Attachment 2 Alternative Design Concept Evaluation

November 26, 2024

Norwich Wastewater Treatment Plant Capacity Expansion Class EA
Review of Design Alternatives

				Alternative 1: Fixed Film AG			Alternative 2: MABR			Alternative 3: SAGR		
Evaluation Criteria	Maximum Achievable Total	Weight (A)	Scoring Guidance	Score (B): Scenario 1	Justification	Total (AxB): Scenario 1	Score (B): Scenario 2	Justification	Total (AxB): Scenario 2	Score (B): Scenario 4	Justification	Total (AxB): Scenario 4
Grand Total	**100.2**					**68.2**			**74.4**			**77.5**
Operational	**33.3**					**24.2**			**26.1**			**28.2**
1	**33.3**					**24.2**			**26.1**			**28.2**
1.1 Reliability and Resilience - System's ability to maintain performance under varying conditions and loads	9.1	1.8	1: Highly vulnerable to high loadings and flows- Effluent quality at risk during adverse conditions 2.5: Average resilience to high loadings and flows- Effluent quality typically met during adverse conditions 5:Highly resilient to high loading and flows - Reliably maintains effluent quality through adverse conditions.	3.0	All systems will be designed to meet the effluent criteria at a variety of design flows and loadings (ADF, PDF, MMF, effluent recirculation). Lagoon system can offer some buffering to peak flows. In a fixed film system all BOD/TAN removal processes would occur within the south lagoon .Sludge build up and/or high influent flows could result in short-circuiting though the lagoon and insufficient contact time with the fixed film media resulting in increased TAN concentrations. Careful design of baffles would be required to mitigate short-circuiting. Fixed film modules are fully subject to cold temperatures in the lagoon.	5.5	4.0	All systems will be designed to meet the effluent criteria at a variety of design flows and loadings (ADF, PDF, MMF, effluent recirculation). Lagoon system can offer some buffering to peak flows. Flows from the south lagoon are routed through the MBBR resulting in reduced opportunity for short-circuiting. MBBR tank is covered for resistance to cold temperatures and can be equipped with a heater if requested.	7.3	4.5	All systems will be designed to meet the effluent criteria at a variety of design flows and loadings (ADF, PDF, MMF, effluent recirculation). Lagoon system can offer some buffering to peak flows. Flows from the south lagoon are routed through the SAGR resulting in reduced opportunity for short-circuiting. SAGR is located underground and is covered with a layer of mulch for resistance to cold temperatures, no heater is required.	8.2
1.2 Ease of Maintenance - Frequency and complexity of required maintain	6.1	1.2	1. Requires significant maintenance over a year 3. Requires moderate maintenance over a year 5. Requires minor maintenance over a year	4.0	Supplier has indicated that operations will need to increase the airflow of the modules' integrated diffusers every 4-6 weeks to scour / clean the modules and the media to prevent clogging. Maintenance of the fixed film modules will be minimal however will require staff to enter the lagoon. Aeration diffusors cleaning and/or membrane replacement every 5 to 7 years for units in the lagoon depending on the specific supplier selected). Blower maintenance requirements (oil changes, belts, filters) will be common between all alternatives.	4.8	4.0	Supplier has indicated that the MBBR system requires little maintenance only attributed to any sensors in the MBBR tank and care of the emersion heater (depending on supplier). County indicated that standard process of draining and inspecting tanks each would require extra work to manage MBBR media. Aeration diffusors cleaning and/or membrane replacement every 5 to 7 years for units in the lagoon and MBBR (depending on the specific supplier selected). Blower maintenance requirements (oil changes, belts, filters) will be common between all alternatives.	4.8	5.0	Supplier has indicated that the SAGR system requires little, if any, maintenance with the exception of topping up the mulch layer as needed. Aeration diffusors cleaning and/or membrane replacement every 5 to 7 years for units in the lagoon (depending on the specific supplier selected). Blower maintenance requirements (oil changes, belts, filters) will be common between all alternatives.	6.1
1.3 Generator Requirements	3.0	0.6	1. Generator required 3. Generator may be required 5. No generator required	3.0	Dedicated generator capacity may be required for the Fixed Film system. Fixed Film system is tied for the highest installed blower capacity (~270 kW) which would result in theoretically a slightly larger generator.	1.8	3.0	Dedicated generator capacity may be required for the MBBR system to prevent media settlement and freezing during winter conditions. MBBR has the lowest installed blower capacity (~140 kW) would theoretically result a slightly smaller generator.	1.8	4.0	Dedicated generator capacity is likely not be required for the SAGR system as system is located underground and risk of freezing is low. SAGR is tied for the highest installed blower capacity (~298 kW) which would result in theoretically a slightly larger generator.	2.4
1.4 Operator Training and Skill Requirements - Training and qualifications needed for operation	6.1	1.2	1. Highly specialized training and qualifications required. Continuous oversight of the process required. 3. Similar training, qualifications and operational requirements compared to Tavistock WWTP. 5. Low training and qualifications requirements. Minimal operational oversight needed.	4.0	System requires very little training and qualifications to operate, similar to Tavistock	4.8	3.5	System requires very little very little training and qualifications to operate. Few operational parameters which require adjustment.	4.2	4.0	System requires very little very little training and qualifications to operate. Few operational parameters which require adjustment.	4.8
1.5 Scalability and Flexibility - Ease of future expansion or adaptation to increased demand	6.1	1.2	1. Requires construction of new parallel process 2 - 4. Requires construction/upsizing of a portion of the process 5. Minimal changes required to existing process	3.5	Increased TAN loading can be accommodated by increasing the number of fixed film modules however this will be limited spatially by the lagoon size. Increased BOD loading will require more aeration in the lagoon. More volume could be required to increase HRT depending on the flow increase. Effluent storage will be the most challenging thing to accommodate given the spatial constraints on the site and is common to all alternatives.	4.2	5.0	Increased TAN loading can be accommodated by increasing the media fill fraction to a point and then will require additional MBBR reactors. Increased BOD loading will require more aeration in the lagoon. More volume could be required to increase HRT depending on the flow increase. Effluent storage will be the most challenging thing to accommodate given the spatial constraints on the site and is common to all alternatives.	6.1	4.0	Increased TAN loading can be accommodated by adding SAGR bed(s). Increased BOD loading will require more aeration in the lagoon. More volume could be required to increase HRT depending on the flow increase. Effluent storage will be the most challenging thing to accommodate given the spatial constraints on the site and is common to all alternatives.	4.8
1.6 Lagoon Cleanout Consideration	3.0	0.6	1. Floating or ground mounted aeration equipment and Fixed Film Media 3. Floating or ground mounted aeration equipment 5. Empty lagoon with minimal obstructions	1.0	Fixed Film System includes floating or fixed media modules which must be moved or removed from the lagoon to allow cleaning to take place.	3.0	3.0	MBBR system includes aeration equipment which must be moved or removed from the lagoon for cleanout to take place.	1.8	3.0	SAGR system includes aeration equipment which must be moved or removed from the lagoon for cleanout to take place.	1.8
Economical	**15.2**					**13.2**			**13.4**			**11.1**
1	**15.2**					**13.2**			**13.4**			**11.1**
1.1 Capital Costs - Initial investment required for installation and construction	6.1	1.2	Brackets based on Cost - Linear Ranking of available points base - 5 for least expensive	5.0	Capital Cost Opinion: $17,890,000 Includes: Fixed film modules, lagoon aeration equip and baffle, process building (containing blowers, tertiary filters, UV system and chemical dosing system), effluent storage lagoons and pumping station, effluent pump upgrade.	6.1	4.8	Capital Cost Opinion: $18,480,000 Includes: Concrete MBBR tank and media, lagoon aeration equip and baffle, process building (containing blowers, tertiary filters, UV system and chemical dosing system), effluent storage lagoons and pumping station, effluent pump upgrade.	5.9	4.3	Capital Cost Opinion: $20,930,000 Includes: SAGR bed (stone media, mulch, aeration and influent distribution piping, geo-membrane), lagoon aeration equip and baffle, process building (containing blowers, tertiary filters, UV system and chemical dosing system), effluent storage lagoons and pumping station, effluent pump upgrade.	5.2
1.2 Operational and Maintained (O&M) Cost - ongoing costs for energy, staffing, repairs, and chemical use	6.1	1.2	Yearly O&M costs brackets - Linear Ranking of available points base - 5 for least expensive	4.7	O&M Cost Opinion: $204,400 Includes: Aeration power and replacement parts, WW pumping power, UV disinfection power and Alum.	5.6	5.0	O&M Cost Opinion: $189,450 Includes: Aeration power and replacement parts, WW pumping power, UV disinfection power and Alum.	6.1	3.6	O&M Cost Opinion: $264,600 Includes: Aeration power and replacement parts, WW pumping power, UV disinfection power and Alum.	4.4
1.3 Funding Eligibility - Potential for grants, subsidies, or incentives that could offset costs	3.0	0.6	Average Score provided to all. No technology more eligible for funding.	2.5	Average Score	1.5	2.5	Average Score	1.5	2.5	Average Score	1.5

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Grand Total		**100.2**					**68.2**			**74.4**			**77.5**
Environment		**27.3**					**18.2**			**20.6**			**20.9**
1		**27.3**					**18.2**			**20.6**			**20.9**
1.1	Energy Efficiency - Energy use/requirements of treatment technology. Ability to assist County with meeting energy use targets	6.1	1.2	Linear ranking by installed power of major duty equipment. Includes: Blowers, Pumps, Filters, UV system, Heating/Ventilation	3.3	Major Equipment Power: 380 kW	4.0	5.0	Major Equipment Power: 250 kW	6.1	3.0	Major Equipment Power: 410 kW	3.6
1.2	Footprint and Land Use - Land requirements and impact on surrounding areas	3.0	0.6	1:Requires more footprint that existing system 3:Same footprint as the existing system (Or fits within the existing footprint) 5:Requires less footprint that existing system	5.0	System can be accommodated in the South Cell only	3.0	3.0	System can be accommodated in the South Cell and ISF Footprint	1.8	4.0	System can be accommodated in the South Cell and ISF Footprint. Manufacturers indicates some of the South Cell can be used for additional storage.	2.4
1.3	Greenhouse Gas(GHG) Emissions - Estimated emissions associated with construction and operation	3.0	0.6	GHGs are difficult to quantify at this level of detail. GHGs will likely be driven by the construction of the effluent storage lagoons (significant earth moving) and process building which are common. Operationally it is likely that the blowers will use the larger fractions of electricity	2.5	Provided Average Score	1.5	3.0	Provided higher that average score due to reduction in aeration energy usage and therefor associated emissions.	1.8	2.5	Provided Average Score	1.5
1.4	Effluent Quality and Compliance - Ability to meet or exceed regulatory limits for effluent quality	6.1	1.2	2.5 (Average) - System reliably meets the required effluent limit. 5 - System can achieve effluent limits under adverse conditions and/or provide higher quality under average conditions.	3.0	System will be able to meet the effluent criteria. Lagoon system can offer some buffering to peak flows.	3.6	4.0	System will be able to meet the effluent criteria. Lagoon system can offer some buffering to peak flows and MBBR design offers more protection against short-circuiting and cold weather (covered tank).	4.8	4.5	System will be able to meet the effluent criteria. Lagoon system can offer some buffering to peak flows and SAGR design offers more protection against short-circuiting and cold weather (located underground).	5.5
1.5	Sludge Generation - Volume and characteristics of sludge produced	6.1	1.2	All system will produce filter sludge which will be recycled back to the lagoons. 2.5 - (Average) - Lagoon Quality (30 mg/L) 5 - Secondary Effluent Quality (10-15 mg/L)	2.5	Effluent TSS assumed to be similar to MBBR (30 mg/L). Assumed similar to typical lagoon effluent.	3.0	2.5	MBBR effluent to be approx. 30 mg/L per manufacturer	3.0	4.0	SAGR effluent <20 mg/L per manufacturer	4.8
1.6	Will the technology protect Oxford's water?	3.0	0.6	5 - All -As a part of the ACS effluent criteria were developed which are protective of the environment. All alternatives are capable of achieving these limits under typical conditions.	5.0		3.0	5.0		3.0	5.0		3.0
Social &Cultural		**24.4**					**12.5**			**14.3**			**17.4**
1		**12.1**					**6.4**			**7.9**			**10.3**
1.1	Community acceptance - Anticipated community support or concerns	3.0	0.6	1: Significant community concerns 5: Community concerns not anticipated.	4.5	Some community concern due to more novel technology with limited similar installations in Ontario. New effluent storage lagoon could cause concerns though this is common for all alternatives	2.7	5.0	Similar installations in North America. New effluent storage lagoon could cause concerns though this is common for all alternatives	3.0	5.0	Similar installations in Ontario and North America. New effluent storage lagoon could cause concerns though this is common for all alternatives	3.0
1.2	Noise and Odor Control - Potential impacts on nearby residents	6.1	1.2	New effluent storage lagoon could cause concerns though this is common for all alternatives 2.5 (Average Score) - provided for typical wastewater odour/noise concerns. 5 - Significant reduction of odour and noise concerns.	2.5	Lagoons could cause odours if septicity occurs (typical).Noise from blowers will be common from for all alternatives and controlled with enclosures.	3.0	2.5	Open tankage could cause odours if septicity occurs (typical). Noise from blowers will be common from for all alternatives and controlled with enclosures.	3.0	4.0	Completely located underground therefore mitigating odour concerns with SAGR system. Noise from blowers will be common from for all alternatives and controlled with enclosures.	4.8
1.3	Health and Safety - Impact on the health and safety of plant workers and the public	3.0	0.6	All alternatives will be designed to be safe for staff and the public. Some process have safety features intrinsic to their design. 1 - More Safety Procedures and/or PPE required 2.5 - Some hazards eliminated through the alternative's design 5 - Hazards eliminated through the alternative's design	1.0	All processes are in the South Lagoon and would require entry into the lagoon if maintenance was required.	0.6	3.0	MBBR system is contained in a aeration tank. Aeration system is located in South Lagoon	1.8	4.0	SAGR system is completely underground and does not require/allow operators to enter. Aeration system is located in South Lagoon	2.4
2		**12.3**					**6.1**			**6.4**			**7.1**
2.1	Alignment with Community Values - Degree to which the technology aligns with the community's environmental and cultural goals	3.0	0.6	Average Score provided to all. All technologies would protect the County's environment.	2.5		1.5	2.5		1.5	2.5		1.5
2.2	Indigenous Considerations - Potential impacts on Indigenous lands, rights, and cultural sites	3.2	0.6	New process will be contained within existing plant footprint therefore limiting the impacts to Indigenous land and cultural sites. Average score provided to all.	2.5		1.6	2.5		1.6	2.5		1.6
2.3	Cultural Heritage and Aesthetic Impact - Visual impact and potential effects on local historical and cultural sites	3.0	0.6	New process will be contained within existing plant footprint. Average Score provided to all.	2.5	New process will be contained within existing plant footprint.	1.5	2.5	New process will be contained within existing plant footprint.	1.5	2.5	New process will be contained within existing plant footprint.	1.5
2.4	What level of direct & indirect new employment will derive from the scenario?	3.0	0.6	1 - Only Local Labour 3 - Local Labour and some local materials 5 - Local Labour and some local materials	2.5	Local Labour may be used for construction	1.5	3.0	Local Labour may be used for construction	1.8	4.0	Significant volume of local Materials (stones, mulch) would be required to construct the SAGR beds. Local Labour may be used for construction	2.4
Grand Total		**100**					**68.2**			**74.4**			**77.5**