

**REUSE OF RENOVATED MUNICIPAL WASTEWATER  
FOR  
GOLF COURSE IRRIGATION**

**report to**

**PRINCE EDWARD ISLAND DEPARTMENT OF TECHNOLOGY and ENVIRONMENT**

**from**

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# **REUSE OF RENOVATED MUNICIPAL WASTEWATER FOR GOLF COURSE IRRIGATION**

## **Acknowledgements**

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The case studies have depended entirely on the knowledge, experience, and enthusiastic cooperation of the following individuals:

James Bebee, Priddis Green Golf Club  
Steve Black, CH<sub>2</sub>M Gore and Storrie Limited  
Tom Forthyse, Osprey Ridge Golf Club  
Eric Jackson, City of Vernon  
Gordon Lang, D'Arcy Ranch Golf Club  
Dwain Simpson, Innisfail Golf Club  
Trevor Smith, Predator Ridge Golf Club.

Additional information was provided by officials of the Environment Departments of Alberta, British Columbia, Nova Scotia and Ontario.

# **REUSE OF RENOVATED MUNICIPAL WASTEWATER FOR GOLF COURSE IRRIGATION**

## **1. Introduction**

The objective of this report is to provide information that can help to guide decisions about the use of renovated municipal wastewater for golf course irrigation, with particular reference to seasonal applications such as those that might exist on Prince Edward Island.

Irrigation is an essential element of golf course management. The water required for golf course irrigation may come from natural sources (surface or groundwater), municipal systems, or from renovated wastewater.

Well over 200 golf courses are known to be irrigated with renovated wastewater. Most of these are in the southern United States and Hawaii, or in other countries with similar climates. About 20 are in northern areas of the United States. At least 9, 6 of which are discussed in this report, are in Canada.

Renovated wastewater, as considered here, is wastewater from a municipality or residential development that has been treated to the extent that it can be beneficially reused for other purposes without adverse effects on public health or the environment.

Benefits of use of renovated wastewater for golf course irrigation could include:

- use of renovated wastewater is less costly than use of wastewater from other sources
- water of sufficient quantity or adequate quality is not available from another source
- reuse of wastewater provides a more cost-effective and environmentally beneficial alternative to other methods of wastewater disposal
- conservation of water resources
- reduced demand on a municipal water supply
- addition of nutrients and micronutrients is beneficial to turf growth.

Planning, design and management of golf course irrigation systems that use renovated wastewater must take into account:

- regulatory concerns about protection of public health and the environment
- concerns about possible effects of renovated wastewater on golf course soils and vegetation
- costs associated with installation and operation of the irrigation system.

This report does not attempt to describe all of these matters in detail. It does attempt to identify, and provide references to information about, matters that should be taken into account by those responsible for planning, design, and management of golf course irrigation systems that use renovated wastewater.

Preparation of this report involved a review of relevant literature, and detailed interviews with: representatives of Canadian golf courses that irrigate with renovated wastewater, provincial officials responsible for regulation of wastewater reuse, and others involved with design or management of these systems. Searches of the extensive CWRS library on water reuse, of the U.S Small Flows Clearing House data base, and the internet, did not add useful information.

Useful references are listed in Section 8. Nine Canadian golf courses that currently use renovated wastewater for irrigation were identified: 3 in Alberta, 3 in British Columbia, 2 in Ontario, and 1 in Nova Scotia. Information from 6 of these is included in the case studies in Appendix A. Appendix B includes information about relevant provincial regulations in Alberta, British Columbia, and Ontario. The references provide information about U.S. federal and state regulations.

## **2. Regulatory Issues**

Regulations, ordinances, and legal liabilities associated with use of wastewater on golf courses are discussed at length in (1).

Provincial regulations from Alberta, British Columbia, and Ontario are reproduced in Appendix B.

U.S. Environmental Protection Agency Guidelines for Water Reuse, quoted in (1), include the following water quality limits for reuse applications that include golf course irrigation:

- Treatment: secondary; filtration; disinfection
- pH: 6 to 9 BOD: 10 mg/L Turbidity: 2 ntu, or SS: 5 mg/L Fecal coliform: nil  
Cl<sub>2</sub> residual: at least 1 mg/L
- Monitoring: pH and BOD- weekly; Turbidity and Cl<sub>2</sub> residual- continuous; Coliform- daily
- Setback of irrigated areas from potable water supply wells.

These limits are accompanied by detailed interpretive comments. Some of these limits are more restrictive than limits applied by some U.S. states, which are also cited in (1). Others impose additional requirements, such as: groundwater monitoring, setbacks from dwellings, signs indicating that renovated wastewater is used or stored, or limitations on when irrigation can occur (typically at night) (1)(2)(3).

The case study examples in Appendix A suggest that development and application of regulations for the use of renovated wastewater should recognize the quality of that water. A simple example is the requirement for, and content of, warning signs: if the effluent has been thoroughly disinfected it may be of better quality than that of local alternative water courses, and in either case signs warning of use of "non-potable water" rather than "effluent" may be appropriate.

### **3. Environment**

There do not appear to be many environmental issues that are uniquely associated with the use of renovated wastewater for golf course irrigation.

Positive environmental effects of irrigation with renovated effluent, which are significant in some areas, are:

- avoidance of the need to discharge effluent into sensitive areas such as beaches or water supplies
- conservation of scarce water resources which are replaced by renovated effluent
- the nutrient content of reclaimed wastewater can provide an economic advantage by reducing the cost of commercial fertilizers.

Environmental concerns could include:

- contamination of surface and groundwaters by bacteria and other organisms
- odours associated with renovated wastewater may be noticeable to golfers
- nitrate contamination of groundwater supplies
- unsightly algal and weed growths in reservoirs, ponds, and hazards.

These concerns are expected to be addressed on Prince Edward Island by secondary treatment and disinfection of effluent that will be subjected to prolonged storage before it is reused for golf course irrigation.

Measures discussed in Section 2. and Appendix B address public health concerns.

Prolonged storage is expected to remove the slight musty smell of fresh secondary effluent, which might be noticeable and distasteful to some golfers. The City of Vernon, B.C. (Appendix A5), which provides renovated wastewater to the Predator Ridge Golf course after prolonged storage and final chlorination, has no odour problems. Some odour problems were experienced when the storage reservoir was constructed in the late 1970s, because effluent is withdrawn from the bottom of the reservoir. The problem was solved by installation of an aeration system, and could be avoided in a new system by use of a floating withdrawal system (6).

Nitrogen and phosphorus are chemical nutrients that are applied as a part of turfgrass management. These nutrients, usually provided by commercial fertilizers, may be replaced in part by use of renovated wastewater.

If nutrient application- in commercial fertilizers or renovated wastewater- is properly managed, there is little potential for unsightly and possibly odourous algal and weed growths in lakes, ponds, and hazards, or of nitrate contamination of groundwater.

If nitrogen is applied at a rate that exceeds the ability of the plant and soil system to contain it or convert it to nitrogen gas, the excess nitrogen may pass through the surface soil and into groundwater. High concentrations of nitrogen, particularly in the form of nitrate, are considered a health hazard in drinking water.

None of the golf courses in Appendix A identified nitrogen contamination of groundwater as a problem. In Vernon, B.C., two-thirds of the nitrogen in the secondary effluent is lost during prolonged storage (6).

If treated wastewater is impounded in an open reservoir a water quality maintenance program, which should include one or more of the following measures, is needed:

- screening or filtration to remove solids, such as algal growths, to reduce maintenance of sprinkler systems
- control or prevention of algal growth by an algicide, or a light inhibitor such as blue dye
- a mixing system
- rechlorination to maintain a residual in the distribution system.(3)

Adequate circulation and aeration are necessary for algal and odour control. Aeration can be provided by fountains, air injection, waterfalls, or constructed wetlands.(1)

Algae and weeds in ponds and hazards are concerns that can be addressed by assuring that nutrients in fertilizers or effluent are not applied to, or washed into, these bodies.

#### **4. Soils and Vegetation**

The quality of water that is applied in irrigation is an obvious concern to those responsible for management of the soils and vegetation on which a golf course depends.

Irrigation water quality parameters that are of concern include: pH, carbonate, bicarbonate, calcium, magnesium, sodium, potassium, conductivity, boron, chloride, sulphate, and adjusted SAR (Sodium Adsorption Ratio).

The case study examples in Appendix A make it clear that effects of these parameters, which are discussed below, are of particular concern to golf course operations in western Canada.

These concerns may not be shared in other areas or other situations, where:

- effluent quality is different as a result of treatment
- effluent is diluted by other sources of irrigation water
- higher rates of natural rainfall and runoff result in flushing of problem salts from soils

- different soil types exist.

These factors should be considered by persons with specialized knowledge of this subject.

Bicarbonates and carbonates both increase pH, and are a source of alkalinity, which may affect the water and soil. If the total concentration of bicarbonates plus carbonates exceeds 150 mg/l the resulting increase in pH may affect nutrient availability. Options used to offset this effect include use of acid-forming nitrogen fertilizers, sulfur addition to the soil, or acid injection into the irrigation water. This problem is common to four of the five courses in the Appendix; ground gypsum is applied in one case, acid injection in the other three.

The adjusted SAR is based on the ratio of sodium to calcium+magnesium in the water. Excess sodium replaces calcium on soil exchange sites, which can result in soil compaction and reduce infiltration into the soil. The usual recommendation for a SAR above 10 is application of calcium, usually as gypsum, and excess irrigation to leach the sodium. The SAR values at the Canadian courses in the Appendix are well below this value.

Conductivity is a measure of total soluble salts, or salinity of the water. While most turf species used on golf courses are reasonably salt tolerant, ground covers, ornamental plants, trees and shrubs may be affected if salt concentrations are too high. There is no recommended restriction on use of irrigation water if the conductivity is less than 3 mmhos/cm. Salinity is not considered a problem at the Canadian courses in the Appendix.

Boron, chloride, and sulphate may be toxic to plants if concentrations are too high. Concentration of boron higher than 1 to 2 mg/l (0.33 for some ornamental plants), and of chloride plus sulphate above 250 to 400 mg/L, are considered excessive. Concentrations of these ions in the irrigation waters at the courses in the Appendix are below these limits.

Other parameters that may require regular or occasional measurement are nitrogen, phosphorus, suspended solids, and heavy metals. An excess of inorganic or organic nitrogen may require careful control of fertilizer application. Phosphorus, and nitrogen, may encourage algal blooms in storage ponds. Excess suspended solids can seal the soil surface, alter the hydraulic properties of soils, or clog sprinkler head openings. If concentrations of heavy metals build up in soils they may complex with phosphorus and other elements and make them unavailable to plants. None of these problems were reported from the case study golf courses.

## **5. Planning, Design, and Management Issues**

### **Planning**

Reference (1) includes a "Developers/Operators Checklist" for use of wastewater for golf course irrigation, which includes the following headings:

- Sampling soils: sample soils well in advance of conversion to effluent, to track effects of the change; sample from different parts of the course- tees, greens, fairways, rough; sample irrigated soil quarterly to allow for adjustment of watering schedule and use



of mitigative measures.

- Water quality: initial and periodic water analysis; verify effluent source, noting that if industrial waste is included more undesirable elements may be present; verify treatment type, more is better; establish maximum BOD, TSS, and TDS levels in advance.
- Pumping and storage: considerations include- existing pumped or gravity supply; need for additional pumping; form and amount of storage; need for algae control; possible use of fresh water for greens, tees, ornamental lakes and sensitive plants.
- Miscellaneous: operation, maintenance and safety issues to be considered.

## **Design**

Design considerations related to irrigation with renovated wastewater include (1):

- Screening and /or filtration of stored effluent to avoid clogging of the irrigation system
- If acid injection is involved, consideration of corrosion effects
- Avoidance of cross-connections between potable and non-potable water systems
- Labeling and colour coding of non-potable pipes and equipment
- Provision of flush valves at low spots and dead ends to allow removal of debris
- Location of sprinkler heads to avoid contamination of drinking fountains, canteens, food and drink machines, etc.

Sprinkler head location may also have to consider contamination of, or nutrient addition to, water hazards.

References (1)(2)and(3) discuss storage of renovated wastewater. Reasons for storage may be:

- to balance supply and demand
- to supplement wastewater with another source
- to contain excess non-potable water
- a combination of the above.

Seasonal storage may be required where no alternative effluent disposal method is available (3).

Sizing of storage facilities is discussed in (2). Control of algae, weeds, and odours is discussed in (1) and (3).

## **Management Concerns**

Issues that may concern a golf course superintendent include (1):

- Many older greens have low infiltration rates, and require close attention to avoid turf failure, the risk of which may be increased if there is a possibility that use of renovated wastewater may further reduce infiltration capacity and require reconstruction of greens.
- If the level of the nutrients in the renovated wastewater is high, and especially if it is variable, staff will lose the ability to carefully control rates of nutrient application.
- If the application of renovated wastewater only at night results in a shortened application period, application rates will be increased, and the capacity of pumps and piping may be inadequate.
- If the course is committed to accept and use a certain amount of renovated wastewater, and there is no alternative use for or disposal of water in excess of that used for irrigation, the superintendent may be forced to overwater the course, i.e., irrigation will be based on

effluent disposal needs instead of proper golf course management.

Management functions that are discussed in (1) and (3) are:

- Public relations: Member and player concerns that must be satisfied include odours, course appearance, legal liability, health risks, and adjacent property values.
- Design and Construction Administration: plan checking, inspection, record drawings.
- Operation and Maintenance: monitoring and testing; staff, player, and public safety.

## **6. Cost Considerations**

Potential benefits of adoption of irrigation with renovated wastewater are listed in Section 1.

Based on the information presented above, following are potential sources of costs that might be associated with installation and operation of a golf course that uses renovated municipal wastewater. Which of these costs will actually be incurred is a site specific question. Cost considerations may differ depending on whether a new or retrofitted system is considered.

- increased irrigation storage capacity
- replacement of pumps and piping to provide increased hydraulic capacity
- possible reconstruction of older greens
- more sophisticated monitoring and control systems
- measures to control algal growths and dissolved oxygen depletion in storage ponds
- equipment, chemicals, and associated operating costs, to treat renovated wastewater to address water quality problems.

## **7. Summary**

This report is not intended to provide site-specific answers to those who will consider use of renovated wastewater on Prince Edward Island. It is expected to identify the matters to be addressed, and the questions to be asked, by those who will consider this issue.

Salient points that should be considered are:

- Well over 200 golf courses now use renovated wastewater for irrigation.
- At least 9 of these courses are in Canada: 3 in Alberta, 3 in British Columbia, 2 in Ontario and very recently, one in Nova Scotia.
- There are a variety of situations in which irrigation with renovated wastewater can provide significant benefits; some additional costs can be anticipated.
- Evaluation of costs and benefits of using renovated wastewater for irrigation of a particular golf course are site specific; this report tries to identify the nature of potential benefits and costs, and provides references and examples.
- The only specific concern related to the effect on golf courses in Canada of using renovated wastewater for irrigation appears to be elevated levels of bicarbonate, and associated pH. This concern – which may not apply in different situations related to soil conditions, effluent quality, or effluent dilution – has been addressed by addition of acid to the irrigation water, and by addition of ground gypsum to greens and tees.

- Based on experience elsewhere prolonged storage, as proposed for systems on Prince Edward Island, followed by screening and terminal disinfection, will address concerns about odours from renovated wastewater.
- Nutrients applied for turfgrass management—in fertilizers or renovated wastewater—should not have adverse effects on surface or ground waters if properly applied.
- Many U.S. states and at least three Canadian provinces have addressed the question of regulations or guidelines for protection of public health and the environment when irrigation of a golf course with renovated wastewater is considered.
- The case studies presented here provide examples that may help to guide future decisions about the use of renovated wastewater for golf course irrigation.

### **8. References**

1. United States Golf Association, 1994, "Wastewater Reuse for Golf Course Irrigation", Lewis Publishers.
2. Pettygrove, G.S. and T. Asano, 1984, "Irrigation with Reclaimed Municipal Wastewater", California State Water Resources Board.
3. American Water Works Association, 1994, "Dual Water Systems", AWWA Manual M24.
4. Balogh, J.C. and Walker, W.J., eds., "Golf Course Management and Construction, Environmental Issues", Lewis Publishers.
5. Alberta Environmental Protection, 1997, draft "Guidelines for Municipal Wastewater Irrigation".
6. Eric Jackson, 1999, City of Vernon, personal communication.

## **APPENDIX A**

### **Case Studies of Canadian Golf Courses Using Renovated Municipal Wastewater for Golf Course Irrigation**

- A1. D'Arcy Ranch
- A2. Green Briar
- A3. Innisfail
- A4. Osprey Ridge
- A5. Predator Ridge
- A6. Priddis Green

## A1. D'Arcy Ranch Golf Club

**Location:** Okatoks (close to south Calgary ), Alberta.

**Description:** 6919 yard 18 hole course.

**Source of Irrigation Water:**

Wastewater from the Town of Okatoks normally provides 100 percent of irrigation water. Water from a creek is an alternate source. In 1999, which was a very wet year, no irrigation water was required.

**Wastewater Treatment:**

**Operating Season:** Mid-April - mid-October

**Reason for Re-use:**

Effluent disposal; environmentally friendly course; provides alternative source.

**Alternative source:** Local creek; pumped into storage.

**Effluent Storage:**

Three reservoirs with total capacity 168,000 m<sup>3</sup>; effluent screen and filter before pumping to sprinklers.

**Number of Holes:** 18

**Number Irrigated:** 18

**Amount of Irrigation Water Used in Typical Year:** 150,000 m<sup>3</sup>/season

**Area Irrigated:** 100 ha

**Average Irrigation Rate:** 150 mm/season

**Application Method:** Spray irrigation at night.

<b>Irrigation Water Quality:</b>	<b>STP Effluent</b>	<b>Irrigation Pond</b>	<b>Creek</b>
• pH	7.3	7.0	7.6
• Conductivity (mmhos/mm)	1.4	0.9	0.58
• Adjusted SAR	2.87	3.85	1.3
• Ca (mg/L)	95	76	75
• Na (mg/L)	125	71	24
• Total Alkalinity (mg/L)	310	309	251
• Bicarbonate	378	377	307
• Salt Concentration (mg/L)	892	584	374
• Boron (mg/l)	0.09	0.11	0.02

**Water Quality Concerns:**

High sodium binds chemicals/ties up fertilizers. High bicarbonate concentration/hard water hardens soil. Algae and weeds in ponds.

**Remedial measures:** Gypsum added, especially to tees and greens (10 kg/100m<sup>2</sup>/month). Acid addition not used- expensive. Have sprayed ponds with Reglone A, or hand-dredged.

**Consultants re irrigation system:** Original system- Evergreen Irrigation, Calgary  
Pumping system- MacPherson and Thom, Calgary

**Source of Information:**

Gordon Lang, Course Superintendent. P (403) 938-6282; F (403) 938-6352.

## A2. Green Briar

**Location:** Nottawasaga River, east of Allison, Ontario.

**Description:**

Green Briar Retirement Community and Nottawasaga Inn Convention and Recreation Complex.

**Source of Irrigation Water:**

Green Briar Complex Wastewater Treatment Plant.

**Wastewater Treatment:**

Activated sludge, nitrification, chemical precipitation for PO<sub>4</sub> removal, sand filter, UV disinfection.

**Operating Season:**

**Reason for Re-use:**

Reduce P discharge to river to allow plant expansion; value of nutrients to course; environmental example.

**Alternative source:**

River water; effluent is 10 percent of total irrigation water.

**Effluent Storage:**

**Number of Holes:** 36

**Number Irrigated:** 36

**Amount of Irrigation Water Used in Typical Year:**

**Area Irrigated:**

**Average Irrigation Rate:**

**Application Method:** Spray irrigation.

**Irrigation Water Quality:**

**Water Quality Concerns:**

None expected: very high quality, highly diluted effluent, and high rainfalls avoid soil problems.

If algae in ponds due to P in river water.

**Remedial measures:** None required.

**Consultants re irrigation system:** Developer's staff.

**Source of Information:**

Steve Black, CH2M Gore and Storrie Limited<sup>1</sup>, P (416) 499-9000.

Peter Biffis, Green Briar Golf Course P (416) 364-5068 (not contacted).

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1. This firm also designed the Brook Lea Golf Course, the only other course that Steve knows is currently irrigating with effluent in Ontario.

### A3. Innisfail Golf Club

**Location:** Innisfail, Alberta

**Description:** Semi-private, not for profit, golf club.

**Source of Effluent:** Town of Innisfail Treatment Plant (Town Manager- Dale Mather).

**Wastewater Treatment:**

**Operating Season:** April 21- October 15.

**Reason for Re-use:** Effluent disposal, and only other source is a river 3 km away.

**Alternative source:** Local surface runoff into pond.

**Effluent Storage:** Pond with capacity of about 85,000 m<sup>3</sup>. Screen on pump inlet cleaned weekly.

**Number of Holes:** 18

**Number Irrigated:** 18

**Amount of Irrigation Water Used:** 1998- 45,000 m<sup>3</sup>, 1999- 3,600 m<sup>3</sup> (wet year)

**Area Irrigated:** 31 ha

**Average Irrigation Rate:** 143 mm/season

**Application Method:** sprinkler irrigation, usually at night.

**Irrigation Water Quality:**

	Irrigation Water
• pH	8.3
• Conductivity (mmhos/mm)	0.9
• Adjusted SAR	10.3
• Ca (mg/L)	43
• Na (mg/L)	152
• Total Alkalinity (mg/L)	
• Bicarbonate	397
• Salt Concentration (mg/L)	602
• Boron (mg/l)	0.09

**Water Quality Concerns:**

High sodium, pH, and bicarbonate. Duckweed in shallow ponds, not necessarily effluent related.

**Remedial measures:**

Acid injection (using Fairway pH). Previously added ground gypsum to greens. For duckweed occasionally use CaSO<sub>4</sub>, or mechanical removal.

**Consultants re irrigation system:** Acid injection system: The 9-mire Group, Prosper, Tx.

**Source of Information:**

Dwayne Simpson, Course Superintendent. P (403) 227-3444; F (403) 227-1203.

#### A4. Osprey Ridge Golf Club

**Location:** Bridgewater, Nova Scotia

**Description:** Resort community and golf club.

**Source of Irrigation Water:**

Treatment plant now serving clubhouse and maintenance facility; capacity 21 m<sup>3</sup>/day; future expansion may service associated residential area.

**Wastewater Treatment:**

Septic tank, recirculating sand filter, chlorination, contact chamber, 0.1 ha polishing pond.

**Operating Season:** Mid-April - End October.

**Reason for Re-use:** No option for effluent disposal.

**Alternative source:** Bridgewater water supply.

**Effluent Storage:** 27,000 m<sup>3</sup> pond that receives effluent and Town water.

**Number of Holes:** 18

**Number Irrigated:** 18

**Amount of Irrigation Water Used:** New system, dry year, estimate 250,000 m<sup>3</sup>.

**Area Irrigated:**

Now 16 ha, but could increase to 40 ha to include roughs if dry spell persists.

**Average Irrigation Rate:** 1700 mm/season, based on dry year.

**Application Method:** Spray irrigation, usually at night

**Irrigation Water Quality:** Effluent from Chlorine Contact

• Total Coliform (per 100 ml)	<2
• Fecal Coliform (per 100 ml)	<2
• pH	6.8
• BOD (mg/L)	3
• Total Suspended Solids (mg/L)	6

**Water Quality Concerns:**

None at this time: new system, effluent highly diluted, town water has chlorine residual.

**Remedial measures:** None

**Consultants re irrigation system:** D. Roy Lauzon Canada, Inc., Quebec.

**Source of Information:**

Tom Forsyth, Course Manager and Superintendent. P (902) 543-3273; F (902) 453-2522.



### A5. Predator Ridge Golf Resort

**Location:** Vernon, B.C.

**Description:** Resort community and golf club. 27 holes to be expanded to 36.

**Source of Irrigation Water:** City of Vernon

**Wastewater Treatment:** All of Vernon's wastewater is subjected to secondary treatment, chlorination, prolonged storage, chlorination, and pumping to irrigation sites (including 2 golf courses) in the summer months.

**Operating Season:** April 1- October 15.

**Reason for Re-use:** No other source; can use up to 4,500 m<sup>3</sup> of effluent/day.

**Alternative source:** None.

**Effluent Storage:** 13,600 m<sup>3</sup> pond; effluent from pond screened before pumping.

**Number of Holes:** 27

**Number Irrigated:** 27

**Amount of Irrigation Water Used in Typical Year:** 150,000 m<sup>3</sup>/season

**Area Irrigated:** 73 ha

**Average Irrigation Rate:** 200 mm/season

**Application Method:** Spray irrigation, usually at night

**Irrigation Water Quality:**

	Effluent	Irrigation
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Pond

• Total Coliform (per 100 ml)	<1	
• Fecal Coliform (per 100 ml)	<1	
• pH	7.3	7.3
• Chloride (mg/L)	81	
• Nitrate +Nitrite (mg/L)	5.8	
• Organic Nitrogen (mg/L)	0.1	
• Total Phosphorus (mg/L)	3.9	
• Orthophosphate (mg/L)	3.6	
• Total Nitrogen (mg/L)	10	
• BOD (mg/L)	12	
• Total Suspended Solids (mg/L)	16	
• Conductivity (mmhos/mm)		1.2
• Adjusted SAR		5.0
• Ca (mg/L)		91
• Na (mg/L)	100	96
• Total Alkalinity (mg/L)		370
• Bicarbonate		452
• Salt Concentration (mg/L)		746
• Boron( mg/L)		0.07

**Water Quality Concerns:** High pH and bicarbonate in effluent. Effect of effluent on water quality in water hazards. Algae and weeds in ponds and hazards.

**Remedial measures:** Sulphuric acid injection into fertilizer injection, aiming at pH of 6.4 and bicarbonate concentration of 80 to 90 mg/L. Gypsum added to tees and greens. Care exercised not to spray effluent into water hazards. Aerate for algae.

## A6. Priddis Green Golf Club

**Location:** Priddis, Alberta

**Description:** Golf Club and Residential Development

**Source of Irrigation Water:** Residential area that is part of the development that includes the golf course.

**Wastewater Treatment:**

**Operating Season:** Last week April- first week October.

**Reason for Re-use: Effluent disposal.**

**Alternative source:** In a dry period may pump from other ponds on course to dilute effluent. Permitted to discharge effluent into local stream once/year.

**Effluent Storage:** Pond that also receives local surface runoff.

**Number of Holes:** 27

**Number Irrigated:** 9

**Amount of Irrigation Water Used in Typical Year:** 11,400 m<sup>3</sup>/season

**Area Irrigated:** 12 ha

**Average Irrigation Rate:** 113 mm/season

**Application Method:** Sprinkler irrigation, at night.

<b>Irrigation Water Quality:</b>	<b>STP Effluent</b>	<b>Irrigation Pond (no effluent)</b>
• pH	7.1	8.5
• Conductivity (mmhos/mm)	1.0	1.0
• Adjusted SAR	3.65	1.22
• Ca (mg/L)	65	98
• Na (mg/L)	64	24
• Total Alkalinity (mg/L)	246	250
• Bicarbonate	301	305
• Salt Concentration (mg/L)	629	615
• Boron (mg/l)	0.17	0.03

**Water Quality Concerns:** Bicarbonate and base ions.

**Remedial measures:** Acid injection.

**Consultants re irrigation system:** Irrigation system- golf course developer  
Acid injection system: SoilTech Northwest,  
WallaWalla, Washington

**Source of Information:**

James Bebee, Course Superintendent, P (403) 931-3391; F (403) 931-3219

**Consultants re irrigation system:** Municipal and golf course staff.

**Source of Information:**

Trevor Smith, Course Superintendent. P (250) 542-9404 (ext 200); F (250) 542-3835

Eric Jackson, Director of Water Reclamation, City of Vernon. P (250) 545-8682;

F (250) 545-8682

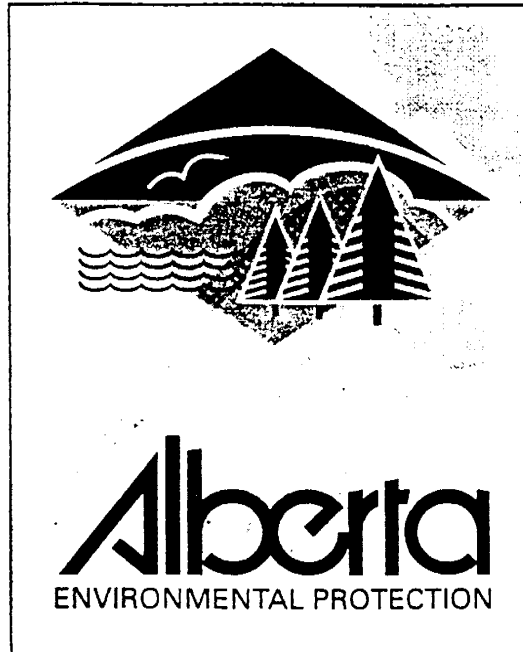
**APPENDIX B**  
**Provincial Regulations**

- B1. Alberta
- B2. British Columbia
- B3. Ontario

B1. Alberta

**DRAFT**

**GUIDELINES FOR MUNICIPAL WASTEWATER  
IRRIGATION**



**DECEMBER 1997**

**Standards & Guidelines Branch  
Environmental Assessment Division  
Environmental Regulatory Service**

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### **3.0 ASSESSMENT OF SITE SUITABILITY FOR PROPOSED WASTEWATER IRRIGATION DEVELOPMENT**

Land classification and other relevant site characterization activities are generally performed after completing the initial wastewater characterization, and the results indicate that the wastewater is suitable for irrigation.

In general, development of a municipal wastewater irrigation system must:

- i) provide safe longterm management of the landbase;
- ii) ensure public acceptance; and
- iii) protect community's capital cost of the project.

Careful assessment and characterization of the landbase and other site-related inputs are therefore required prior to any system design. A site is to be classed as suitable for wastewater application only if it is found to possess soil, climatic, and physical characteristics that enable effective utilization of the wastewater applied without causing future damage to the landbase or to the underlying groundwater. Site conditions must also be such that they effectively restrict any detrimental offsite movement of the wastewater through either groundwater migration, surface runoff or drift from the irrigation spray. The following sections outline the various land classification and soil testing requirements that must be addressed prior to actual wastewater irrigation system design and approval.

#### **3.1 Land Suitability for Irrigation**

The minimum requirement with which any land must comply to be suitable for receiving wastewater irrigation must be a Land Class 3 as defined by Standards For The Classification of Land For Irrigation in the Province of Alberta (Alberta Agriculture, 1990<sup>11</sup>) and the Procedures Manual for Land Classification For Irrigation in Alberta (Alberta Agriculture, 1992<sup>4</sup>). The level of investigation shall be at a Level II intensity (Alberta Agriculture, 1990<sup>11</sup>, 1992<sup>4</sup>). As municipal wastewaters have much higher nitrate levels than other irrigation waters in Alberta, it is necessary to further restrict wastewater application for lands where the natural water table is less than 2.1 metres below ground surface and/or impermeable bedrock is encountered at less than four meters below ground surface. In addition, for compliance with the land irrigability criteria, the following soil and site characterization details must also be collected and reported.

# ALBERTA ENVIRONMENT FACSIMILE COVER SHEET

ENVIRONMENTAL SERVICE - PARKLAND REGION  
#304, 4920 - 51 STREET  
RED DEER, ALBERTA T4N 6K8

FAX NO. 340-5022

MAIN SWITCHBOARD: 340-5310

DATE: Sept. 20, 1999

NO. OF PAGES TO FOLLOW: 2.

FROM: ALVIN BEIER, RET.  
Environmental Service, Parkland Region - Red Deer

TO: Name: Don Weller  
Bus: Del Tech  
Voice: \_\_\_\_\_ Fax: 902-494-3105

VOICE: Steve Johnson (403) 340-7739 (Regional Engineer)  
Alvin Beier (403) 340-5568 (Technologist)  
Colleen Besselink (403) 340-7052 (Admin. Support)

**MESSAGE:**

The attached are standard clauses used when an Approval to Operate or Letter of Authorization for Irrigation are issued to municipalities.



## **SECTION 4.5: IRRIGATION**

- 4.5.1** The approval holder shall not dispose of treated wastewater by way of irrigation except as provided in this approval or as otherwise authorised in writing by the Director.
- 4.5.2** The approval holder shall use treated wastewater from the wastewater stabilization pond storage cells(s) for irrigation of lands only if all of the following conditions are satisfied:
- (a)** the treated wastewater is taken from the final storage pond of the wastewater stabilization pond(s);
  - (b)** 30 meters of land separates all treated wastewater irrigated land from other adjacent properties except when adjacent property owners give written permission to reduce this distance;
  - (c)** 60 meters of land separates all treated wastewater irrigated land and each of the following:
    - (i)** seasonal drainage courses;
    - (ii)** public roads;
    - (iii)** railway lines;
    - (iv)** water wells; and
    - (v)** any boundary property lines;
  - (d)** 100 meters of land separates all treated wastewater irrigated lands and each of the following:
    - (i)** lakes, streams, or rivers;
    - (ii)** water reservoirs or watercourses; and
    - (iii)** occupied residential dwellings;
  - (e)** the land irrigated with treated wastewater shall be used to grow only the following during the period in which the land is being irrigated with treated wastewater:
    - (i)** forage, grain or oilseed crops; or
    - (ii)** grass or sod;
  - (f)** landowners adjacent to the golf course have been notified that treated sewage effluent is being used to irrigate the golf course;
  - (g)** signs have been posted in the clubhouse and around the golf course notifying golfers that treated sewage effluent is being used to irrigate the golf course;

(h) irrigation standpipes and outlets on the golf course have been marked to indicate that they are part of a wastewater irrigation system and not part of the potable water system;

(i) irrigation shall only take place between 2200 hours and 0400 hours.

4.5.3 The treated wastewater irrigation application rate shall not exceed the capacity of the soil to absorb moisture, and there shall not be any runoff from the irrigation site.

4.5.4 The approval holder shall apply treated wastewater for irrigation purposes at a maximum daily average rate of \_\_\_\_\_.

4.5.5 The approval holder shall apply treated wastewater for irrigation purposes at a maximum average annual rate of \_\_\_\_\_.

4.5.6 The approval holder shall not use treated wastewater for irrigation when any one of the following conditions exist:

(a) winds are in the \_\_\_\_\_ direction; or

(b) wind speed exceeds 30 kilometres per hour; or

(c) 7-day period prior to harvesting; or

(d) during harvesting; or

(e) 30-day period prior to grazing of dairy cattle; or

(f) 7-day period prior to grazing by livestock other than dairy cattle; or

(g) any period during which any livestock is grazing; or

(h) if the soil is frozen or snow covered.

4.5.7 There shall be no direct or potential cross-connection between the treated wastewater irrigation system and any waterworks system.

*Waste Management Act*

**WASTE MANAGEMENT ACT MUNICIPAL SEWAGE  
REGULATION**

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**PART 1 – INTERPRETATION****Definitions**

1 In this regulation:

“Act” means the *Waste Management Act*;

“aquifer” includes any soil or rock formation that has sufficient porosity and water yielding ability to permit the extraction or injection of water at rates greater than or equal to 5 L/minute;

“average dry weather flow” or “ADWF” means the daily municipal sewage flow to a sewage facility that occurs after an extended period of dry weather such that the inflow and infiltration has been minimized to the greatest extent practicable and is calculated by dividing the total flow to the sewage facility during the dry weather period by the number of days in that period;

“biosolids” means inorganic or organic solid residuals from a sewage facility, or septic tank sludge, resulting from a municipal sewage treatment process which has been sufficiently treated to reduce vector attraction and pathogen densities, such that it can be beneficially recycled;

“BOD<sub>5</sub>” means the total 5-day biochemical oxygen demand;

**Toxicity**

- 9** (1) A person must not discharge effluent, unless
- (a) the discharge passes a 96 hour LC50 bioassay test as defined by Environment Canada's Biological Test Method, Reference Method For Determining Acute Lethality of Effects to Rainbow Trout, Reference Method, EPS 1/RM/13, or
  - (b) if the discharge fails a bioassay test described in paragraph (a) that was conducted at a "Regular" time as specified in Schedule 6, Table 3, the discharge passes that test as conducted as a follow up under Column 5 in Schedule 6, Table 3.
- (2) Subsection (1) does not apply if
- (a) the discharge is to ground,
  - (b) the discharge quality meets a maximum BOD<sub>5</sub> not exceeding 10 mg/L and a maximum TSS not exceeding 10 mg/L,
  - (c) the discharge does not exceed a maximum daily flow of 5 000 m<sup>3</sup>/d and the discharger demonstrates to the satisfaction of the manager that the discharge does not adversely affect the receiving environment,
  - (d) the discharge is to open marine waters,
  - (e) the discharge is diluted such that at the outside boundary of the initial dilution zone the dilution ratio exceeds 100:1 and the discharger demonstrates to the satisfaction of the manager that the discharge does not adversely affect the receiving environment,
  - (f) reclaimed water is being provided or used in accordance with this regulation, or
  - (g) the discharger demonstrates to the satisfaction of the manager that the discharge does not adversely affect the receiving environment.
- (3) If subsection (1) applies, a person must not discharge effluent unless the discharge is monitored for toxicity in accordance with the requirements of Schedule 6, Table 3.

**Use of reclaimed water**

- 10** (1) A person must not provide or use reclaimed water unless
- (a) the standards for use of reclaimed water as set out in Schedule 2 are met,
  - (b) use is limited in accordance with Schedule 2 for unrestricted public access and restricted public access,
  - (c) for systems without seasonal storage, emergency storage is provided so that
    - (i) if the reclaimed water does not meet the standards required, the flow can be diverted until such time as the standards are met and designated water uses can continue, and
    - (ii) a minimum 20 days of emergency storage is provided, and

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Part 4 – Standards for Effluent Reuse and Discharges to the Environment

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- (d) an environmental impact study has been conducted in accordance with condition 8 in Schedule 1.
- (2) A person providing or using reclaimed water must, in addition to any seasonal storage for the reclaimed water that is provided,
  - (a) provide an alternative method of disposing of the reclaimed water and describe that method in the operating plan under section 16, or
  - (b) satisfy the manager that no alternative method described in paragraph (a) is required to assure public health protection and treatment reliability.
- (3) Despite subsection (1) (c) (ii), and provided that the treatment processes are built with multiple units capable of meeting the reclaimed water standard with one unit not in operation, emergency storage may be reduced to a minimum of 2 days.
- (4) If the required emergency storage required by subsection (1) (c) is temporarily not available, the discharger must
  - (a) divert the reclaimed water to a disposal method which complies with this regulation, and
  - (b) if the disposal method is to ground and the reclaimed water meets the unrestricted public access standards, the reclaimed water may be discharged to ground provided the time of subsurface travel before a surface discharge is not less than 2 days.
- (5) The discharger must ensure that a provider of reclaimed water is prohibited from using any dual distribution system to convey reclaimed water unless the distribution system incorporates design, construction, maintenance and inspection safeguards to prevent cross connections.
- (6) In subsection (5), “**dual distribution system**” means a water distribution system that distributes 2 grades of water to the same service area; one potable and the other non-potable.
- (7) No person may provide for the use of reclaimed water unless specifically authorized
  - (a) in writing by the local health authority having jurisdiction, or
  - (b) under a local service area bylaw under which the municipality or a private corporation under contract to the municipality assumes the responsibility for ensuring compliance with this regulation and that proper operation and maintenance will be carried out.
- (8) For the unrestricted public access category, a person must not be a provider of reclaimed water unless the person
  - (a) develops, to the satisfaction of the manager, user information and communication materials related to the use of reclaimed water, and
  - (b) provides annually to all users copies of the materials required by paragraph (a).

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Part 4 – Standards for Effluent Reuse and Discharges to the Environment

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- (9) Methods of treatment for reclaimed water other than those included in this regulation and their reliability features may be accepted by the manager if the discharger demonstrates to the satisfaction of the manager that the methods of treatment and reliability features will assure an equal degree of treatment, public health protection and treatment reliability.
- (10) Initial dilution zones are not applicable to reclaimed water used for stream augmentation, creating impoundments, maintaining wetlands or marshes or for emergency disposal to ground unless a standard specified under condition 4 in Schedule 1 makes them applicable.

**Discharges to water**

- 11** (1) A person must not introduce effluent to water unless
  - (a) the effluent quality standards for discharges to water as set out in Schedule 3 or 5 are met, and
  - (b) an environmental impact study has been conducted in accordance with condition 8 in Schedule 1.
- (2) A person must not introduce effluent to a water body identified in Schedule 5 as areas of prohibited discharge.

**Discharges to ground**

- 12** A person must not introduce effluent to ground unless
  - (a) the effluent quality standards for discharges to ground as set out in Schedule 4 or 5 are met, and
  - (b) an environmental impact study has been conducted in accordance with condition 8 in Schedule 1.

**Advanced treatment**

- 13** (1) If environmental impact studies set out in condition 8 in Schedule 1 indicate the need for more stringent standards for the specified effluent quality parameters or for additional parameters in order to protect human health and the environment, the discharger may be required by the manager in writing to:
  - (a) meet more stringent or additional standards,
  - (b) provide advanced treatment beyond that specified in Schedules 2 to 5, or
  - (c) meet mass loading limits specified by the manager.
- (2) For introduction of effluent to the water bodies and above aquifer areas identified in Schedule 5, the discharger must ensure that the requirements for advanced treatment are met.

## PART 5 – DESIGN AND CONSTRUCTION OF SEWAGE FACILITIES

### General

- 14** (1) Release of a discharge is prohibited, unless the discharger ensures that
- (a) the design of a sewage facility registered under section 3 is capable of consistently meeting the requirements of this regulation,
  - (b) the facility design and the inspection necessary to ensure that the construction methods, materials and constructed facilities meet the design criteria are undertaken by a qualified professional who has expertise in the particular aspect of the design,
  - (c) a copy of drawings are certified correct and sealed by a qualified professional, and
  - (d) a copy of the drawings required in subsection (1) (c) are retained by the discharger for inspection by the manager at any time.
- (2) The design of a municipal sewage collection system is exempt from this Part.

### Design procedure: large municipality

- 15** (1) In addition to the requirements of section 14, for discharges for which the contributory population equivalent to the sewage facility is greater than 5 000 persons, the discharger must undertake a staged approach to design as follows:
- (a) concept level planning;
  - (b) preliminary engineering;
  - (c) detailed design.

## PART 6 – MANAGEMENT AND OPERATIONS

### General

- 16** (1) A person must not introduce a discharge to the environment, unless
- (a) the discharger, at least 90 days before any construction commences, develops an operating plan for any sewage facility,
  - (b) the operating plan referred to in subsection (1) (a) is prepared by a qualified professional who
    - (i) is familiar with the facility, and
    - (ii) has expertise with respect to the proper operation of the facility, and
  - (c) the operating plan details the requirements for all of the following:
    - (i) proper operation and maintenance of sewage facilities;
    - (ii) for reclaimed water use on vegetation, the maximum application rate based on agrology studies for the vegetation to which the reclaimed water is applied;
    - (iii) emergency procedures;



- 5 Monitoring for fecal coliforms is only required if disinfection of the effluent is a requirement.
- 6 For marine discharges in this flow category, monitoring of BOD<sub>5</sub> and TSS is not required.
- 7 Based on an initial 60 days of compliance with the quality limit, the discharger must conduct weekly presence or absence testing for coliform monitoring. If the presence of any coliform is detected, daily fecal coliform testing must be reinstated until the quality limit is in compliance. Fourteen tests must be conducted to demonstrate that the discharge is back in compliance and then weekly presence/absence testing must be resumed.
- 8 When conducting a confirmation toxicity test in accordance with note 9 or when monitoring in accordance with column 5, the discharger must also monitor ammonia levels at the same time. The temperature and pH of the sample at the time of sampling must be recorded.
- 9 If a toxicity test is failed, the discharger must notify the manager immediately and conduct a confirmation toxicity test within 7 days of the date of the previous toxicity sample was taken.
- 10 If two consecutive toxicity tests are failed, monitoring is to be conducted at a frequency specified by column 5, until three consecutive toxicity tests are passed, after which testing reverts to the frequency specified in column 4.

**SCHEDULE 7 –  
 DESIGN STANDARDS FOR SEWAGE FACILITIES**

*(Condition 11 in Schedule 1)*

**1 General**

- (1) Environmental impact studies must be undertaken for facility siting, as set out in condition 8 of Schedule 1.
- (2) The discharger must demonstrate to the satisfaction of the manager that any proposed alternative measures:
  - (a) meet or exceed the requirements of this Schedule;
  - (b) do not adversely affect the performance of the sewage facility;
  - (c) do not adversely affect the receiving environment.
- (3) Based on any information related to the discharge or the receiving environment, or both, the manager may require additional or alternative measures to protect the environment.

**2 Treatment Facilities**

- (1) Treatment facilities must be designed to achieve the applicable effluent quality standards in Schedules 2 to 5 at all times.
- (2) Design criteria must ensure that average effluent values are substantially better than the maximum limits specified such that the maximum limits are met at all times.
- (3) The design must consider the operation certification level of staff and the availability of professional or specialist advice.
- (4) Duplicate or standby facilities are required as described in Appendix 1 to Schedule 7.

- (5) Reliability categories must be determined based on the environmental impact study results.
- (6) Reliability categories are defined as follows:
  - (a) Category I - Treatment works for reclaimed water or that discharge to waters or land that could be permanently or unacceptably damaged by effluent that is degraded in quality for even a few hours (for example, discharges near drinking water sources, shellfish waters or waters used for contact sports where “shellfish waters” means water bodies that have or could have sufficient shellfish quantities that recreational or commercial harvesting would take place or water for which commercial shellfish leases have been issued);
  - (b) Category II - Treatment works that discharge to waters or land that would not be permanently or unacceptably damaged by short term effluent degradation, but would be damaged by continued (several days) effluent quality degradation (for example discharges to recreational land and waters);
  - (c) Category III - Treatment works not otherwise designated as Category I or II.
- (7) Biosolids or sludge must not be discharged into outfalls.
- (8) Disinfectants must be completely mixed with effluent before entering the contact tanks.
- (9) Septic tanks must have a hydraulic capacity of at least 2 day minimum detention time at maximum daily flow.

### 3 Pumping Facilities

- (1) A minimum of 2 pumps are required with each pump capable of pumping peak design flows.
- (2) For larger pumping stations where multiple pumps are required, the station must have sufficient capacity to pump peak design flow with largest pump out of service.
- (3) Standby power is required as follows:
  - (a) for a 2 pump station, a receptacle for a portable generator;
  - (b) for multiple pump station, an on-site generator.
- (4) Provision must be made so that standby power is activated prior to the hydraulic capacity of the pump station being exceeded.

### 4 Outfalls

- (1) Outfall analysis and design must be carried out by a qualified professional.
- (2) Outfall design must be according to initial dilution zone specifications (section 5 of this regulation) and incorporate the following minimum standards:
  - (a) an outfall diffuser must be designed and located
    - (i) at a sufficient depth to maximize the frequency that trapping of the effluent below the surface of the water body occurs,
    - (ii) to ensure that the discharge does not cause water quality parameters, outside the initial dilution zone, to exceed known water quality guidelines,

- (iii) to intercept the predominant current and avoid small currents that tend to move in toward the shore, and
- (iv) in the channel in which most of the water of the river or stream flows to achieve maximum dilution;
- (b) an outfall to marine waters, estuaries, or lakes with a surface area greater than 100 ha, must meet the depth, flow and distance standards set out in Appendix 2 to Schedule 7;
- (c) subject to the requirements of Schedule 5, the minimum depth below mean low water for any outfall located in marine waters, or lakes with a surface area greater than 100 ha, is 10 m;
- (d) a diffuser section that will provide a minimum 10:1 dilution within the initial dilution zone;
- (e) the prevention of air entrapment;
- (f) protection from wave, boat and marine activity;
- (g) adequate weighting to prevent movement from currents, ice or possible entrainment of air;
- (h) corrosion protection;
- (i) protection from damage during construction.

#### 5 Discharges into Ground

- (1) Design must be carried out by qualified professional.
- (2) The following standards must apply to exfiltration and rapid infiltration basins:
  - (a) at least 2 basins must be provided, to allow cleaning of one basin to proceed while the others is in operation, and to act as a safety factor for unusual conditions;
  - (b) for 2 basin systems, each basin must be capable of accepting all the effluent under annual average rainfall conditions;
  - (c) setbacks as specified in subsection (3) (h) must be provided.
- (3) If disposal is by sub-surface means, the following standards must apply:
  - (a) the land area must be sufficient to permit application rates as shown in Schedule 4;
  - (b) percolation rates must be determined in accordance with established procedures described in, B.C. Reg. 411/85, the Sewage Disposal Regulation, under the *Health Act*. Alternatively, a qualified professional may use soil classification, coefficient of permeability or other suitable information to determine an equivalent loading rate;
  - (c) examination by a qualified professional is required and if percolation time is greater than 20 minutes, the bed hydraulics must be confirmed by a hydrogeological assessment;
  - (d) sub-surface fields and a surrounding buffer strip at least as wide as the distance prescribed by Row 2 of the Table H must be kept free of building or hard surfacing of any kind and must not be put to uses which may cause damage to the system or interfere with its operation;
  - (e) septic tanks have a screen or filter and must be accessible for pumpout, inspected annually and must be pumped out a minimum of once every 3 years or at a frequency sufficient to ensure that sludge accumulation does not exceed 20% of the tank depth.

Records of pumpout frequency must be submitted to the manager with the annual report;

- (f) a pressure distribution system must be used for drainage pipes fed by a dosing syphon or pump;
- (g) the drainage pipes must be provided in 2 fields with a third undeveloped field being retained as a standby area. Drainfields must be constructed with trenches on 3 m on-centre spacing. If a qualified professional determines that the performance of the drainfield is not adversely altered by varying the spacing a minimum spacing of 2 m is permissible. In the case where less than 3 m on-centre spacing is used, the standby area must be doubled. Except if reductions in length are allowed, each of the 2 developed fields is to have at least the length of drainage pipe indicated in Table 4 of Schedule 4;
- (h) drainfields setback requirements in addition to those specified in Schedule 4:

**Table H - Minimum Setback Requirements**

	Feature	Minimum Setback Distance	
		Maximum Daily Flow	
		<37 m <sup>3</sup> /d	≥ 37 m <sup>3</sup> /d
Row 1	property boundary	3 m	6 m
Row 2	building drain(*)	5 m	10 m
Row 3	Christina Lake	**	**
Row 4	surface water	30 m	30 m
Row 5	surface water within Okanagan basin	30 m	150 m
Row 6	water well	60 m	90 m
Row 7	water well within an unconfined aquifer	60 m(***)	300 m(****)

- (\*) The sewage treatment facility itself is to be considered as a building;
- (\*\*) As determined by adherence to Christina Lake Official Community Plan;
- (\*\*\*) Based on a hydrogeological assessment to determine the minimum distance required to protect water quality of the water well distance from water well must be extended accordingly;
- (\*\*\*\*) Based on a hydrogeological assessment conducted by the discharger to determine the minimum distance required to protect water quality of the water well, the distance from the water well may be reduced or extended as required by the manager. In no case shall the distance be less than 90 m;
  - (i) subsurface visual inspection capability must be provided;
  - (j) trenches must be a minimum of 0.6 m in width. Trench bottoms must be at least 0.3 m below the pipe invert. Pipe cover must meet local frost protection requirements but must not be less than 0.15 m. The drainage pipe must be no less than 70 mm in diameter, unless a pressure distribution system is utilized;
  - (k) seepage beds or mounds must be constructed using AMERICAN SOCIETY OF TESTING MATERIALS C33 sand and must receive written approval from the manager.

- (4) If required, monitoring wells must be installed as determined by a qualified professional in sufficient number and orientation to measure background and receiving environment water quality. Horizontal as well as vertical arrays for sampling must be considered. At least 3 wells per aquifer are necessary and at least one background monitoring well is required.

**6** Reclaimed Water Application

- (1) Subject to note 1 to Appendix 1 to Schedule 2, the type of reclaimed water use must be one of those indicated in Schedule 2.
- (2) The provider of reclaimed water must ensure that the design ensures that the Health and Safety Criteria for use of reclaimed water as set out in Appendix 3 to Schedule 7 are met.
- (3) If application of reclaimed water is by irrigation, the following standards must apply:
- (a) if application of reclaimed water is not continuous, seasonal storage or an alternative method of disposal that complies with the standards set out in Schedules 3 and 4 is required;
  - (b) storage ponds must be provided to contain the design average daily effluent flow occurring outside the growing season, plus an allowance from an analysis of the cumulative volumes needed for a reduced irrigation season due to at least 5 years of wet weather equivalent to rainfall or snowmelt events with a 5-year return period. Average rain, seepage and evaporation conditions must be accounted for in the design.
  - (c) the design area to be used for reclaimed water application must be sufficient so that effluent discharge will not be necessary under the following conditions:
    - (i) outside the growing season;
    - (ii) for restricted public access category
      - (A) during and for 3 days prior to harvesting of crops;
      - (B) during and for 6 days prior to grazing by dairy cattle;
      - (C) during and for 3 days prior to pasturing by livestock other than dairy cattle unless the meat is inspected under the Federal Meat Inspection Program;
  - (d) the restricted public access reclaimed water must be confined to the area designated and approved for use by the manager;
  - (e) maximum ground surface slope must not exceed 20%, unless greater slopes are approved in writing by the manager.
- (4) For reclaimed water meeting the unrestricted public access category, the constructed drain field length, as specified in Table 4 to Schedule 4, can be reduced provided the requirements set out in condition 8 of Schedule 1 are met. If design flows have been applied for a period of 5 years without hydraulic problems, the manager may, subject to recommendation by a suitably qualified professional, allow the area of the fields to be reduced.

**APPENDIX 1 TO SCHEDULE 7**  
**EQUIPMENT AND PROCESS RELIABILITY CATEGORY FOR TREATMENT FACILITIES**

Component	Reliability Category					
	I		II		III	
	Treatment System	Power Source	Treatment System	Power Source	Treatment System	Power Source
Holding basin	Adequate capacity for all flows		Not applicable		Not applicable	
Degritting		Optional		No		No
Primary sedimentation	Multiple units <sup>a</sup>	Yes	Same as category I	Yes	Two minimum <sup>a</sup>	Yes
Trickling filters	Multiple units <sup>b</sup>	Yes	Same as category I	Optional	No backup	No
Aeration basins	Multiple units <sup>b</sup>	Yes	Same as category I	Optional	Single unit permissible	No
Blowers or mechanical aerators	Multiple units <sup>c</sup>	Yes	Same as category I	Optional	Two minimum <sup>c</sup>	No
Diffusers	Multiple sections <sup>d</sup>		Same as category I		Same as category I	
Final sedimentation	Multiple units <sup>b</sup>	Yes	Multiple units <sup>a</sup>	Optional	Two minimum <sup>a</sup>	No
Chemical flash mixer	Two minimum or backup <sup>e</sup>	Optional	No backup	Optional	Same as category II	No
Chemical sedimentation	Multiple units <sup>b</sup>	Optional	No backup	Optional	Same as category II	No
Flocculation	Two minimum <sup>a</sup>	Optional	No backup	Optional	Same as category II	No
Effluent filters	Two minimum <sup>b</sup>	Yes	Same as category I	Yes	Same as category I	Yes
Disinfection basins	Multiple units <sup>b</sup>	Yes	Multiple units <sup>a</sup>	Yes	Same as category II	No
Aerobic digesters	Two minimum <sup>a</sup>	Yes	Same as category I	Optional	Single Unit	No
Anaerobic digesters	Two minimum <sup>a</sup>	Yes	Same as category I	Optional	Two Minimum	No
Facultative lagoons	Two cells <sup>b</sup>		Two cells		Two cells	
Aerated lagoons	Two cells <sup>b</sup>	Yes	Two cells	Optional	Two cells	No
Package treatment plants	Multiple units <sup>b,f</sup> or ability to repair within 48 hours	Yes	Two units or ability to repair single unit within 48 hours	Yes	Single unit may be permissible	No

- a Remaining capacity with largest unit out of service must be for at least 50% of the design maximum flow.
- b Remaining capacity with largest unit out of service must be for at least 75% of the design maximum flow.
- c Remaining capacity with largest unit out of service must be able to achieve design maximum oxygen transfer; backup unit need not be installed.
- d Maximum oxygen transfer capability must not be measurably impaired with largest section out of service.
- e If only one basin, backup system must be provided with at least 2 mixing devices (one may be installed).
- f Effluent filtration is required in conjunction with ground disposal.

**APPENDIX 2 TO SCHEDULE 7**  
**OUTFALL DEPTH, FLOW AND DISTANCE CALCULATIONS**  
**FOR MARINE, ESTUARY AND LAKE DISCHARGES**

- 1 For discharges less than 5000 m<sup>3</sup>/d,
- (a)  $Q_c$  must be greater than or equal to  $Q_a$ , where:
- $Q_a$  = the maximum daily flow (m<sup>3</sup>/d),
- $Q_c$  = the calculated critical flow (m<sup>3</sup>/d) and is calculated as described below,
- $D$  = depth (m) of the shallowest diffuser port below mean low water and must be equal to or greater than 10 m, and
- $d$  = distance (m) to the closest port of the diffuser from the mean low water mark and must be equal to or greater than 30 m
- and
- (b)  $Q_c$  must be the greater positive value of  $Q_{c1}$  or  $Q_{c2}$ , where:
- $Q_{c1}$  =  $(D+0.075d-21) / 0.0029$
- and
- $Q_{c2}$  =  $(D+0.075d-12.225) / 0.025$
- 2 For outfalls with a diffuser, the terminus, for the purposes of the calculation in note 1, must be considered as the closest and shallowest port.
- 3 For discharges greater than 5000 m<sup>3</sup>/d, depth and distance to be determined by environmental impact study and computer modeling of the discharge.

**APPENDIX 3 TO SCHEDULE 7**  
**HEALTH AND SAFETY CRITERIA FOR USE OF RECLAIMED WATER**

**1 Construction Criteria**

- (1) All reclaimed water valves, outlets, quick couplers and sprinkler heads must be of a type or secured in a manner that only permits operation by personnel authorized by the user. All piping, valves and outlets must be marked to differentiate reclaimed water from domestic water. All reclaimed water controllers, valves, etc., must be affixed with reclaimed water warning signs. All piping must be of a distinct colour to differentiate reclaimed water from domestic water.
- (2) Use or installation of hose-bibbs on any irrigation system presently operating, or designed to operate with reclaimed water, regardless of the hose-bibb construction or identification, is not permitted unless it can be demonstrated to the manager that special circumstances justify their use.
- (3) There must be at least a 3 metre horizontal and a 0.3 metre vertical separation (with domestic water above the reclaimed water pipeline) between all pipelines transporting reclaimed water and those transporting domestic water.

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- (4) There must be no irrigation or impoundment of reclaimed water within 30 metres of any water well or in-ground reservoir used for domestic supply unless it can be demonstrated to the manager that special circumstances justify lesser distances to be acceptable.
  - (5) There must be no connection between a potable water supply, irrigation water or industrial wells and piping containing reclaimed water, except through an air gap separation or reduced pressure principle device.
  - (6) Impoundments must have perimeter signs indicating that the reclaimed water stored is not safe for drinking (e.g. ATTENTION: RECLAIMED WASTEWATER - DO NOT DRINK, bliss symbols should be used).
  - (7) Impoundments must be designed, operated and maintained to minimize fluid leakage. Any leakage must not aggravate or produce soil or bedrock instability or erosion elsewhere or impact ground or surface water quality.
  - (8) The perimeter of the disposal area must be graded to prevent ponding along public roads or other public areas.
  - (9) For the restricted public access category of reclaimed water, fencing or other barriers must be installed, where needed, to restrict public access.
  - (10) At areas irrigated with reclaimed water, warning signs must be posted in sufficient numbers and size and at strategic locations to advise the public that reclaimed water is being used and is not safe for drinking purposes and for the restricted public use category for personal contact as well (e.g., Warning -RECLAIMED WATER - AVOID CONTACT - DO NOT DRINK; bliss symbols, and the "Mr. Yuck" symbol).

## 2 Operation Criteria

- (1) Restricted public access reclaimed water must be confined to the area designated and approved for use (e.g., wind blown spray must be prevented from leaving the property). For use of reclaimed water on parks, playgrounds and school grounds the reclaimed water provider must ensure that no direct contact between the reclaimed water and any person occurs while irrigation is occurring.
- (2) Precautions must be taken to ensure that reclaimed water will not have contact with any facility or area not designated for use, such as passing vehicles, buildings, domestic water facilities or food handling facilities.
- (3) Drinking water facilities must be protected from direct or wind blown reclaimed water spray.
- (4) Tank trucks and other equipment which are used to distribute reclaimed water must be clearly identified with warning signs.
- (5) Adequate measures must be taken to prevent the breeding of insects and other vectors of health significance, and the creation of odors, slimes or unsightly deposits.
- (6) Golf score cards and signage posted at visible locations must indicate that reclaimed water is used.
- (7) Irrigation with reclaimed water must not occur within 60 m of areas where food is handled or consumed.



- (8) Irrigation must be controlled to prevent ponding and run-off of reclaimed water.
- (9) Direct public contact with reclaimed water must be minimized.
- (10) A contingency plan including provisions for notification of local health authorities, must be developed outlining the action to be taken in the event effluent quality fails to meet required standards and which identifies alternative methods of disposal during a series of wet years.

**3 Notification**

- (1) The provider of reclaimed water must provide, on request, to the manager and to local health authorities reports containing information on:
  - (a) the quality and quantity of reclaimed water;
  - (b) the use (method of irrigation and the crop(s) and area(s) irrigated);
  - (c) the reason for non-compliance with these health criteria, if appropriate, and corrective action taken.

[Provisions of the *Waste Management Act*, R.S.B.C. 1996, c. 482, relevant to the enactment of this regulation: section 57 (1) and (3)]

### **B3. Ontario**

The Ontario Ministry of Environment has no specific policy, regulations, or guidelines related to use of treated wastewater for golf course irrigation. Approvals have been handled on case-by-case basis.

Conditions of approval for systems applying undiluted effluent have included:

- enhanced secondary treatment plus disinfection
- periods without high winds or the presence of people.

They currently do not require signs indicating that wastewater effluent is being used for irrigation.

For recent applications that involved adding treated golf course wastewater to large irrigation ponds where the disinfected effluent is highly diluted by surface water, they have not applied any special conditions.

Mohamed Dhella  
Head, Water And Wastewater Approvals Branch  
Tel: (416) 314-8573  
email: dhallamo@ene.gov.on.ca

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