

***BCWWA 2007 AGM & Conference
Penticton, BC***

***Sun Peaks Utilities Wastewater Treatment Plant
7 Years of Operations***

There are now over 12 USBF plants in operation in British Columbia. The facility at the Sun Peaks Resort is today the largest (in BC) and, installed in 1999, one of the earliest.

This presentation will outline the plant's operating experiences and operating data, and touch on the resorts' future considerations towards environmental sustainability, including water reuse for golf course irrigation and snow making.

History

Sun Peaks Resort is situated at the base of Tod Mountain approximately 40 kilometers northeast of Kamloops, British Columbia. Tod Mountain, with a summit elevation of 2,152 meters was originally developed as a ski operation in the early 1960's. In 1972, the former operator decided to develop a few residential lots and formed a private utility to operate a simple community water supply and wastewater leaching field that was replaced in 1987 with a simple lagoon system. While the permit granted with a maximum disposal of 230 m³/day, discharge was intermittent, if at all.

In 1992, the property was purchased by Nippon Cable Company Limited and the resort's name was changed to Sun Peaks. Nippon's strategy for Tod Mountain was to upgrade the ski lift and trail system and transform the area into a major four-season, destination mountain resort with all the amenities.

In 1993, the resort operator, Sun Peaks Resort Corporation completed the Tod Mountain Master Plan and entered into an agreement with the Provincial Government to take the resort from a winter only ski hill to a year round community that will eventually support as many as 24,000 residences and visitors during any period.

Sun Peaks' base development has been rapidly expanding since 1993. As a consequence, wastewater flows at the Sun Peaks Utilities' treatment facility have been steadily increasing. Sun Peaks Utilities Co. Ltd., (known as SPUCL) has made a number of improvements to the lagoon system to keep pace with the increasing hydraulic and organic loading. These improvements ranged from surface aeration mixers to sub-surface fine bubble diffusion piping.

Simple to Complex Treatment

But after the 1998 Christmas period when the holding time in the 6,000 cubic meter lagoon dropped to under 6 days, Sun Peaks Utilities decided to replace the lagoon with a system that could deal with the growing flows.

After evaluating a few alternatives, SPUCL decided to go with the Upflow Sludge Blanket Filtration (USBF) system supplied by Ecofluid Systems Inc. The Design/Build contract was awarded to Knappett Construction Ltd. in the latter part of July 1999, the construction began on August 24, 1999 and the plant started receiving wastewater on November 19, 1999. By December 15, the effluent was below 10 BOD₅ and 10 Total Suspended Solids.

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Plant Design

The overall design of the system allowed for four bio-reactors, each containing an anoxic zone, an aeration zone and a clarifier that contained a floating sludge blanket that acted as a filter media through which the final effluent flowed.

It was because of this floating sludge blanket in a “V” shape clarifier that makes handling of flows that can change 10 fold in the matter of a month and double the flow from weekend to weekday possible.



Year	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007
Highest Flow	930	997	1,244	1,206	1,303	1,362
Lowest Flow	35	42	127	157	186	198

The decision to go with a USBF system was based on a phased modular design of the plant allowing for incremental expansions that would match the number of people within the resort. The first phase installed in 1999 included 2 bioreactors with 3 clarifiers and a waste sludge storage tank.

Depending on the flows, this sludge tank was pumped out from once a day to once a week. The sludge at about 0.5% solids was then trucked off site.

Plant Upgrades and Expansions

The resort’s growth required a number of upgrades and expansions since its start up in 1999. In 2001, fourth clarifier was added to the initially installed three.

With the trucking costs to move the wasted sludge off-site rising, the Utility went to community for approval in 2002 to increase usage rates in order to purchase a sludge dewatering centrifuge and to move towards composting on site.

In the summer of 2003, the plant biology was expanded by an addition of two biological compartments, anoxic and aeration.

Last year the plant airlift RAS pumps were exchanged for mechanical pumps to save air, and a new waste sludge pre-thickener was installed to improve sludge handling. Unfortunately only one third of the pre-thickener installation was completed in time for 2006/2007 winter operation.



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Unfortunately or fortunately, it never stops when you grow as rapidly as Sun Peaks, and so this year we will be replacing the existing dewatering equipment, finish sludge pre-thickener installation, and add another air blower (bringing us to three).



At present the plant nominal average day capacity is 900 m³/d, (300 kg BOD₅/d), with peak hourly flow of 120 m³/h. With more air capacity and enhanced sludge management, we will be able to process the higher levels of influent expected this winter.

As with any resort community, it is recognized that any additional plant expansion at the current site is limited by the available real estate.

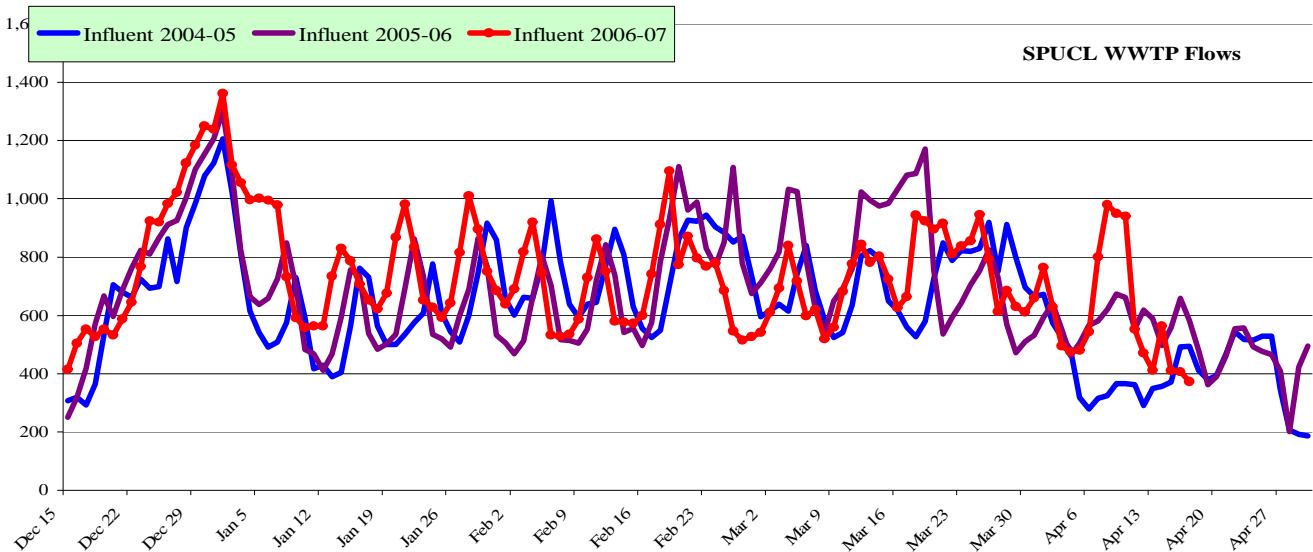
Operating the plant for over seven years enabled us to gather the plant operating and costs data, and acquire experience, which may be of interest to you and which we will share with you in the following.

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Operating Data

Each fall is like starting a new plant when we double the size from summer to winter mode. We take bets on what the new years flow will be and whether we guess correctly on the number of homes built.



We have learned to track lift tickets sold and occupancy rates to help us get prepared for each week. We track when holiday fall and weather trends. You wouldn't believe how powder ski days and rain events can affect flows.

Influent Characteristics

Ski resorts (and this may apply to mountain resorts in general) are not your 'typical influent' generators. Flows change dramatically from day to day and holiday period to holiday period.

At Sun Peaks, we implemented the plumbing code similar to Australia for water conservation and thus the average daily flow per person is currently 220 liters and dropping (the Canadian average is 375 liters). Then you add day visitors to the mix adding about 40 liters per person per day (very high ammonia content).

To get a better reading of the incoming influent, we analyzed hourly composite samples collected every hour throughout the day. The results illustrate a very uneven pattern of influent characteristics throughout the day as can be demonstrated by one such sample below.

2007	Low mg/L	Hour	High mg/L	Hour	Average mg/L
BOD ₅	120	6:30 am	590	9:30 am	385
COD	310	5:30 am	1300	9:30 am	813
N-NH ₄	30	1:30 pm	107	8:30 am	61

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The variable biological loading throughout the day is a challenge on its own but it is not limited there. We also measured reduced alkalinity, and at times disproportionately high COD (possibly due to the type of cooking oils and cleaning detergents used in the resort's restaurants and hotels). Add to this, the fact that the influent temperature may change 5-7 deg C within a matter of days, and the highly fluctuating flow (as high as 110 m³/h instantaneous hourly peak), and ... well, you are getting the picture.

How do we cope?

To 'smooth-out' the variable biological loadings, our air blowers are controlled by a continuous DO monitor/VFD (variable frequency drive) system (this helps, except for being short of air at times, which will change with the installation of another blower this year).

Our source water is from wells and has very little buffering capacity and with the addition of up to 3,000 day skiers adding only ammonia to the wastewater stream, we have some issues with pH during the treatment process. To 'control' alkalinity we have been adding slaked lime (Ca(OH)₂) into the anoxic and aeration compartment – as much as 100 kg/day. This year, we have gone through almost 100 – 25 kg bags. The good news is the slaked lime is available locally and only costs about \$11 per bag and has proven very useful.

There is not much we can do about the rest of the challenges, except to be more vigilant ~~ee~~ controlling FOG (fat, oil and grease) at source (customers).

Effluent Parameters

Our MSR requires the effluent not to exceed 30 mg/l each for BOD₅ and TSS and as a rule we do much better. BOD₅ is typically less than 10 mg/l, TSS from 5 to 20 mg/l, ammonia less than 1 mg/l and Total Nitrogen in the 10 to 20 mg/l range. When we do not waste sludge and return the supernatant from the sludge dewatering process back into the influent flow, the Total Phosphorus is biologically reduced to 2 to 3 mg/l.

The following is an analysis of grab samples taken at about 11 am on March 7, 2007

		Bioreactor 1	Bioreactor 2	Bioreactor 3	Bioreactor 4
BOD ₅ (<i>Effluent</i>)	mg/l	5			
TSS	mg/l	5.7	9.7	3.7	3.7
Ammonia (as N)	mg/l	0.067	0.077	0.073	0.079
Nitrate (as N)	mg/l	6.75	4.17	7.42	6.58
Nitrite (as N)	mg/l	0.0504	0.0969	0.0545	0.0468
Total Nitrogen	mg/l	8.1	7.6	8.9	6.96
Total Phosphorus	mg/l	6.86	9.87	5.78	6.04
Chloride	mg/l	110	111	112	109
pH	mg/l	7.99	7.70	7.78	7.80
Conductivity		853	900	900	880

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This sample was taken right after our highest flow period and after US President's week (2nd highest annual occupancy period). BOD₅ was not analyzed, however, based on the effluent and other samples taken show that BOD₅ is usually less than 10 mg/l. Together with averages of 5.7 mg/l for TSS, 0.074 mg/l for ammonia, and 7.9 mg/l for total nitrogen the results were well under the most stringent MSR requirements.

Total average phosphorus of 7.1 mg/l is much elevated from what we have experienced before the centrifuge installation. Almost all 'biologically uptaken' phosphorus returns to the system with the centrifuge supernatant recycle back to the equalization tank.

Capital Costs

The total capital cost since 1999 to date, including the initial construction of the wastewater treatment plant, the upgrades and the sludge dewatering system, all work out to a total capital cost of approximately \$2,550 per m³/d, or \$7,700 per kg BOD₅/d.

Looking back, SPRC and SPUCL have invested just over \$2.5 million between the initial installation and subsequent upgrades to build a plant that can handle 1,000 cubic meters of peak sustainable flows (vs. peak day flows). If we were to build the same sized plant today, (assuming no infrastructure other than the lagoon in place) the costs would be between \$4 million and \$5 million. This confirms that the decision in 1999 by the Board of Directors to proceed with a wastewater treatment system that could grow in phases at the rate needed was the correct choice for a capital investment.

Operating Costs

Total operating cost includes many contributing costs of which the main 'direct costs' are the costs of electricity, wages and benefits, chemicals, repairs and maintenance, waste sludge disposal, and lab analysis.

Averaged over the respective years these direct operating costs shown in the following table:

Direct Costs	Fiscal 2001 2000-01	Fiscal 2002 2001-02	Fiscal 2003 2002-03	Fiscal 2004 2003-04	Fiscal 2005 2004-05	Fiscal 2006 2005-06
Wages & Benefits	65,577	81,071	89,100	103,332	98,870	134,161
Electricity	8,334	8,143	8,025	10,654	12,254	12,167
Chemicals	5,825	5,135	10,771	9,048	6,338	9,522
STP Disposal	23,309	41,660	15,256	23,020	7,300	2,835
Sewer analysis	11,976	13,106	10,140	9,666	10,174	9,091
Total	115,021	149,115	133,292	155,720	134,936	167,776
Total Flows (m ³ /year)		129,398	143,606	151,763	168,352	175,782
Total BOD (kg BOD ₅ /year)		42,701	47,390	50,082	55,556	55,366

Operating Costs

Cost per m ³		\$1.15	\$0.93	\$1.03	\$0.80	\$0.95
Cost per kg BOD ₅		\$3.49	\$2.81	\$3.10	\$2.43	\$3.03

(Influent 330 mg/lBOD₅)

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By tracking our costs on a biological loading basis, we know what expansion is going to cost from an operating point of view and can structure future rates that are in line with the costs. The operating costs are year round average costs and they are of course negatively affected by the high seasonality of our operation.

General Operating Experience

At Sun Peaks we developed 'per bed factors' to gauge both our water demand and the biological loading as opposed to the daily flows determination in a traditional municipal environment. The factor allows us to predict when each expansion will be needed rather than in the past where something had to break down before the system would be expanded.

After all, you have to get it right for the Christmas/New Years holiday period or you might as well go home. Nothing is more fun than going into the General Manager's office on New Year's Eve and saying that if the lagoon goes up 1 more inch, you are going to shut the town's water off. I had to do this December 31, 1998 and by November 1999, we had a new treatment plant.

Future Challenges & Considerations

With very little dilution and unhealthy eating habits, the **upstream management of FOGs** is becoming very important. We are currently working with the restaurants in the resort to become more proactive in dealing with their grease traps and oil trapping systems.

Sun Peaks is currently under a trial for **biosolids management** using composting. However there is a number of challenges that range from too cold in the winter, to too dry in the summer, to the price of land to perform composting. We are currently exploring options that may include gasification or gravel pit reclamation.

Our next challenge is the **disposal of effluent**. Our current use of rapid infiltration trenches only allows for a maximum daily discharge of 850 cubic meters. The resort is built on the side of a mountain and more land for RI trenches is limited. Options currently under study include stream augmentation, snow making and golf course irrigation. The challenge with the last two options is weather.

As you saw from the early flow graph, influent flows can change significantly from hour to hour and day to day. **Upstream flow balancing** would allow more consistent flows into the plant and better treatment of the waste stream. From the first of November each year to the end of December, influent flows can increase five plus times.

The Operator's Experience

Our key challenge at Sun Peaks is that in addition to the wastewater treatment plant, we operate three water treatment plants and a gas distribution system. We have now reached a critical mass that allows us to have 5 operators on staff so that we can focus two of the operators on wastewater treatment to give us seven day week coverage.

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Like many small utilities, getting, training and keeping operators is an increasing challenge, no matter what type of system you operate. The USBF system has been very tolerant to operator involvement and support on each expansion has been great.

The ownership of the resort is very happy with the modular expansion options of the USBF system and its ability to expand the system as needed when needed. After all, expansion costs are paid by new users being added to the system (via the developer) rather than existing customers.

The community is very proud of the plant and that it uses a natural process to treat the wastewater. To confirm this, compare our wastewater rates of \$2.17 per cubic meter with many other communities

Would we select the USBF system again – knowing what we know now? - YES!

Thank you for your attention and time permitting, we would be pleased to answer any questions you might have.