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Twin Valley Resort Ltd.
C/O Skyscape Management Inc.
3916 - 1st Street N.E.
Calgary, Alberta
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Attention: Mr. Bill Maher and Mr. John Drake

Reference: Twin Valley Resort in the M.D. of Willow Creek
Preliminary Water and Sewage Design Concept

Gentlemen:

This letter report serves to present the proposed water supply and sewage systems for this resort development. Regulations governing water and sewage systems in Alberta are administered by Alberta Environment. All water and sewage systems proposed for Twin Valley Resort will be designed to meet the standards of Alberta Environment. Alberta Environment's approval will be applied for during detailed design and received prior to construction of the water and sewage systems as per standard policies. The following sections present the design criteria and preliminary design of the water and sewage systems.

1. Design Criteria

The Twin Valley Resort is a proposed resort development consisting of 171 1-acre residential lots for Stage 1. Development will be in phases, with each phase being about 55-60 lots. Since the resort is located adjacent to a large reservoir, domestic water will be drawn from the reservoir. A water license has been reserved for this purpose. The water will be properly treated prior to distribution for potable use. With the reservoir nearby, a community sewer disposal system is required. A separate irrigation system will supply irrigation to public park areas.

To provide for potential future expansion, it is suggested that the water and sewage system should be designed for a projected development twice the size of the current stage 1 of 171 lots. While the subdivision construction will be in phases of approximately 55-60 lots, for future expansion planning, the phase 1 water and sewer engineering design will be for 25% of the potential built out, or a total of 86 lots.

Since this is a resort development intended mainly for summer leisure use, it is anticipated that winter usage of the water and sewer systems will be low. Accordingly, the design water and sewer flow criteria are determined as follows:

DESCRIPTION	DESIGN CRITERIA	
	First Phase	Potential Built out
Number of lots	86 lots	342 lots
Design population @ 3 person/lot	258	1026
Water Consumptive Rates:		
Annual average day flow (low winter usage) @ 70 gal/day/capita (210 gal/day/lot)	18,060 Igal	71,820 Igal
Maximum day flow (for water supply design) @ max day factor of 3 X ave. (630 gal/day/lot)	54,200 Igal	215,500 Igal
Peak hour flow (for distribution pumping) @ peak hour factor 3 X max.	115 Igal/min	450 Igal/min
Annual average water use:	6.6 MIGal (24.4 ac-ft)	26.2 MIGal (96.7 ac-ft)
Feature and Central Park Irrigation (29 acres gross) At 6 inch per gross acreage:	15 ac-ft	15 ac-ft
Potential recreation area irrigation		42 ac-ft
Sewage Generation Rates		
Annual average flow (low winter usage) @ 65 gal/day/capita	16,800 Igal	66,700 Igal
Annual sewage quantities	6.1 MIGal (22.7 ac-ft)	

2. Preliminary Water System Design

The water system will include:

- water intake and pump station
- water treatment plant
- treated water storage reservoir
- distribution pump house
- distribution piping network

2.1 Water intake and pump station

The water intake is proposed to draw water from the reservoir via a submersible pump located within a fish-friendly intake screen. The intake will be designed for the maximum day flow plus an allowance for irrigation water.

The water will be pumped to the water treatment plant via a water supply pipeline. The water supply pipeline will also be extended to the ponds to supply make-up water and irrigation water.

2.2 Water Treatment Plant

Twin Valley Reservoir obtains its water mainly from the Little Bow River/Highwood River. The water body is sufficiently large and algae are not expected to be a major problem. Should algae not be a problem, a Full Conventional Treatment system including chemical flocculation, clarification, filtration and disinfection which meets Alberta Environment and Canadian potable water standards is proposed. This is the same process used by other communities and the only process Alberta Environment would allow without a pilot plant. For disinfection, proper chlorine CT contact time will be incorporated into the reservoir baffling and detention.

In case of algae issues, a Dissolved Air Flotation (DAF) Treatment plant would be used. This will include dissolved air flotation pretreatment/clarifier, filtration and disinfection. Again, proper CT contact time will be incorporated. Prior to a DAF plant being adopted, a pilot plant must be completed to Alberta Environment's approval.

For either treatment system, continuous flow and turbidity metering will be included as a part of the system control which will be computer based for ease of operation. The disposal of filter backwash water will be to the sewerage system. Sludge will be stored in a holding tank and periodically disposed of offsite.

2.3 Clear Water Storage Reservoir

The clear water storage reservoir will be divided into two components. The first component is to provide the necessary CT contact time. This part of the reservoir will be provided with baffling for proper mixing and contact. The second component is to provide for flow demand storage and fire fighting/emergency storage. This second component is typically of a maximum day capacity plus a fire fighting provision. Exact capacity will be determined when the design process and details are known.

2.4 Distribution Pump Station

The distribution pump station will supply pressurized domestic

water from the storage reservoir to the distribution system. The pump station will be designed to supply the peak hour flows. Provision for standby power will be incorporated. For Phase 1, a minimum of two pumps will be provided with one being on standby. Additional pumps will be added as the system grows. A minimum distribution pressure of about 50 psi will be maintained using a variable speed drive on one of the pumps.

A fire-truck fill water point will be included in the design.

2.5 Distribution Piping Network

The water distribution piping will run along roads in a looped network for efficiency. The distribution pipes will be minimum 6 inch diameter PVC AWWA C900 pipes. From the roads, 1-inch water services will be extended to the individual lots for connection to the houses. Individual water meters will be required of all houses to encourage water conservation. As well, water saving fixtures are stipulated in the architectural control.

3. Preliminary Sewerage System Design

Due to the proximity to the reservoir and permeable soil conditions, individual on-site septic tank-tile field systems are not suitable. A community sewer system is desirable. With the low density development of 1-acre lots, a conventional gravity sewer system is not efficient. Instead it is proposed to use an Orenco sewer system. With Alberta Environment's approval, Orenco sewer systems have been installed in Alberta communities such as Sherwood Hills (175 connections), Ranchlands (72 connections) and 5 other communities. They have operated successfully since 1989 for both collection, transmission and sewage treatment.

An Orenco sewer system consists of the following:

3.1 On-site Collection, Primary Treatment and Pumping Tank

A pre-fabricated concrete tank complete with storage, filter and a turbine pump will be installed for each house. The tank collects the sewage from the house similar to a standard gravity sewer. In the tank, the solid is allowed to settle (primary treatment). The effluent is filtered and pumped away via a transmission main to an off-site secondary treatment facility to meet Alberta Environment's final disposal standards. There is no disposal of the effluent on the lot itself. Solids are removed from the tank every 10-12 years. The collection/pumping tank will be provided with full automatic control and remote monitoring via internets to the local operators and to Orenco's central monitoring station. (Orenco insists on their monitoring of the systems as a part of their quality control program.) The whole system will be operated by a utility company.

3.2 Sewage Transmission

The pumped effluent will be transmitted to a secondary sewage treatment facility via a watertight pressure piping (forcemain) system. The forcemain will be a 3 to 4-inch PVC pressure pipeline following the contour of the land buried about 8 feet deep. With a pressure system there will not be any manholes on the roads. The forcemain will be installed a minimum of 10 feet from a watermain as per Alberta Environment guidelines.

3.3 Sewage Secondary Treatment and Disposal

A sewage treatment plant will receive all the effluent from the tanks for further treatment to Alberta Environment's standards. Since the effluent has already received primary treatment in the tank, its quality is much higher than raw sewage. A low maintenance treatment system such as a textile filter system would reduce the effluent to Alberta Environment's continuous discharge standards of 25BOD/25TDS. For water conservation, the treated final effluent will be stored in ponds for irrigation. The proposed location of the sewage plant and ponds are at the northwest corner of the stage 2 area. Setback distances as approved by Alberta Environment will be followed.

The secondary treatment system will be supplied as a part of the Orenco package system. It is a prefabricated modular system that can be easily expanded to suit the capacity requirements. The details of the treatment plant will be to Alberta Environment's standards and approval. Similar to the individual tanks, it will be monitored by Orenco in addition to the local operators.

As mentioned, irrigation will be used to dispose of the treated final effluent. Sufficient land has been acquired for this purpose. Since the land has been used for farming, irrigation of this land is not anticipated to be a problem.

4. Public Area Irrigation

A separate irrigation system using raw water will supply water for irrigation of the public areas such as parks. Irrigation of the park will augment the natural precipitation. It is intended that the parks will be kept green but not to a manicured lawn level in keeping with an environmentally sensitive design.

An irrigation pump station will draw water from the central ponds. The pond water level will be maintained by storm drainage and make up from the reservoir water intake. It is anticipated that up to 15 ac-ft of raw water may be drawn from the reservoir for irrigation purpose. As well, water from the final treated effluent storage pond may be used to augment the irrigation flow.

The recreational development potential of the N.W. 1/4 section is being evaluated. Dependent on the type of development to be provided, an irrigation pump station for about 52 ac-ft may be required. This will be confirmed following the decision on the development type.

5. Closing

In the above water and sewage system analysis, we have not specified the flow rates or capacities at this time. This will, of course, depend on the subdivision approval. The flow capacity will at least match the land-use planning approval of the subdivision size. Following subdivision land-use planning approval and prior to detailed design, a report presenting details of the water and sewage system will be submitted to Alberta Environment for approval.

We trust the above is adequate at this early stage of the planning process. Please call us if there are any questions.

Yours truly,

Lee Maher Engineering Assoc. Ltd.

Per:

Brian Lee, P.Eng.

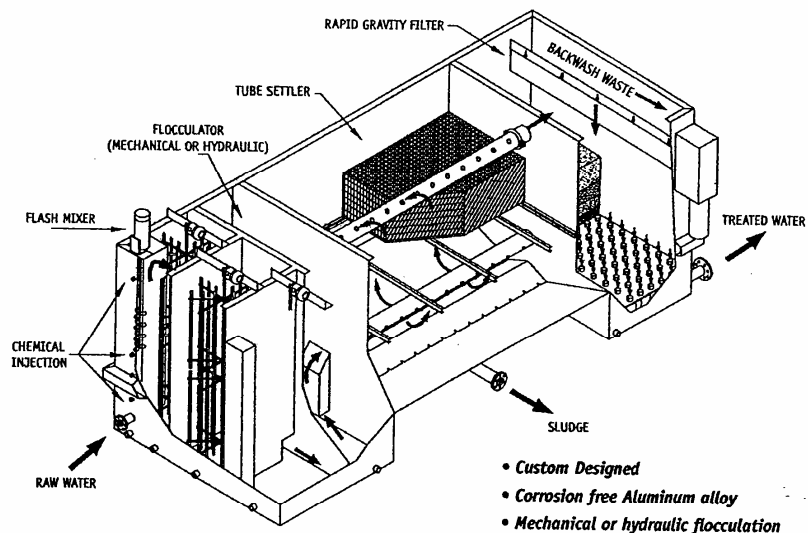
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"ST" Water Treatment Plant

Flocculation/Upflow Clarification/Filtration

The ST range of water treatment plants use proven technologies to produce clear, safe drinking water from low quality sources. Capable of purifying the most difficult types of raw water, they are particularly suitable for surface waters with high and variable contaminant loadings. They excel in treating cold water with high levels of turbidity, iron and manganese.



How it Works

A coagulant is added to the raw water to precipitate dissolved contaminants and encourage suspended particles to group together in the form of "flocs". Gentle agitation in the flocculation zone encourages the flocs to grow and they are then removed by settling within a clarification zone. The accumulated solids are removed hydraulically from the clarifier floor and the clarified water passes on to the filter for final polishing. Solids accumulating within the filter are periodically removed by automatically controlled water or air/water backwashing.

Advantages and Key Features

- Capacities to 700 USgpm, 3,800 m³/d per module; multiple units are available.
- Excellent water quality to less than 0.1 NTU.
- 2.5 log, multi-barrier protection against Giardia and Cryptosporidium.
- All processes custom sized to best meet water quality goals and regulations.
- Quiet, simple and easy to operate with minimal operator intervention.
- Pre-assembled and pre-tested packaged plant often saving 50% or more over in-situ construction.
- Only water, waste and electrical connections needed prior to start up.
- Automatic controls and monitoring systems customized to meet local needs.
- Inlet flow set at constant rate for simple operation; filter rate modulated to match inlet flow.
- Supplied complete with chemical dosing and water quality monitoring systems.

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Typical Plant Dimensions (mm)
(Each plant is custom sized to meet the needs of each application.)

Capacity m ³ /d	20 mins. flocculation 30 mins. settling time Filter rate 9 m/hr			20 mins. flocculation 60 mins. settling time Filter rate 9 m/hr			30 mins. flocculation 90 mins. settling time Filter rate 9 m/hr		
	W	H	L	W	H	L	W	H	L
250	1170	2350	4830	1170	2350	6510	1220	2900	8550
500	1830	2860	6300	1830	2900	7760	1830	2900	8250
750	2440	2860	7050	2130	2900	9930	2440	2900	12160
1000	2740	2860	8440	3050	2900	11600	3050	2900	13000
1500	3240	2900	11600	3050	3200	12510	3660	3330	14050
2000	3750	2900	12300	3660	3330	12650			
2500	4250	2900	12300						
3000	4750	2900	12300						

Flash Mixing

- Multi chemical injection ports for coagulant, polymer, pH adjustment, etc.
- Static or powered mixers.

Flocculation

- Multi-stage hydraulic or mechanical flocculation.
- Carefully designed to minimize short circuiting.
- Hydraulic flocculation has variable nozzles for site adjustable energy input.
- Mechanical flocculators fitted with variable speed drives.

Clarification

- Inlet/outlet manifolds for even flow distribution.
- 60", rigid plastic, settling tube modules, UV and chemical resistant.
- "V" hopper bottom for sludge thickening and hydraulic sludge removal.
- Sludge blanket sample and location ports.
- Flat bottom, mechanical sludge removal option available.

Filtration

- Mono, dual and multi media options.
- Air scour/water backwash for reduced wastage and improved cleaning.
- Nozzle and plenum type underdrain.
- Gravel support base with pipe lateral underdrain.
- "Non-gravel" underdrain systems available.

Chemical Systems

- Full range of chemical mixing and dosing systems.
- Solution tanks, mixers, dosing pumps and safety equipment.

Control Systems

- PLC based for fully automatic operation and backwash initiation and sequencing.
- SCADA system with data logging, report generation and remote monitoring/operation features available.

Water Quality Monitoring

- Analytical packages ranging from bench top testers to full on-line instrumentation are available.

Tank Construction

- Aluminum 5086-H116 and 6061, built to American Aluminum Association/CSA W47.2-M1987. Smooth, attractive, maintenance free surface. Steel and stainless steel are available.

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Website: www.clearwaterworld.com

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Typical Plant Dimensions (mm)
(Each plant is custom sized to meet the needs of each application.)

Capacity m ³ /d	15 mins. flocculation DAF rate 15 m/hr Filter rate 12 m/hr			20 mins. flocculation DAF rate 12 m/hr Filter rate 10 m/hr			30 mins. flocculation DAF rate 10 m/hr Filter rate 10 m/hr		
	W	H	L	W	H	L	W	H	L
250	1870	2360	2700	1370	2360	3250	1370	2360	2970
500	1830	2360	3700	1370	2360	4510	1830	2360	3600
1000	2440	2360	5200	2440	2360	4320	2440	2360	5050
2000	3050	2900	7300	3050	2900	6060	3050	2900	5300
3000	3660	3350	8900	3660	3350	10350	3660	3350	6300
4000	3660	3660	10800	3660	3660	13300			
5000	3660	3660	13400						

- Flash Mixing**
 - Multi chemical injection ports for coagulant, polymer, pH adjustment, etc.
 - Static or powered mixers.
- Flocculation**
 - Multi-stage hydraulic or mechanical flocculation.
 - Carefully designed to minimize short circuiting.
- DAF**
 - Inlet/outlet manifolds for even flow distribution.
 - High rate process loadings to 16 m/hr in summer, 12 m/hr in winter.
 - Skid mounted saturator and recycle system provide up to 10 mg/L dissolved air.
 - Hydraulic or mechanical float removal options with automatic control, speed and frequency adjustment.
- Filtration**
 - Mono, dual and multi media options.
 - Air scour/water backwash for reduced wastage and improved cleaning.
 - Water backwash with surface wash option.
 - Nozzle and plenum type underdrain.
 - "Non-gravel" underdrain systems available.
- Chemical Systems**
 - Full range of chemical mixing and dosing systems.
 - Solution tanks, mixers, dosing pumps and safety equipment.
- Control Systems**
 - PLC based for fully automatic operation and backwash initiation and sequencing.
 - SCADA system with data logging, report generation and remote monitoring/operation features available.
- Water Quality Monitoring**
 - Analytical packages ranging from bench top testers to full on-line instrumentation are available.
- Tank Construction**
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Water...
we treat it right

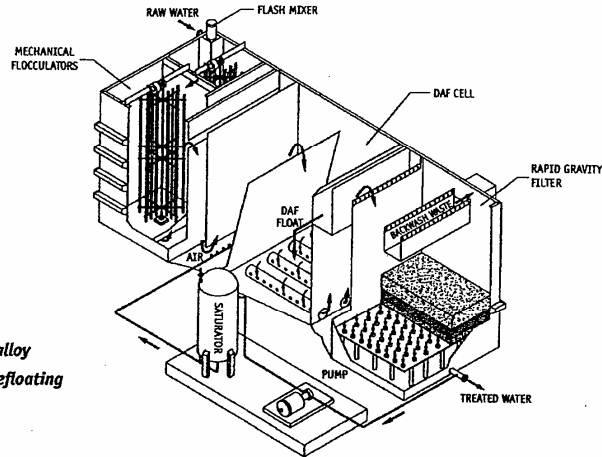
Email: bca@clearwaterworld.com
Website: www.clearwaterworld.com



"DAF" Water Treatment Plant

Flocculation/Dissolved Air Flotation/Filtration

The dissolved air flotation (DAF) range of water treatment plants excel in treating lake and reservoir water containing high levels of color, algae and turbidity not exceeding about 100 NTU. The plants also provide excellent treatment of cold water with high levels of iron and manganese. The DAF process offers significant advantages including excellent algae removal, ease of operation, good tolerance to changing raw water conditions, rapid start up, low volumes of plant waste and significantly reduced building footprint.



- Custom Designed
- Corrosion free Aluminum alloy
- Mechanical or hydraulic defloating

How it Works

A coagulant added to the raw water precipitates dissolved contaminants and encourages particles to form "flocs". Gentle agitation in the flocculator helps these to grow before they pass into the flotation zone. Here, microscopic air bubbles are injected which rapidly float the flocs to the surface. The accumulated float is skimmed off. Clarified water passes to the filter for final polishing and the filter is periodically cleaned by water or air/water backwashing. The 50 micron bubbles used for flotation are formed by recycling a small stream of clarified water through an air pressurized, packed tower saturator to specially designed nozzles at the DAF cell inlet. Here, a rapid pressure drop causes the air to come out of solution and form millions of small bubbles.

Advantages and Key Features

- Capacities to 1,000 USgpm, 5,500 m³/d per module.
- High loading rates, small footprint and significantly lower building costs.
- Excellent color and algae removal, final turbidity less than 0.1 NTU.
- 3 to 4 log, multi-barrier protection against Giardia and Cryptosporidium.
- Low chemical use, coagulant aids often not required.
- Quick start-up and tolerant of changing raw water conditions.
- Quiet, simple and easy to operate with minimal operator intervention.
- All processes custom sized to best meet water quality goals and regulations.
- Pre-assembled and pre-tested packaged plant often saving 50% or more over in-situ construction.
- Automatic controls and monitoring systems customized to meet local needs.
- Inlet flow set at constant rate for simple operation, filter rate modulated to match inlet flow.
- Supplied complete with chemical dosing and water quality monitoring systems.

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