4.0 Wastewater Systems

4.1 WASTEWATER SOURCES

The regulatory authority for the Chinook Lodge wastewater treatment and disposal system is Alberta Environment. The regulatory documents considered for this project are listed below:

(1) Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage System January 2006

(2) Alberta Private Sewage Systems Standard of Practice 1999 handbook

(3) Guidelines for Municipal Wastewater Irrigation, April 2000

The regulatory approval and design requirements for wastewater facilities, as described in this report typically fall under the jurisdiction of Alberta Municipal Affairs however due the expected wastewater flows being over 25 m^3/day, the facility falls within the jurisdiction of Alberta Environment.

In addition to the regulatory requirements noted above, Chinook has considered the Alberta Association of Municipal Districts and Counties (AAMDC) *Model Process* for subdivision approval when private sewage systems are proposed. The information contained in this section is consistent with a Level III assessment due to the level of complexity.

4.1.1 Flows

The wastewater flows for Chinook Lodge are determined by the potable water demand shown in **Table 3.1** and are based on maximum occupancy of the lodge. No system losses are expected due to design and uses. The total maximum flow is 48.8 m^3/day and will be used for design. The average daily flow is expected to be 24 m^3/day. Inflow and infiltration (I&I) is not expected to occur due to the systems low pressure forcemain design and construction methods of directional drilling or open trench continuous pipe construction methods.

4.1.2 Characterization of Wastewater

The domestic wastewater strengths from the Chinook Lodge are summarized in **Table 4.1** and are derived from information taken from the Design Manual: Onsite Wastewater Treatment and Disposal Systems and Wastewater Engineering – Treatment, Disposal and Reuse (Metcalf and Eddy, Inc., Fourth edition).

Table 4.1
Wastewater Treatment Design Parameters for a Flow of 45 m^3/day

Parameter	Inflow (mg/L)
Biological Oxygen Demand (BOD)	250
Total Suspended Solids (TSS)	250
Total Nitrogen	50
Total Phosphorus	10

4.1.3 Setback Distances

The Alberta Environment (AENV) standards state that the setback distances for mechanical wastewater treatment plants are required to prevent the occurrences of objectionable odors in subdivision when plants are operated normally and within designed capacities.

Setbacks from occupied buildings, roadways, water bodies, groundwater wells and property lines can produce the undesired effect of development sterilization. That means that areas within the setback limit cannot contain any of the aforementioned features once the wastewater treatment system is constructed. Depending on the situation, setback distances can be waived by Alberta Environment upon the request of the Municipality and with justification. As per the standards the new plant is proposed be located 300 meters from the lodge.

Table 4.2 outlines the minimum horizontal setback distances from mechanical plants.

Table 4.2
Setback Distances from Treatment Plant

Minimum Setback distance from “working area” of operating plant :	(m)
The property line of the land where the operating mechanical treatment plants or aerated lagoon is located	30 meters
The designed right-of-way of a rural road or railway	30 meters
The designed right-of-way of a primary or secondary highway	100 meters
An “occupied building” where the operating mechanical treatment plants serves a designated municipality	300 meters
Any “occupied building” on the property of a privately owned rural development which the operating mechanical treatment plants serves	300 meters

***** "Occupied building" means a building within which one or more persons reside, work or are served for four or more hours a day; and two or more days a week; and eight or more weeks a year. Without limiting the generality of the foregoing, this includes such developments as school, hospital, food establishment, residences, etc.
** "Working area" means, those areas of a parcel of land that are currently being used or will be used for the processing of wastewater.

4.2 SITE EVALUATION RESULTS FOR WASTEWATER SOIL DISPOSAL

4.2.1 Soils Evaluation

Private sewage systems in Alberta require a soils investigation to determine whether or not the site soils are suitable for treatment and/or disposal. This assessment was performed in conjunction with the Land Classification study performed on July 11, 2011 (**Section 5.3**). Potential treatment sites were analyzed for texture, structure consistence, root presence, limiting layers, depth to ground water features and depth of frost in order to identify the best location for a community wastewater treatment system. The inspection sites were classified as Black Chernozemic, with Orthic and Gleyed subgroups most common, reflecting climate and vegetation influence of the parkland eco region. Depressional areas were typically classified as Gleysolic Order soils. The distribution of Orthic and Gleyed subgroups was somewhat related to slope position, but was in addition likely influenced by differential permeability of underlying saprolite and the thickness of overlying till. Soil drainage for Chernozemic soils ranged from moderately well to imperfectly drained, whereas Gleysolic soils in depressional areas were typically poorly drained.

Parent materials encountered at inspection sites were typically some combination of till and saprolite, with the exception of the deeper till sites where saprolite was not encountered. Till ranged in thickness from being absent (exposed Saprolite) to a blanket (1 to 2 m thick) to approximately 5 m thickness, as reported in completed water wells drill logs. Water well drilling records for the property show that bedrock was encountered at depths below surface ranging from 2 to 28 feet. Till was typically moderately fine textured while saprolite ranged from medium to moderately fine, occasionally fine textured. Till was typically friable whereas saprolite ranged from friable to very firm, or sticky when wet. In general, saprolite became firmer with depth such that it is probably impermeable at some depth below surface. Mapping was successful at separating areas of land based on estimated thickness of till over the saprolite. In general, the more level the topography the thinner the overlying till deposits. Undulating to hummocky areas and inclined surfaces in the southwest corner had the deeper till deposits.

Topsoils were present at all sites and were typically less than 20 cm thick. Carbonate content was relatively high reflecting the carbonate abundance in the region. Laboratory analyses show that soils are non-saline, non-sodic, and that field and lab textures were in reasonable agreement. All sampled profiles had EC less than 0.5 dS/m, and SAR consistently less than 0.5. Salinity and sodicity was therefore not a concern in this setting, as would be expected in this combination of tertiary aged bedrock and relatively well leached profiles. Soil pH, usually neutral to alkaline reflecting high carbonate contents in parent materials.

Surface flow from an emphemeral channel on the property flows to the northwest. A series of linear sloughs located in the southwest of the property also send surface flow to the northwest. Several of the wells at the SW corner of the property indicate till is relatively thick. Well logs from elsewhere on the property mirror results obtained in this soil survey that bedrock occurs relatively close to the surface. The results of soil mapping and irrigation classification are presented in the Irrigation Assessment report.

Profiles were rated in two primary groups, those with soil rating of class 3 and those with soil rating of class 5. Those in Class 3 are typically of the Dunvargan and related variants. Class 3 soils usually had two meters or more of till overlying saprolite. Soils of class 5 included both the Hatfield series for Chernozemic soils on saprolite material. Class 5 soils usually had less than 2 meters of till and much of the area had weathered saprolite near the surface. There were also two delineations of class 5 areas dominated by Gleysolic soils, and these were rated as 5 due to wetness, shallowness to saprolite, or both.

Slopes were usually 9% and less, with most of the property being undulating or level. Areas near an incised drainage system were inclined. Areas with shallower saprolite tended to have level topography, whereas thicker till deposits were associated with undulating to hummocky land surface expression. Despite the relatively shallow slopes, topography ratings for delineations were class 3. These ratings reflect the expectation that irrigation will be conducted by specialized means, rather than through sprinkler irrigation using large diameter pivots. Current small field sizes and irregular shape also preclude any kind of large scale pivot irrigation system that would be implied by class 2 topographic rating.

4.2.2 Limiting Conditions

The soils tested for soil disposal were found to be not suitable due to the impervious nature of the soil’s structure and composition. As a result, all of the treated wastewater will be stored and used for irrigation. This includes all wastewater generated during winter months. The detailed soil log and laboratory information can be found in **Appendix D and F.**

4.3 WASTEWATER SYSTEMS

4.3.1 Collection

No centralized wastewater collection system currently exists in the service area. A gravity system would collect wastewater effluent from the main lodge to a two-compartment septic holding tank commonly known as a Septic Tank Effluent Pump (STEP) system. A STEP system uses an underground wastewater tank to settle out primary solid and transports the decanted liquid to the wastewater treatment facility. Since most of the solids would be retained in the septic tank, the pressure main to the wastewater treatment facility would require low hydraulic velocity. No manholes will be needed on the pressure sewer system. This would eliminate any inflow and infiltration from high stormwater and groundwater flows, considerably reducing design flows in the sewer system. It is proposed the pressure mains would range in size between 50 mm to 75 mm. Vertical alignment of the sewers would generally follow the land contours with their burial depth just below the frost line. This would result in considerable savings in the pipe excavation costs. A conceptual process flow diagram of the proposed low pressure sewer system for the service areas is illustrated on **Figure 4.1**.

Wastewater generation rates will be assumed to be equal to the water use as summarized in **Table 3.1**. This systems design and construction methods outlined in this report assumes negligible system losses will occur.

4.3.1.1 Primary Tank

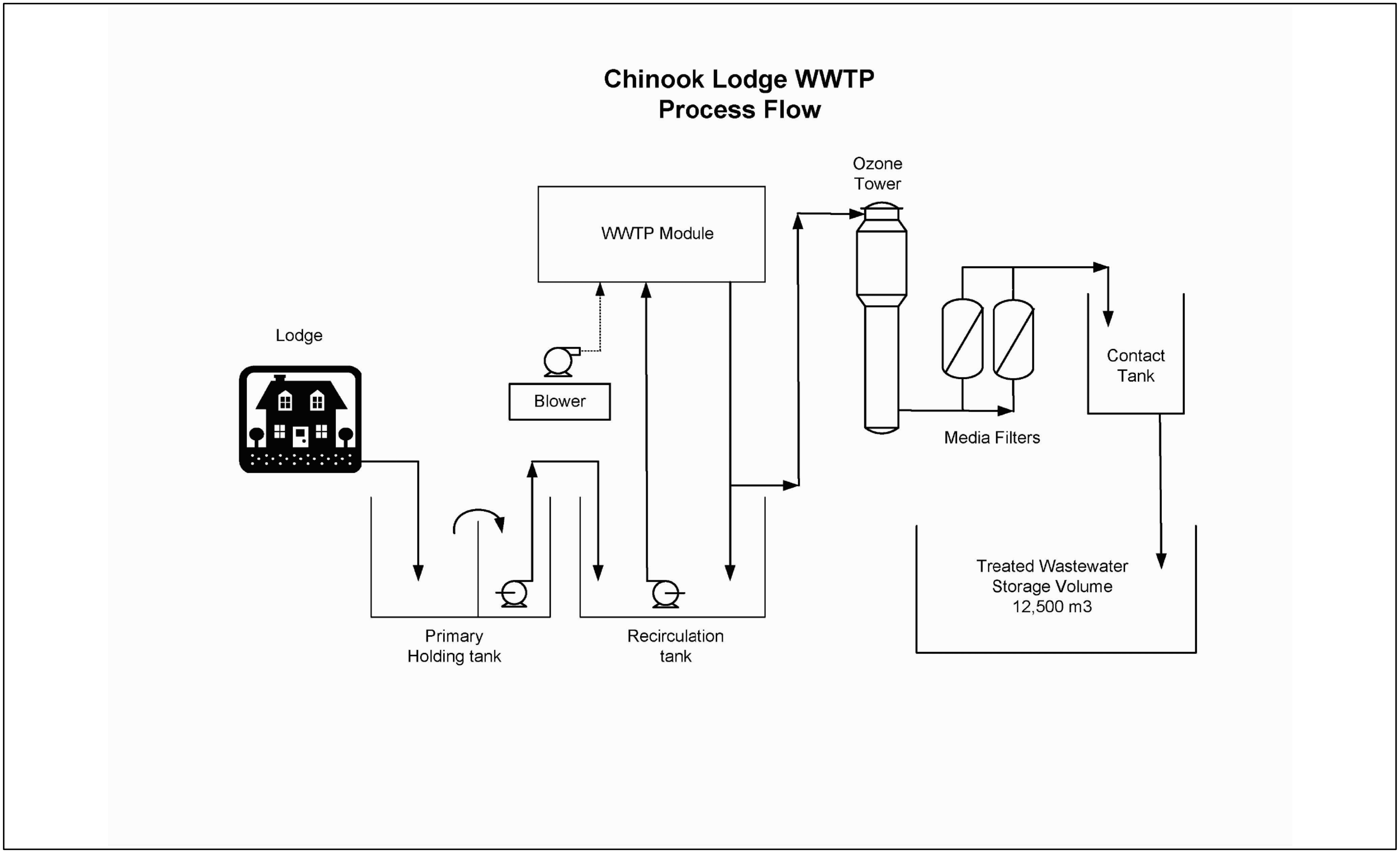
The wastewater from the building will gravity flow into a two compartment tank known as a STEP system. Based on the expected wastewater generation rates we recommend an underground tank with a size of 15 m^3. The tank materials will be further defined during the design stages and will be either concrete or fiberglass.

4.3.1.2 Control Systems

Typical pumping units are equipped with basic operational controls which can be configured according to the operational demands of the system. These control systems can include level sensors, alarms, pressure sensors etc. More advanced control systems have smart features such as digital programmable panels and remote telemetry panels. These advanced controls can allow setting of multiple parameters, and monitoring and communication system operation to suit the system requirements. However, the selection on type of control systems should be made based on detailed hydraulic analysis results for the proposed system and subsequent consultations with the stakeholders.

4.3.1.3 Concept Layout

The treatment plant will be located on the west side of the site at a lower elevation and approximately 300 meters from the lodge to eliminate any lift station as shown in the **Figure 4.2.**



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INTEGRATED WATER MANAGEMENT PLAN

Figure No.

4.1

Title

WWTP Process Flow

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Client/Project

CHINOOK RIDGE LODGE AND GOLF COURSE LTD.

INTEGRATED WATER MANAGEMENT PLAN

Figure No.

4.2

Title

Wastewater Distribution System

4.3.1.4 Treatment System

An Orenco Advanced Treatment Unit (ATU) is selected to treat the Chinook Lodge flow of 48.8 m^3/day and provide the required buffering capacity for peak instantaneous conditions. Advantex System are manufactured by Orenco Systems and is a septic type package system which also includes filtration. The system is built inside an insulated fiberglass tank which is durable and watertight. This system can be installed below-ground or above. ATU's such as the proposed Orenco ATU's are approved for use in Alberta and currently serve many communities and individual residences

The Advantex system will be as shown in **Figure 4.3**. Sewage enters the two compartment processing tank through its inlet tee. In the first compartment the raw sewage separates into three distinct zones: a scum layer, a sludge layer and a clear layer. A flow through ports in the tank's baffle wall allows effluent from the clear layer to flow into the second compartment of the tank. The pump package in the second compartment pumps filtered effluent to a distribution manifold in the Advantex filter. Effluent percolates through the textile media and is collected in the bottom of the filter pod. The treated effluent flows out of the filter pod filtrate return line and is sent through an ozone system to provide disinfection required for irrigation and a media filter to remove any turbidity and is discharged to the storage pond. A Recirculating Splitter Valve (RSV) is provided on the filter return line which automatically splits or diverts the flow between the processing tank and the final discharge. The RSV controls the liquid level within the processing tank. During extended periods of no flow 100% of the treated effluent is returned to the processing tank. The Advantex filters have passive vent system and do not require the use of a fan.

Figure 4.3- ATU System

Advantages and disadvantages to ATU systems are presented **Table 4.4** below:

Table 4.4 Advantages and Disadvantages to ATU Systems	
Advantages to "ATU's"	**Disadvantages to "ATU's"**
• Compact footprint • Attached growth process provides consistent operation that is less susceptible to upset • This technology is primarily located below ground, so there is minimal above ground infrastructure • Multiple treatment units makes this technology favorable for phasing	• Moderate operation and maintenance costs compared to a conventional soil based treatment (septic field)

The ATU system will require approximately 0.1 ha of land on the golf course site as shown on **Figure 4.3** , but additional modules can be added if additional capacity is required. Due to seasonal considerations (winter and summer), both irrigation and storage are required.

Once the wastewater has been treated to irrigation standards summarized in **Table 4.5**, it will be disinfected and the color removed prior to discharge to the irrigation storage pond. Chinook Ridge proposes an ozonation (oxidation) process for disinfection (pathogen destruction) and color removal. Chlorine was considered for this step however found to be less effective at color removal than ozone and residual chlorides may negatively affect turf grass growth. Once an irrigation event is required the stored, treated wastewater will pass through a media filtration system for turbidity removal to protect the irrigation equipment.

AENV's Guidelines for Municipal Wastewater Irrigation, 2000 Section 4.5 Wastewater Storage Pond, provides design criteria for the project. The intent of this criterion is to provide allowances for seasonal variations to deal with abnormally wet conditions and is summarized in **Section 6.2**. Chinook Ridge proposes to filter the treated wastewater prior to irrigation to protect the irrigation equipment.

4.3.1.5 Wastewater Quality Requirements

Wastewater generated on site will be treated and used for irrigation of the golf course. The effluent quality requirements for wastewater irrigation are shown in **Table 4.5.** Chinook Ridge will comply with these performance and monitoring criteria as part of its approval.

Table 4.5 Treated Effluent Quality Standards for Wastewater Irrigation			
Parameter	**Standards**	**Sample**	**Comments**
Total Coliform*	<1000/100 mL	Grab	Geometric mean of weekly samples (if storage is provided as part of the treatment) or daily samples if storage is not provided), in a calendar month
Fecal Coliform*	<200/100 mL	Grab	Geometric mean of weekly samples (if storage is provided as part of the treatment) or daily samples if storage is not provided), in a calendar month
Carbonaceous Biochemical Oxygen Demand (CBOD)	<100 mg/L	Grab/Composite**	Samples collected twice annually, prior to and on completion of a major irrigation event
Chemical Oxygen Demand (COD)	<150 mg/L	Grab/Composite**	Samples collected twice annually, prior to and on completion of a major irrigation event
Total Suspended Solids (TSS)	<100 mg/L	Grab/Composite**	Samples collected twice annually, prior to and on completion of a major irrigation event
Electrical Conductivity (EC)	<1.0 dS/m for unrestricted use 1.0 – 2.5 dS/m for restricted use >2.5 dS/m unacceptable	Grab/Composite**	Samples collected twice annually, prior to and on completion of a major irrigation event
Sodium Adsorption Ratio (SAR)	<4 for unrestricted use 4-9 for restricted use when EC>1.0dS/m >9 unacceptable	Grab/Composite**	Samples collected twice annually, prior to and on completion of a major irrigation event
pH	6.5 to 8.5	Grab/Composite**	Samples collected twice annually, prior to and on completion of a major irrigation event

Table 4 from *Guidelines for Municipal Wastewater Irrigation, 2000*
Note:
* For golf courses and parks only
** Grab sample would suffice if storage is provided; Composite sample is required if storage is not provided.

A land Classification for Irrigation report was completed as a requirement of AENV's Guidelines for Municipal Wastewater Irrigation. The report can be found in **Section 6.3**.

The best practice technology water quality requirements for community populations under

20,000, the water quality guidelines are shown in **Table 4.6.** The requirements for CBOD and TSS are more stringent than the effluent quality requirements for wastewater irrigation. Chinook Ridge will try to meet these higher standards as a best practice method.

Table 4.6
Best Practical Technology Standards For Municipalities With Current Populations <20,000

Type	Parameter	Standards	Sample	Comments
Secondary (Mechanical)	CBOD (COD) TSS	≤25 mg/l ≤25 mg/l	Composite Composite	Monthly average of daily samples Monthly average of daily samples
Aerated lagoons	CBOD (COD)	≤25 mg/l	Grab	Monthly average of weekly samples
Wastewater Lagoons	None Defined	None Defined	None Defined	Lagoons built to the specified design configuration and drained once a year between late spring and early fall do not have a specified effluent quality standard. Early spring discharges may be allowed under exceptional circumstances to comply with any local conditions. Discharge period should not exceed three weeks unless local conditions preclude the rate of discharge

Table 3.1 from *Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems*, *Alberta Environment, 2006*
Note:
1. Current population for municipalities served by the system shall be determined by taking into consideration the equivalent population for industrial waste discharges into the system. If site-specific information is not available, then equivalent population for industrial wastes shall be based on 70grams CBOD per person per day.
2. Sampling frequencies are based on continuous discharge of effluent to a body of water.

In addition to routine monitoring, operation and maintenance, the operator will provide services as required for a mechanical treatment system. These services will include internal process monitoring, minimum quarterly monitoring of the organisms present in the sludge, and regular confirmation testing of the monitoring equipment required for the selected technology. The waste sludge that is generated by the process will be removed once every two to three years to an approved septage receiving facility for treatment and disposal. The ozone disinfection system for the treated effluent and irrigation device filter system will require routine cleaning.

A groundwater monitoring well(s) will be installed around the treated wastewater treatment and storage facility to monitor potential leaks of the system. The location(s) of the groundwater monitoring well(s) will be determined during the design phase. The groundwater monitoring plan is described in **Section 6.8**.

4.3.1.6 Concept Layout

The concept layout for the ATU system is shown in **Figure 4.2**.