Environmentally Sustainable and Cost Effective Decentralized Wastewater Treatment

Swan Lake First Nation, Manitoba

INTEGRATED SUSTAINABILITY

Water, Waste and Energy Management

April 13, 2012

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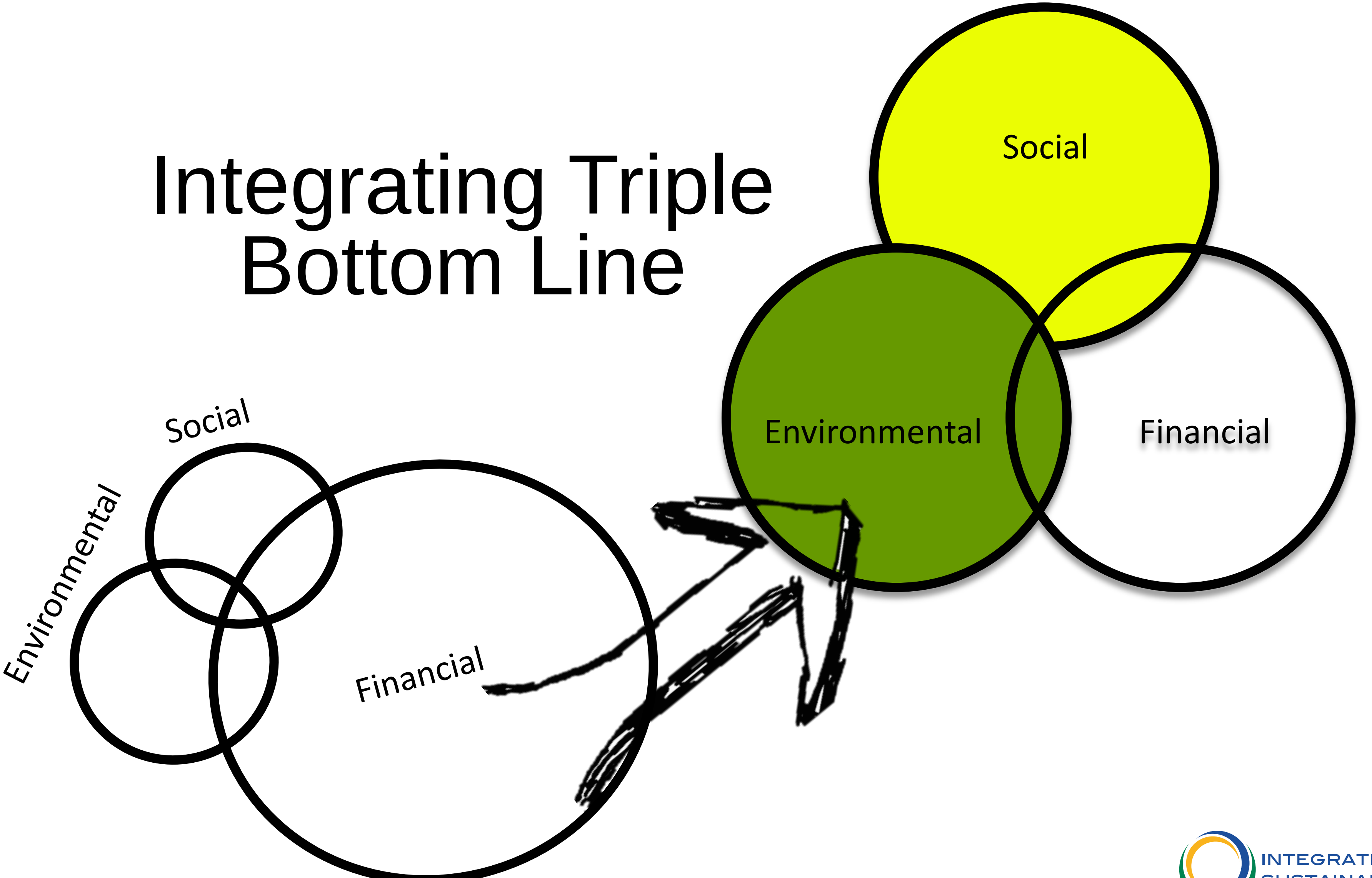
Watertech 2012

Shifting Decision Making

Integrating Triple Bottom Line



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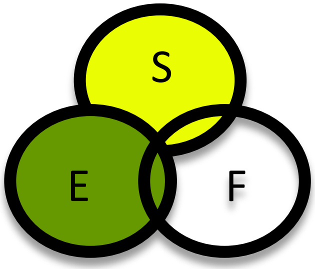
Sustainability in Design

#1 Helping to develop customers' sustainability policies and objectives into Project Reality.

#2 Aim to embed environmental, social and financial sustainability across the project life-cycle.



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Background

- The Swan Lake First Nation (Swan Lake) is planning a Commercial Development
  - hotel, gas bar, conference centre, restaurant, offices, RV Park, and Water Park.
  - Water and wastewater treatment system (760 m3/d)

Goals

- Limit environment impact and meet CCME guidelines
  - Evaluate treatment Options
- Be off-grid by 2017
  - Power Options Review

SLFN Commercial Development Site

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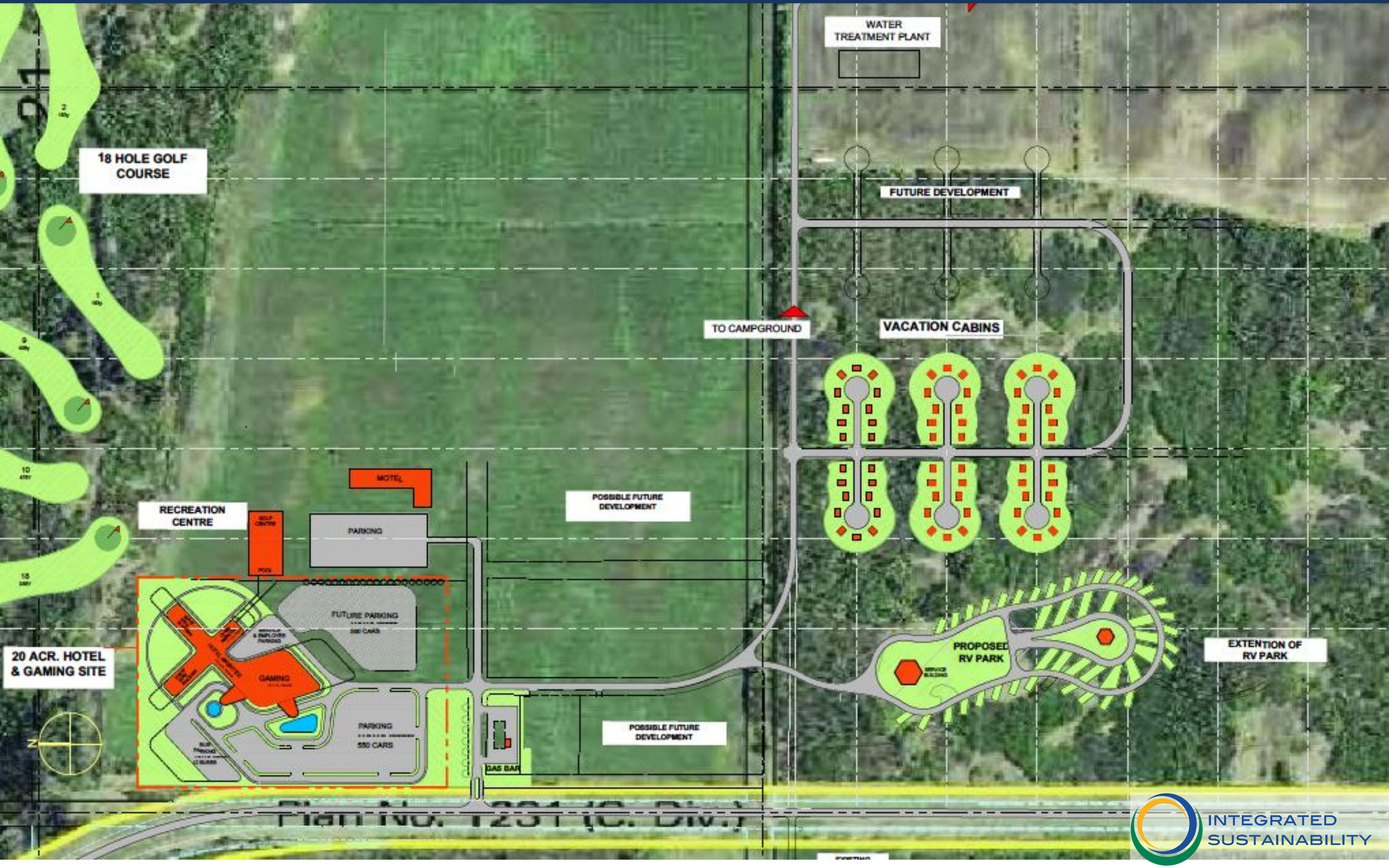
SLFN Development Plan



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Wastewater Treatment Options

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Wastewater Treatment Options

Treatment Options Basis

CCME National Performance Standards for treated wastewater effluent (2009)

- $CBOD_5$ – 25 mg/L
- TSS – 25 mg/L
- Total Residual Chlorine – 0.02 mg/L

Major trends:

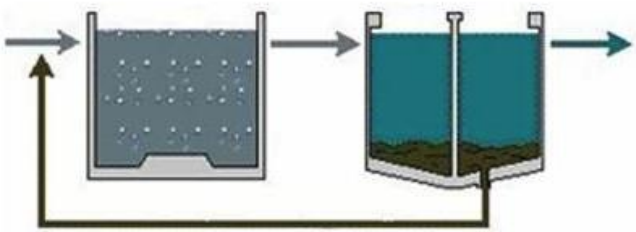
- treatment solutions for:
    - better water quality
    - smaller footprints
    - source water protection – disinfectants, nutrients

Recommendations for stakeholders:

- understand the regulatory changes
- commit to advanced wastewater infrastructure
- steer towards early compliance

Wastewater Treatment System

ACTIVATED SLUDGE



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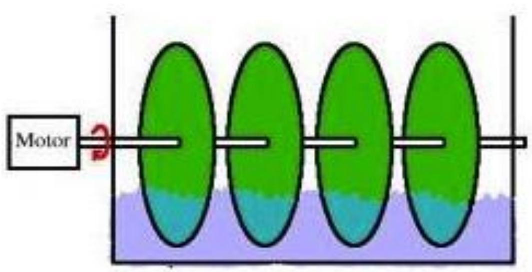

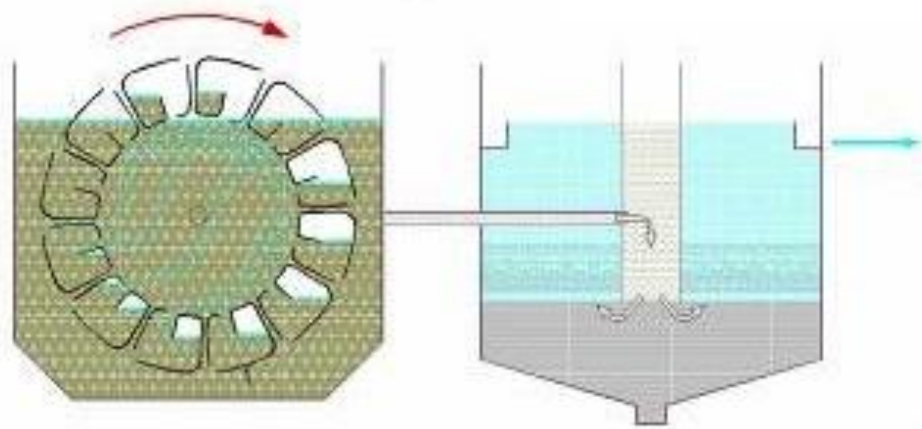

BIO-WHEEL

h2o innovation

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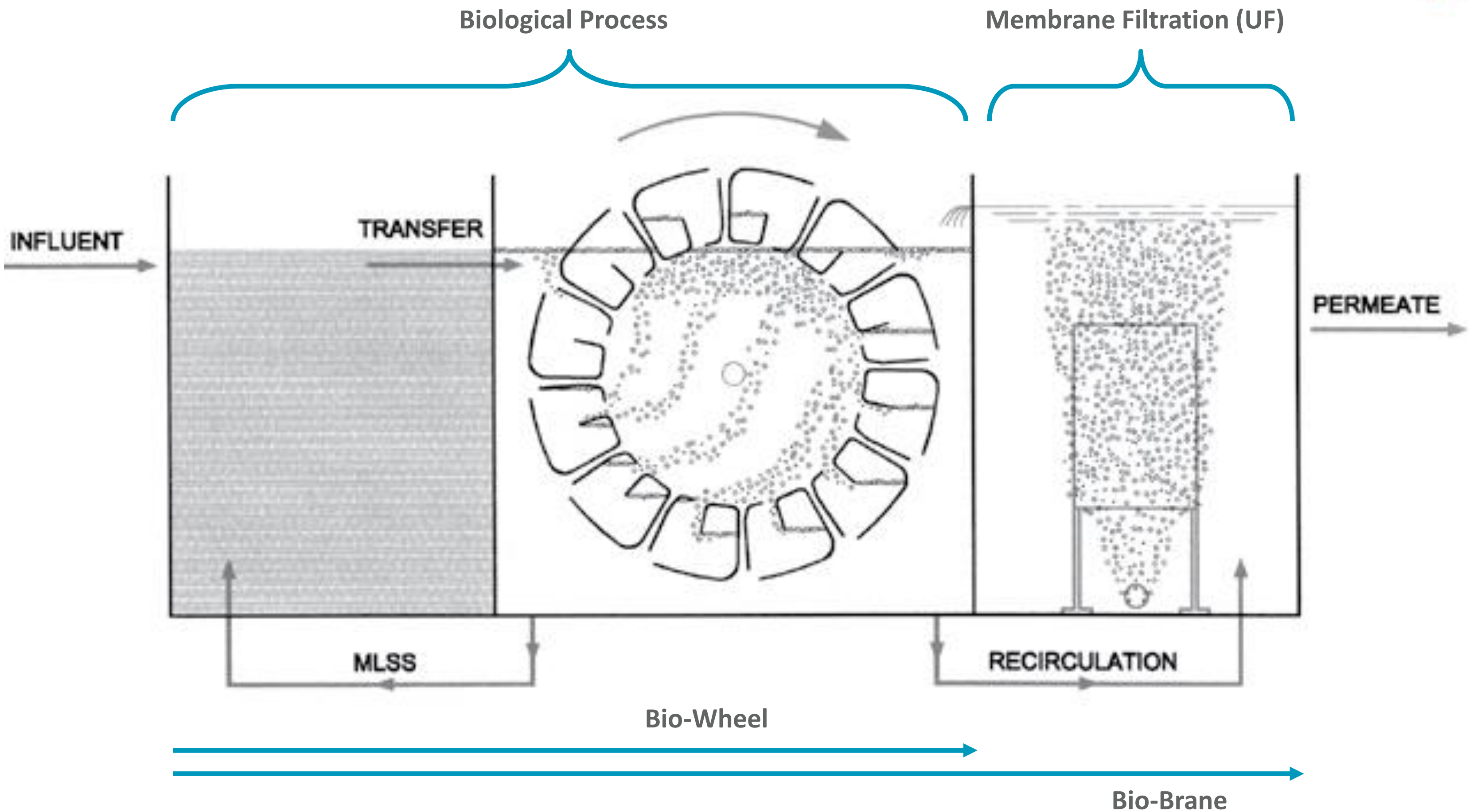
How it works

Bio-Wheel and Bio Brane



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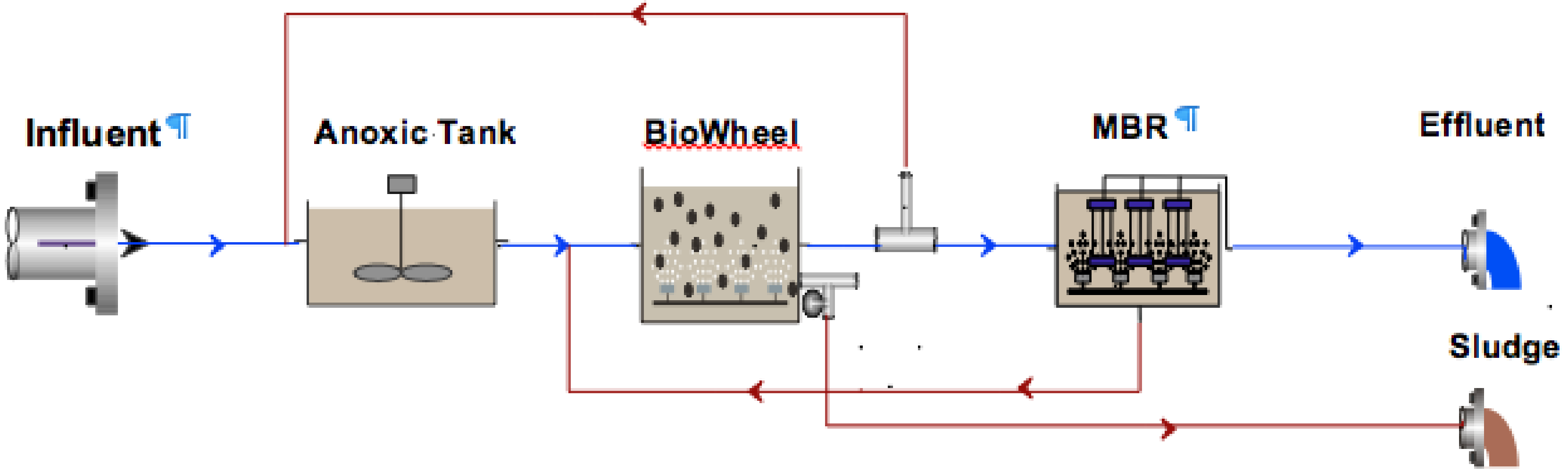
Treatment Model



Process	Influent	Anoxic Tank	BioWheel	MBR	Effluent	Treatment Target
Total $cBOD_5$	250.3	832.5	1048.1	0.8	0.8	5.0
TSS	248.9	3819.3	4983.7	0.1	0.1	5.0
Total P	5.0	62.9	82.2	1.8	1.8	2.0
TKN	40.0	203.6	258.4	2.1	2.1	10.0
Ammonia	26.4	7.0	0.6	0.1	0.1	5.0
pH	7.3	7.4	7.5	7.6	7.6	6.0 -9.0

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Selection of Treatment Technology

An evaluation was conducted to establish the best treatment option. Conventional Wastewater stabilization ponds VS a wastewater treatment plant

* The wastewater treatment technology was selected based on shifting regulations, efficiency and reliability

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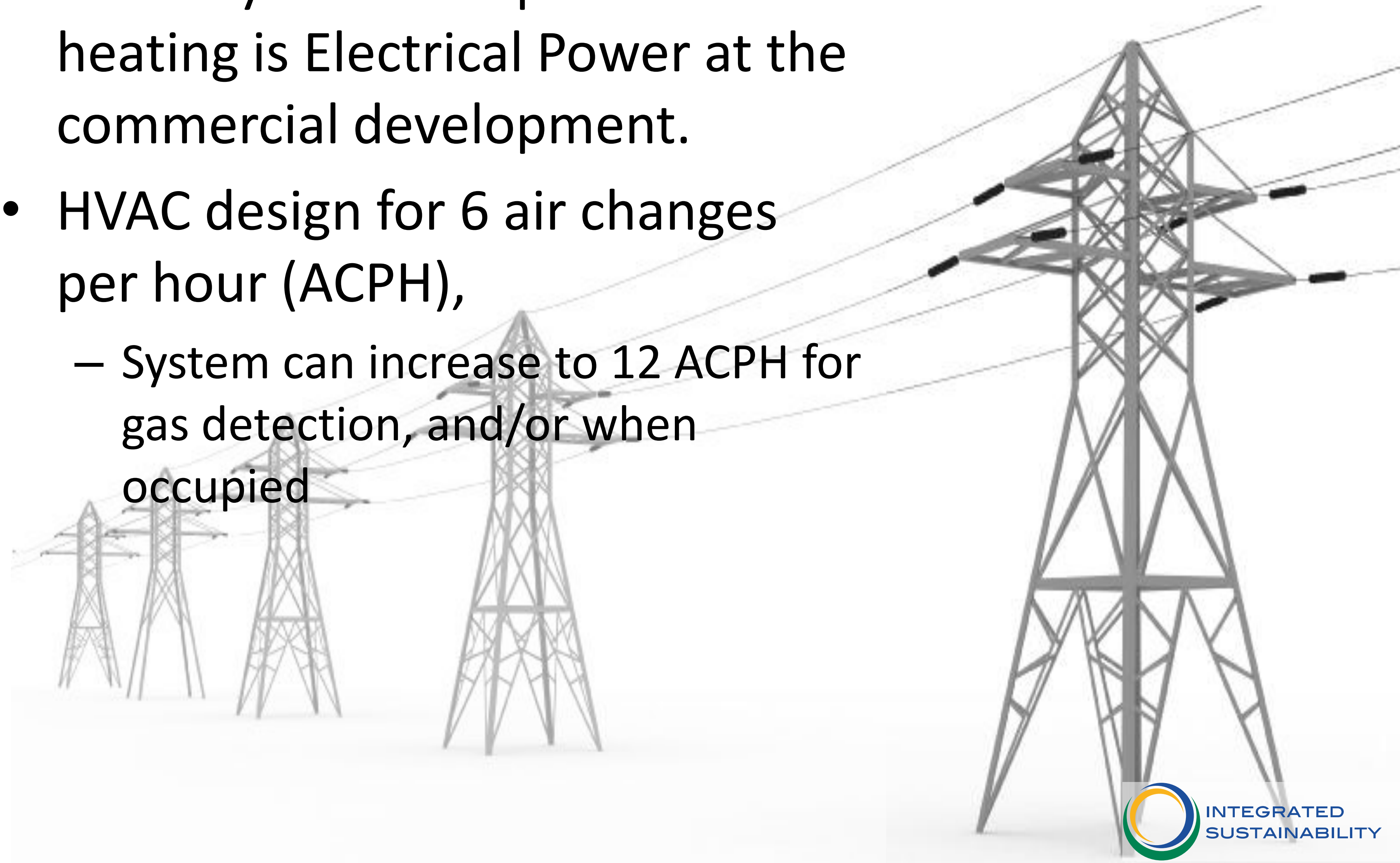
Power Issues

- The only source of power for heating is Electrical Power at the commercial development.
- HVAC design for 6 air changes per hour (ACPH),
  - System can increase to 12 ACPH for gas detection, and/or when occupied



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Design Basis

- Heating required to accommodate 12 ACPH at a temperature of -40° C
- Limit impact on the biological treatment.
- Biological processes are inactive below 10° C
- Ambient temperature is essential for maintaining nitrification / denitrification

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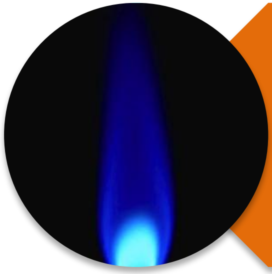
Power Options Evaluation



Heating is the most significant power demand for this facility.

Options to reduce the power demand necessary for providing adequate building heat

Renewable/ Alternative Technologies:

Geothermal, Solar PV, Wind, Heat Recovery, Mix or Resources

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Power Options Basis

- Ambient min. -40° C; building min. 10° C;
- Electrical requirement 350 kVA, (100% hydro);
- WWTP HVAC load 1,200,000 kWh/year (3,200 hours);
- Net metering revenue $0.06/kWh;
- Propane $0.90/L

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Power Option Results

- 50% of winter power consumption is for HVAC.
- Power consumption savings bigger driver than Manitoba Hydro installation cost

- Major opportunity - optimize the HVAC system.
- Base case estimated yearly heating cost is $54,096 to $73,560 which
- minimum of 11 heaters (35 kW)

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Design Option Analysis

CASE	Capital Cost HRV/Geo Capital Costs)	Wind/ Solar Capital Costs	Total Capital Costs	Operating Cost Wind/Solar	Facility Power Requirements	Size	Capacity Factor
HRV	$250,000		$250,000		2.14 GWh p.a.		
Geothermal	$340,000		$340,000		2.04 GWh p.a.		
Wind	$110,000	$1,800,000	$1,910,000	$16/MWh	2.90 GWh p.a.	Wind = 1.0 MW	32% NCF
Solar	$110,000	$6,160,000	$6,270,000	$4/MWh	2.9 GWh p.a.	Solar = 2.2 MW	15% NCF
Geothermal + HRV	$500,000		$500,000		1.89 GWh p.a.	.	
Geothermal + Wind	$340,000	$1,350,000	$1,690,000	$16/MWh	2.04 GWh p.a.	Wind = 0.75 MW	32% NCF
HRV + Wind	$240,000	$1,350,000	$1,590,000	$16/MWh	2.14 GWh p.a.	Wind = 0.75 MW	32% NCF
Geothermal + HRV + Wind	$500,000	$1,350,000	$1,850,000	$16/MWh	1.89 GWh p.a.	Wind = 0.75 MW	32% NCF

Note: NCF = Net Capacity Factor net of losses

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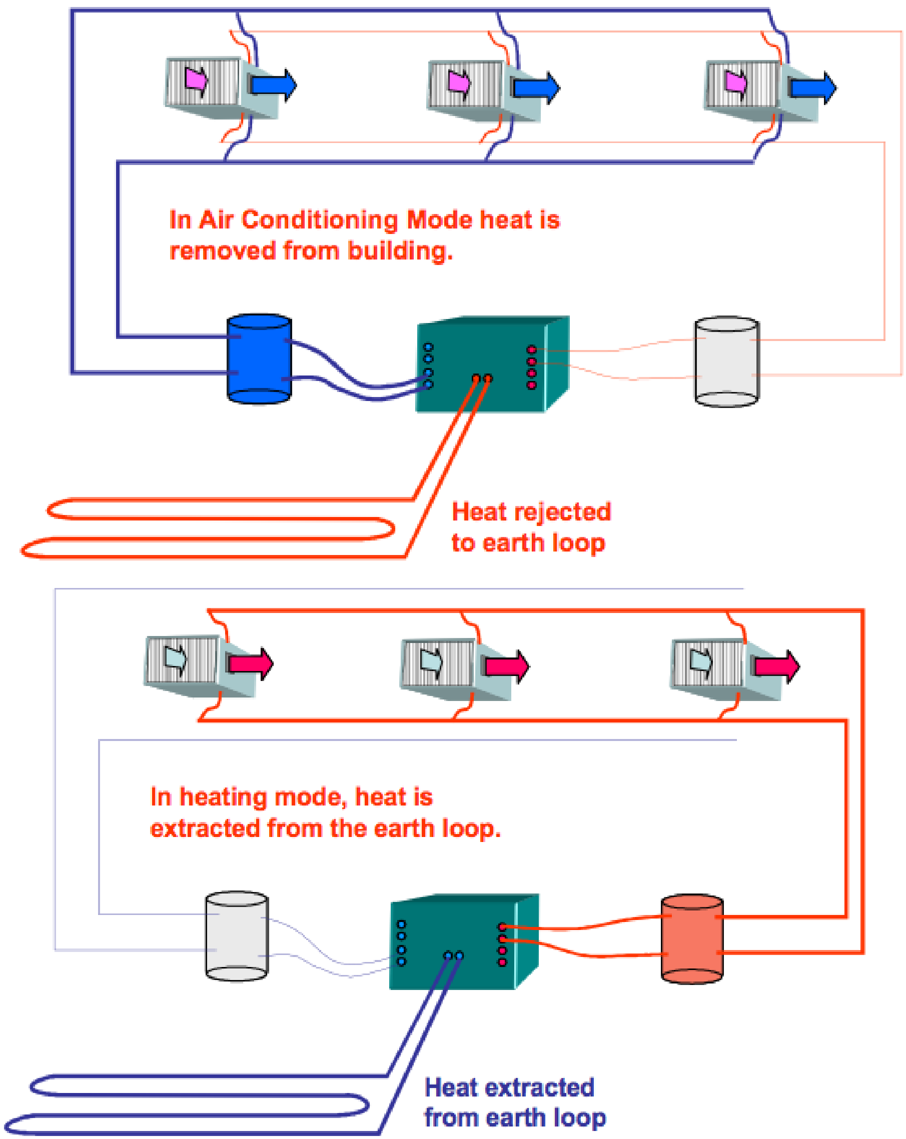
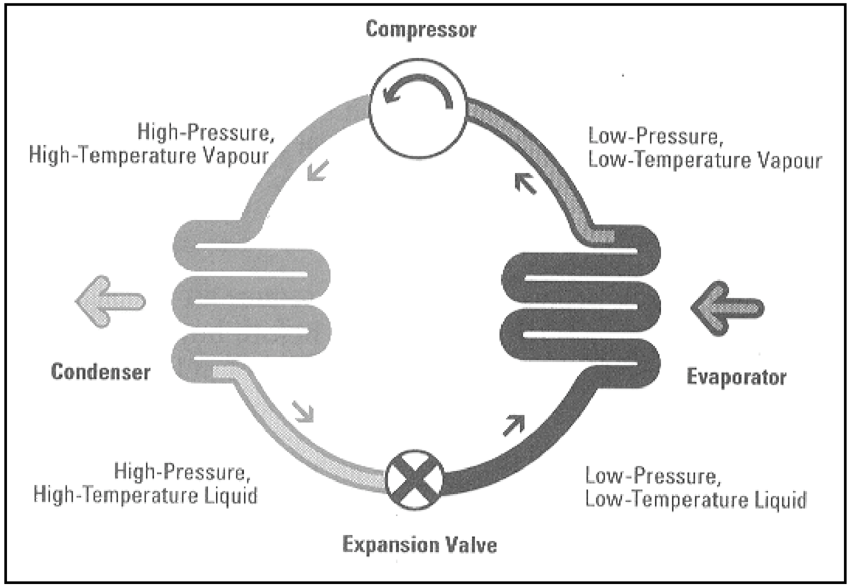
IRR on Capital Investment

Technology Case	*Power Price ($/MWh)* $30.00	$60.00	$110.00
HRV	18%	36%	64%
Geothermal	12%	25%	44%
Wind	-4%	6%	16%
Solar	-8%	-2%	3%
Geothermal + HRV	8%	17%	31%
Geothermal + Wind	0%	9%	21%
HRV + Wind	0%	10%	21%
Geothermal + HRV + Wind	0%	9%	19%

WWTP Geothermal System



- 100 ton System (350 kW)
- Savings of 245 kW/h
- CAPEX $300,000
- Yearly OPEX $5,000
- Yearly Savings $90,000



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Sustainable Economic Advantage

- At power prices above $60/MWh, wind was also attractive, however not as attractive as HRV and/or geothermal.
- Solar was the least attractive option at all power prices evaluated, (+ at prices > $100/MWh)
- The combination of Geothermal and HRV had a lower rate of return than either alone, due to the reduced efficiency of the HRV when combined; and
- Capital requirements for wind power were significant and therefore any combined case with Geothermal and/or HRV had a significantly lower return rate.

Moving Forward

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- A regional combined heat and power (CHP) system that includes both Geothermal, waste management and energy recovery components is being developed for use at this site.
  - Heating, cooling and power for buildings;
  - Energy efficiency increases (70% waste heat to 20% waste heat)
  - Waste management solution and energy recovery
- ISC recently engaged to provide Water Treatment System
  - Groundwater to Greensand Pre-Filtration, Reverse Osmosis, Calcite Polishing

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Integrated Sustainability Consultants Ltd. is a niche engineering company specializing in water and wastewater treatment, water management, waste management and energy solutions.