (also known as Granite Creek), Scully Creek (also known as Schulbuckhand Creek), Furlong Creek, Clearwater Creek, and hot springs. The lake has a mean depth of 7.9 m, a maximum depth of 30 m and an estimated water volume of 108 million m$^3$ (Kerby, 1984). Flushing of Lakelse Lake occurs five to six times a year due to a large watershed and high annual precipitation, with maximum water inputs from snowmelt occurring in spring and summer (McKean, 1986). Lakelse Lake drains via Lakelse River into the Skeena River.

Lakelse Lake and its neighbouring areas are used for residential, commercial and recreational purposes. Lakelse Lake is an important habitat for trumpeter swans and ducks and also a significant salmon spawning habitat responsible for 35% of the Skeena salmon escapement (RDKS, 1992). The Lakelse watershed is a significant habitat for rearing fish due to its shallow and warm waters. The reports by Applied Ecosystem Management Ltd. and Sperling Hansen Associates, Inc. (2001) and Cleugh et al. (1978) listed five species of Pacific salmon (pink, coho, chinook, chum, and sockeye) and other fish species such as cutthroat trout, rainbow trout, Dolly Varden char, squawfish, and large-scale suckers as being supported by the Lakelse watershed.

Jackpine Flats is a rural residential subdivision located to the north-northeast of the north end of Lakelse Lake. The area is located between or beside Sockeye Creek and Williams Creek and groundwater from the area ultimately drains into Lakelse Lake.
The focus of this Liquid Waste Management Plan (LWMP) is to assess the impact of human habitation and its attendant wastewater discharges on the quality of the ground and surface waters in the Lakelse Lake/Jackpine Flats area. The concerns are based on the fact that most, if not all, of the residences in the study area are on septic systems and that some of these systems may be causing environmental problems. These problems include the discharge of nutrients (nitrogen and phosphorus) and/or fecal contaminants, including fecal coliforms, to the ground and surface waters, resulting in potential problems with algal and aquatic weed growth, fish toxicity and/or drinking water source contamination.

The focus of this first Stage 1 LWMP technical memorandum (TM) is to summarize previous studies regarding water quality and treatment issues in the study area. The intent is to set the stage for the LWMP to be able to focus on more specific issues in subsequent Technical Memorandums.

2 WATER QUALITY AND TREATMENT ISSUES

In the March 1992 Lakelse Lake Plan, the Regional District of Kitimat-Stikine (RDKS) expressed that many existing wastewater treatment systems are not functioning correctly due to high groundwater infiltration and poor soil conditions and, therefore, effluent enters Lakelse Lake only partially treated. The RDKS believes that many lakeshore properties are unsuitable for septic tanks and disposal fields without additional soil depth (RDKS, 1992). As a result, the RDKS would like to upgrade existing waste disposal systems wherever possible and to examine the feasibility of alternate waste disposal systems (RDKS, 1992).

Studies have concluded that Lakelse Lake is currently experiencing water quality problems partly due to the water table being only a few feet below the ground surface. A Health Branch survey indicated that 10% to 15% of the waste disposal systems are failing because of the high water table and poor development conditions around the lakeshore (RDKS, 1992). Stantec (2000) as cited by Downie (2003), and Kokelj (2003) report that water contamination may result when septic disposal fields become flooded by the high water levels thereby, moving untreated septic effluent into the lake and/or groundwater. With some of the septic systems functioning poorly, some waterfront homes may have their wastewater piped directly into the lake. McKean (1986) stated that at that time,
there are no direct discharges of effluent into the lake and the only wastes sources
that affect water quality in Lakelse Lake come from diffuse effluents originating
from logging and septic tank tile fields. Since drinking water taken from the lake
is collected close to the shoreline, the direct discharge of waste effluents into the
lake pose great health concerns for residents that use the lake for drinking water
and recreational purposes.

3 LAND USE

Lakelse Lake and Jackpine Flats are primarily residential areas within the study
area. The vicinity is also used for water supply, recreation (swimming and
fishing), transportation (seaplane base), commercial (resorts), public campsites,
picnic grounds, logging, salmon spawning, and sewage disposal from permanent
residences and park sites (Cleugh et al., 1978).

3.1 LAKELSE LAKE

The Lakelse Lake area is made up of approximately 480 parcels of land, of which
only 280 lots have been developed as single family dwellings (RDKS, 2003). The
lot sizes range from 0.3 acre waterfront lots to greater than 1 acre lots (RDKS,
2003). The population count for this area is uncertain because many of the homes
are only occupied seasonally. Using the Census Population per Density Unit of 3.9
for rural Terrace, the current estimated population of the Lakelse Lake area is
approximately 1092 residents.

The Lakelse Lake area is also home to three main commercial development sites:
Mount Layton Hot Springs Resort, Water Lily Bay Resort and Lakelse Lake
Provincial Park.

The Mount Layton Hot Springs Resort is a privately-owned commercial
development that includes a 22 unit motel with a dining room, banquet room, hot
spring pools and waterslide. Liquid wastes are disposed using an on-site filtration
and lagoon system under a permit issued by the Ministry of Water, Land and Air
Protection (MWLAP). The discharge permit allows Mount Layton Hot Springs
Resort to discharge secondary treatment effluent to ground and to Lakelse Lake at
a maximum discharge rate of 30 m³/day with equivalent or better than 30 mg/L
5-day Biochemical Oxygen Demand (BOD₅), 40 mg/L Total Suspended Solids (TSS), 1.0 mg/L Total Phosphorus, and 77 CFU/100 mL E. coli.

Water Lily Bay Resort is a private campground with unserviced RV/campsites and six cabins which are primarily occupied during the months of May through September. Each cabin has a maximum capacity of six people. There is a house on the property where the resort owners reside. The wastewater generated from the house is disposed using a septic tank and tile distribution field under a permit from the Ministry of Health. The wastewater generated from the six cabins is disposed using septic tanks and tile distribution fields.

Lakelse Lake Provincial Park is approximately 350 hectares consisting of about 150 unserviced RV/campsites. There is a sanitation station on-site and pit and flush toilets are located throughout the park. The park wastewater is treated using an on-site septic tank and tile distribution field located near the highway, away from Lakelse Lake. Currently, there is no permit authorizing the operation of this treatment system.

3.2 JACKPINE FLATS

Jackpine Flats located north of Lakelse Lake is both a high density (minimum 2 acre lot size) and low density (minimum 10 acre lot size) rural subdivision consisting of approximately 222 parcels of land, with approximately 200 single family dwellings (RDKS, 2003). The area south of Williams Creek Bridge has a five acre minimum lot size (RDKS, 2003). The population count for this area using the same Census Population per Density Unit of 3.9 would give an approximate current population of 780 residents.

The Jackpine Flats area is primarily residential as detailed above; however, the area also consists of a seasonal children’s camp run by a local church group, a small mobile home park with approximately five units, hobby farms for raising livestock including horses and cattle, and a small saw mill which produces cedar shakes (Pellegrino, 2003).
4 SURFACE WATER QUALITY

Surface water quality data for Lakelse Lake and its tributaries has been presented in numerous reports dating from 1974 to 2003 (see reference list). The time length of the studies varied from samples collected five times within thirty days, to samples collected at various intervals throughout the year.

Nine stations on Lakelse Lake, Lakelse River and the major tributaries were monitored seven times each between December 1974 to October 1975 by the Department of Fisheries and Environment. The water quality results were reported by Cleugh et al. (1978) and are as follows: dissolved oxygen ranged from 51 to 90 percent saturation at all sites, near neutral pH at all sites, specific conductivity ranged from 210 to 265 umho/cm² at the hotsprings site and 21 to 65 umho/cm² at all other sites, nitrite concentrations were below detection limit, low level concentrations of nitrate, ammonia nitrogen and total phosphorus. The low phosphorus concentrations in Lakelse Lake did not appear to be the limiting factor for algae production. Low biomass and low plankton productivity, indicate oligotrophic phytoplankton productivity. Poor zooplankton numbers and species may be the result of low phytoplankton biomass. Fast growing macrophyte and benthic communities, possibly due to uncontrolled discharging of nutrients into Lakelse Lake were noted. The hotsprings were not significant in affecting the chemistry of the lake because the flow from the hotsprings is only approximately 8 L/s, or 1/2500 of the total outflow from the lake.

McKean (1986) summarized water quality data collected since 1974 by both the Federal and Provincial Governments and reported the following: maximum lake surface temperatures did not exceed 17°C, typical dissolved oxygen concentrations were typical for well flushed lakes (never below 50 percent saturation in the bottom waters), relatively good water clarity during non-freshet periods, turbidity was 1 to 2 NTU during freshet periods, and mildly acidic rain influenced samples, potentially due to industrial activity (aluminum smelter, pulp mills). The lake was considered to be oligotrophic due to low phosphorus concentrations, low oxygen depletion rates of bottom waters, and low chlorophyll a results.
No present nutrient problems were detected in Lakelse Lake according to a 1992 study by the Pollution Control Branch (RDKS, 1992).

Ten locations, primarily surface water sources in the Lakelse Lake area were monitored for water quality over a four-month period for a Lakelse Lake Hard Surfacing Project Drainage and Environmental Study by Applied Ecosystem Management Ltd and Sperling Hansen Associates, Inc. (2001). Water quality analysis results indicate the water in the Lakelse Lake area is high quality with the following characteristics: near neutral, slightly acidic pH, low conductivity, low hardness, low or non-detectable concentrations of major cations, anions, nitrogen species and dissolved metals, low concentrations of total metals with the exception of iron which exceeded drinking water criteria in six of ten samples, and detectable presence of total coliforms and occasional detection of fecal coliforms.

Lakelse Lake water quality sampling results for 2002 and 2003, reported by Downie (2003) state the lake samples taken from one sampling site on the westside of the lake (residential intake) and two sampling sites on the east side of the lake (one residential intake and one resort intake) had low to undetectable levels of fecal coliforms, E. coli, and Enterococci during summer sampling, with higher bacterial concentrations during fall sampling. All three of the sampling sites met the fecal coliform “disinfection only” water quality objectives of less than 10 colony forming units (CFU)/100 mL. However, since many of the Lake residents use raw (untreated) water, the “no treatment” water quality objectives should be used. Under the “no treatment” water quality objectives, there should be 0 CFU/100 mL for fecal coliforms, E. coli, and Enterococci. In the summer samples (90th percentile) taken from the Mt. Layton Hot Springs Resort, both fecal coliform concentrations (8.8 CFU/100 mL) and Enterococci concentrations (2.4 CFU/100 mL) were detected. The fall samples (90th percentile) taken from the western residential intake and the resort intake exceeded the “no treatment” water quality objectives for fecal coliforms (5 and 9.8 CFU/100 mL, respectively), E. coli (3.4 and 5.2 CFU/100 mL, respectively), and Enterococci (1.6 and 3.6 CFU/100 mL, respectively).

A total of 21 sites were sampled May, July and September of 2003 and the results are reported in a draft by Kokelj (2003 draft). According to “no treatment”
drinking water guidelines, fecal coliforms, *E. coli* and *Enterococci* concentrations should not exceed 0 CFU/100 mL. Fecal coliforms, *E. coli* and *Enterococci* concentrations were detected at least once at every upstream and downstream sampling sites with most downstream sites having greater concentrations than upstream sites, as shown in Figure TM1-1. The fecal coliform concentrations ranged from <1 to 110 CFU/100 mL at the upstream sites and from <1 to 260 CFU/100 mL at the downstream sites. *E. coli* concentrations ranged from <1 to 100 CFU/100 mL at the upstream sites and from <1 to 240 CFU/100 mL at the downstream sites. *Enterococci* concentrations ranged from <1 to 100 CFU/100 mL at the upstream sites and from <1 to 1130 CFU/100 mL at the downstream sites. The presence of these pathogens suggests that Lakelse Lake water is not safe to drink untreated.

As shown in Figure TM1-2, test results also indicate elevated concentrations of phosphorus (>0.011 to .034 mg/L) in samples taken from Eel Creek, Provincial Park Creek, Mountain Creek, Williams Creek, and Whalen Creek. The maximum concentration of total phosphorus for drinking water and recreation is 0.010 mg/L. High concentrations of phosphorus, such as those found in some tributaries of Lakelse Lake can contribute to excessive plant growth and algal blooms. According to Donnelly et al. (1998), clay rich bottom sediments are capable of storing phosphorus and, therefore, are a large source of bioavailable phosphorus for algal growth. Phosphate in the bottom sediments is associated with clay minerals and iron. Phosphorus can be released from bottom sediments during stratification when oxygen levels fall to around 32% saturation.

In the *Lakelse Lake Draft Management Plan*, Kokelj (2003) reported that watershed residents have noticed the growth of an invasive species, *Elodea canadensis* in Lakelse Lake. This species has infested other lakes in the region to a point where it occupies most of the shoreline. A correlation between an increase in *Elodea* infestation in the lake and an increase in human activity contributing to an increase in sediment delivery rates into the lake was detailed by Kokelj (2003). Stream channel modifications in the Lakelse area have caused slope failures which in turn may have led to an increase in sediments entering the streams and, hence, Lakelse Lake. In turn, Elodea canadensis thrives in areas with fine grained sediments. The presence of iron (which does not threaten human health) in Lakelse Lake tributary samples, influences aesthetic water quality objectives and
may also be the primary micronutrient contributing to *Elodea canadensis* growth. As shown in Figure TM1-3, September 2003 samples from upstream and downstream locations in Provincial Park Creek had iron concentrations as high as 3.11 mg/L and 3.49 mg/l respectively, while other downstream sites ranged from 0.04 to 3.19 mg/L (Downie, 2003B).

5 GROUNDWATER QUALITY

The residents of Jackpine Flats acquire their drinking water from shallow, 5 to 20 m deep, wells located on each property. Due to the surface to groundwater depth being in the general range of 6 to 7 m and the soils tending to have high to very high percolation rates, a groundwater monitoring program was initiated in July 2002 by the Environmental Quality Section of the Skeena Region British Columbia MWLAP in consultation with an Environmental Health Officer from the Ministry of Health, and representatives from the RDKS. The results of the groundwater quality analysis are detailed in a draft report by Downie (2003) and summarized in the following paragraphs of this technical memorandum.

Water sampling took place in summer and fall of 2002 and spring and summer of 2003. Initially, three sampling sites were created (JF1-JF3). At a later time, additional sampling sites were established (JF4-JF9). Samples were collected using the methods outlined in the *BC Field Sampling Manual* by Clark (1996). Groundwater samples were collected five times within 30 days for summer and also again for fall. Samples were collected from the following areas in the Jackpine Flats subdivision following a 3 minute flushing of the water lines:

- **JF1**: A 5 m deep groundwater well expected to be above any influence of the subdivision.
- **JF2**: An 18 m deep groundwater well located near the middle of the subdivision.
- **JF3**: A 13 m deep groundwater well located downstream of the other sampling sites.
- **JF4**: A 6 m deep groundwater well located on the edge of the subdivision. Added in October 2002.
• JF5: An 18 - 24 m deep groundwater well located near the upstream/middle part of the aquifer. Added in August 2003.
• JF6: A 12 - 18 m deep groundwater well located near the middle of the aquifer. Added in April 2003.
• JF7: An unknown depth groundwater well located near the edge of the aquifer and may or may not be influenced by the subdivision. Added in August 2003.
• JF8: A 17 m deep groundwater well located in an upstream part of the aquifer. Added in April 2003.
• JF9: A 10 m deep groundwater well located in a downstream part of the aquifer. The site was added in the August 2003 sample set to replace JF3.

According to Downie’s report (2003), the analysis results of the groundwater sampling sites indicate no significant difference between the sampling sites. The microbiological results for the groundwater samples were low or undetectable. The samples did not meet the MWLAP disinfection only guideline for Enterococci in five of 94 samples. Fecal coliforms were detected once at a concentration of 46 CFU/100 mL. E. coli was not detected in any of the 94 samples. Sample sites JF3, JF4, and JF6 exceeded the MWLAP guidelines for iron (≤0.3 mg/L). Downie concludes by stating, “No site had consistently poor results for any indicator, and there was no correlation between detections of bacteria, chloride, nitrate and ammonia.” He suggests that the random occurrences of bacteria and low concentrations of ammonia, nitrate and chloride may be caused by localized influences such as, surface water infiltrating the groundwater aquifer. There is no hard evidence of sewage contamination in Jackpine Flats.

6 SOILS

In Chemical, Biological and Physical Characteristics of Lakelse Lake, BC by Cleugh et al. (1978), the Lakelse region was geologically characterized as comprising of rocks such as diorite, granodiorite, granite and porphyritic granite and include limestones, marbles, cherty quartzites and argillites. The Lakelse Lake basin is comprised mainly of aluvium and glacial silt.
According to a study by McKean (1986), soils in this area are rated moderate to poor for the renovation of septic tank effluent. Some of the lots on the western shore of Lakelse Lake have good soil; however, the majority of homes located on the lake shoreline are built on moderate to poor soil.

The soils on the eastern side of Lakelse Lake, along the lake margin are organic, which characteristically have a high water table making sewage disposal using septic tanks difficult (Kerby, 1984). Also, the high water table and proximity to major water bodies makes sewage disposal and flooding difficult to deal with. Areas with organic soils may require the use of a community sewage system to handle future growth.

Jackpine Flats area soils are coarse to bouldery gravel that have high to very high percolation rates which in turn result in poor sewage treatment (Kerby, 1984). Due to the nature of the soils, this area has the potential to contaminate Williams Creek and the Lakelse Lake watershed. An increase in housing density in Jackpine Flats would require examination and monitoring of groundwater nutrient levels. Soil condition and percolations vary depending on location, within major soil units, and also seasonally (water table may increase and decrease due to seasonality). For most effective treatment of household wastes, the preferred percolation rates are between 5 to 30 minutes per inch (Kerby, 1984). Some of the Ministry of Health’s records show percolation rates of well under 1 minute, implying that very little treatment of septic tank effluent would occur.

Soils on Lot 8, which include a land area of 17.9 hectares in Jackpine Flats were assessed and documented by Professional Agrologist, David W. Yole (1996). The soils on this lot are primarily composed of (approximately 85%) flat lying glacio-fluvial outwash deposits which are made of sands to sandy loams in the upper 50 cm of the soil profile. There is a high volume of gravel/cobbles (greater than 40% in the soil pits). Some deposits are pure sand. Soils at the site have been exposed to intense leaching and appear to be acidic. Soils are rapidly drained due to low organic matter content, very coarse soil textures and high coarse fragment content.

Yole concludes by stating that soils appear to be nutrient deficient, evidenced by soil classification and interpretation, vegetative indicators, and fire history of the
area. Majority of the site would be classified as non-arable with moisture and
stoniness limitations. Property is poorly suited for agricultural purposes, and
surrounding properties also have a very poor agronomic potential.

Based on a recent on-site inspection of the area and review of available
percolation rates, by Associated Engineering staff, it is clear that the Jackpine
Flats area soils are very permeable. This could lead to future problems with
groundwater well contamination and/or nutrient contamination of Williams Creek,
Sockeye Creek and/or Lakelse Lake.

7 CONCLUSIONS

Based on the above, there appear to be some valid concerns about the potential for
human habitation and the discharge of treated or partially treated wastewater to
effect Lakelse Lake, either directly or indirectly. Fecal contamination of ground
and surface waters is the greatest concern. Nutrient loadings to Lakelse Lake are
important, but not life-threatening per se. Technical Memorandum Number 2
(TM 2) will begin to investigate the potential for these impacts by discussing the
need for wastewater treatment.

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REFERENCES


Regional District of Kitimat-Stikine Zoning Bylaw No. 57, Lakelse Lake.

Regional District of Kitimat-Stikine Zoning Bylaw No. 37, Greater Terrace.


Yole, David W., "Soil Survey and Agricultural Capability Classification of Lot 8, D.L. 1728, Range 5, Coast District, Plan 8971 (Jackpine Flats Area South of Terrace)," May 1996.