AECOM

Appendix G

Preliminary Screening Detailed Results

Table 1 Preliminary Screening Results – Particulate Removal Technologies

Alternative Particulate Removal Technologies	Preliminary Screening Observations and Comments	Short-Listed	
		Yes	No
Conventional Treatment (coagulation/flocculation/ clarification followed by granular media filtration)	**Compliance:** As a treatment alternative, this option is able to comply with the treatment objectives set up for the Burloak WPP expansion; however, the use of alum in the coagulation process could potentially result in treated water aluminum concentrations in excess of 100 µg/L, if coagulation chemistry is not optimized. It should be noted that 100 µg/L has been set as an operational guideline for Burloak WPP and is not considered a health-based standard. **Technical Feasibility:** Significant increase in operational complexity in the overall system and monitoring requirements due to the presence of two separate and different sub-plants (existing membrane plant and new conventional treatment plant). Introduction of various and new treatment processes that require chemistry/operator attention for water quality variations, new chemical systems, different backwash procedures, and residue management requirements. In the case of high rate ballasted flocculation clarifiers, the process will result in a significant increase in residuals as the process is operated with a coagulant, polymer and micro-sand. Overall, the use of conventional treatment will result in an increased reliance on process control for successful operation of the system. **Capacity:** If the treatment comprises coagulation/flocculation/gravity clarification using plate settlers and granular media filtration, the required footprint for this option could be provided within the existing site to the capacity required for Phase 4 expansion (220 ML/d). If the treatment comprises ballasted floc clarifiers and granular media filtration, the design capacity required for Phase 4 expansion (220 ML/d) can be accomplished in terms of footprint without extending beyond the existing boundaries. **Summary:** Conventional treatment is able to satisfy the preliminary screening criteria in terms of compliance and technical feasibility. ***However, with respect to capacity and assuming that plate settlers will be used for clarification purposes, the use of conventional treatment will not allow the Region to meet the design and ultimate site capacity within the existing site boundaries. Alternatively, based on the assumption that ballasted floc clarifiers will be used in the clarification step, then conventional treatment will be able to meet the design and ultimate site capacity within the existing site boundaries. Therefore, conventional treatment using ballasted floc clarifiers will be considered as a feasible particulate removal technology.***	✓	
Direct Filtration (coagulation/flocculation followed by granular media filtration)	**Compliance:** As a treatment alternative, this option is able to comply with the treatment objectives set up for the Burloak WPP expansion; however, the use of alum in the coagulation process could potentially result in treated water aluminum concentrations in excess of 100 µg/L, if coagulation chemistry is not optimized. It should be noted that 100 µg/L has been set as an operational guideline for Burloak WPP and is not considered a health-based standard. This alternative does not provide a multi-barrier approach for physical removal as the clarification process does not exist. **Technical Feasibility:** Direct filtration is a technology used for source waters where turbidity is consistently ≤ 5 NTU. Based on the turbidity model validation sampling completed by Gartner Lee Limited in 2003, in the vicinity of the proposed intake location, turbidity concentrations of 3 and 4 NTU were frequently reported (at the sampling time). Additionally, turbidity measurements close to 100 NTU were also reported for one sampling station (SW7-Bronte Harbour) at various depths. The applicability of this technology from a technical and operational standpoint would be compromised based on the sampled turbidity levels reported in the past. The pathogen barrier would not be robust during potential episodes of high raw water turbidity and filter runs would become so short that it would be impossible to maintain production targets. Significant increase in operational complexity in the overall system and monitoring requirements due to the presence of two separate and different sub-plants (existing membrane plant and new direct filtration plant).		×

Alternative Particulate Removal Technologies	Preliminary Screening Observations and Comments	Short-Listed	
		Yes	No
	Introduction of various and new treatment processes that require higher chemistry/operator attention for water quality variations (when compared to conventional treatment), new chemical systems, different backwash procedures, and residue management requirements. Overall, there is an increased reliance on process control for successful operation of the direct filtration treatment system. **Capacity:** Since direct filtration does not require the construction of clarifiers, this option is capable of meeting the capacity criteria for the plant design capacity. **Summary:** Consistent with the turbidity results reported by Gartner Lee Limited in August 2003, it can be concluded that the pathogen barrier would not be robust and that production targets would not be able to be maintained during potential episodes of high raw water turbidity, thus, system reliability during these episodes may be compromised. Therefore, direct filtration will not be considered a feasible particulate removal technology for this project and is eliminated from further consideration.		
Membrane Filtration	**Compliance:** As a filtration technology, membrane filtration is able to meet or exceed comfortably the treatment objectives set up for the Burloak WPP expansion. **Technical Feasibility:** Membrane filtration is compatible with the existing treatment processes. The performance reliability of the system is expected to be consistent regardless of the variability of the source water quality; therefore, the filtration technology provides robustness to the overall system. **Capacity:** Membrane filtration provides the ability to meet comfortably the design capacity for the plant of 220 ML/d. **Summary:** Membrane filtration is able to meet all the preliminary screening criteria in terms of compliance, technical feasibility and capacity. Considering that the existing Burloak WPP already has membrane technology as the filtration process, there are embedded technical and operational benefits that this technology has to offer if implemented for the future capacity expansions of the plant. ***Therefore, membrane filtration will be considered as a feasible particulate removal technology.***	✓	

Table 2 Preliminary Screening Results – Disinfection Technologies

Alternative Disinfection Technologies	Preliminary Screening Observations and Comments	Short-Listed	
		Yes	No
Chlorination (alone)	**Compliance:** Chlorine can be used to provide virus and *Giardia* inactivation, but an additional disinfectant needs to be provided to achieve the 0.5-log *Cryptosporidium* inactivation required by the Region's overall disinfection objectives. Chlorine can produce disinfection by-products (DBPs); hence continuous monitoring of DBPs should be practiced. **Technical Feasibility:** The existing system uses chlorine for primary disinfection purposes outside of the T&O season (when ozonation is not practiced); therefore, there is no compatibility issues anticipated from implementation of this option or additional operational, maintenance or monitoring requirements. **Capacity:** Not applicable since chlorine alone on the existing site cannot achieve the required inactivation of *Cryptosporidium*. **Summary:** Chlorination alone cannot meet the multi-barrier treatment objective for Cryptosporidium inactivation, and thus, cannot be considered as an option for primary disinfection.		×
UV Irradiation (alone)	**Compliance:** UV alone is able to meet or exceed the treatment objectives for *Cryptosporidium* and *Giardia*; however, the required credits of at least 2.0 to 4.0-log virus inactivation cannot be provided given the typical UV dosages; and thus, chlorine (or ozone) will be needed. **Technical Feasibility:** The existing system uses UV to provide a minimum of 1.0-log *Cryptosporidium* and *Giardia* inactivation; therefore, there is no compatibility issues anticipated from implementation of this option or additional operational, maintenance or monitoring requirements. UV with hydrogen peroxide can oxidize T&O compounds, so the same technology can be used for two separate treatment objectives. **Capacity:** Not applicable UV irradiation alone cannot achieve the minimum requirement of 2.0 log virus inactivation. **Summary:** UV irradiation alone cannot meet the treatment objective for virus inactivation, and thus, cannot be considered as a feasible primary disinfection technology.		×
UV Irradiation (with chlorine)	**Compliance:** The combination of UV with chlorine will continuously meet and exceed the treatment objectives established for the Burloak WPP. Chlorine can produce disinfection by-products (DBPs); hence continuous monitoring of DBPs should be practiced. Technical Feasibility: The existing Burloak WPP has been designed to provide the required *Giardia* and *Cryptosporidium* inactivation through UV disinfection. The required virus inactivation in the existing plant is achieved by ozonation during the T&O season and by chlorination during the remainder of the year. Therefore, implementation of this option (UV with chlorine) will be fully compatible with the existing practices at the plant and consequently would not represent any issues in terms of operational complexity, system reliability or operation and maintenance requirements. UV with hydrogen peroxide can oxidize T&O compounds, so the same technology can be used for two separate treatment objectives. **Capacity:** Implementation of UV with chlorine provides the project with the ability to meet the capacity required for Phase 4 expansion (220 ML/d). By incorporating a technology in the treatment train that is able to provide a dual benefit (e.g., disinfection and taste & odour control), space needs for an additional treatment process are minimized and consequently, the overall footprint requirement is reduced.	✓	

Alternative Disinfection Technologies	Preliminary Screening Observations and Comments	Short-Listed	
		Yes	No
	Summary: UV irradiation in combination with chlorination as a primary disinfection technology allows the project to meet comfortably the criteria from a compliance, technical and capacity requirements perspective. ***Therefore, UV irradiation in combination with chlorination will be considered as a feasible primary disinfection technology.***		
Ozonation (alone)	**Compliance:** Ozone will continuously meet and exceed the treatment objectives established for the Burloak WPP. Ozone can produce bromate and assimilable organic carbon, hence continuous monitoring of these parameters should be practiced. **Technical Feasibility:** Existing system comprises use of ozonation for virus inactivation during the Taste & Odour season; therefore, implementation of this option will be fully compatible with the existing practices at the plant and consequently would not represent any issues in terms of operational complexity, system reliability or operation and maintenance requirements. Although ozone is short-lived and must be generated on-site, this practice is currently employed at the plant; thus system reliability and security of supply will not be compromised. Ozone can oxidize organic compounds including T&O compounds, so the same technology can be used for two separate treatment objectives. **Capacity:** Implementation of ozone for primary disinfection allows the project to meet the capacity required for Phase 4 expansion (220 ML/d). By incorporating a technology in the treatment train that is able to provide a dual benefit (e.g. disinfection and taste & odour control), space needs for an additional treatment process are minimized and consequently, the overall footprint requirement is reduced. **Summary:** Ozonation as a primary disinfection technology allows the project to meet comfortably the criteria from a compliance, technical and capacity requirements perspective. ***Therefore, it will be considered as a feasible primary disinfection technology.***	✓	

Table 3 Preliminary Screening Results – Taste & Odour (T&O) Control Technologies

Alternative Taste & Odour Control Technologies	Preliminary Screening Observations and Comments	Short-Listed	
		Yes	No
Ozonation	**Compliance:** Ozone will continuously meet and exceed the treatment objectives established for the Burloak WPP. Ozone can produce bromate and assimilable organic carbon, hence continuous monitoring of these parameters should be practiced. **Technical Feasibility:** Existing system comprises use of ozonation for virus inactivation during the Taste & Odour season; therefore, implementation of this option will be fully compatible with the existing practices at the plant and consequently would not represent any issues in terms of operational complexity, system reliability or operation and maintenance requirements. Although ozone is short-lived and must be generated on-site, this practice is currently employed at the plant; thus system reliability and security of supply will not be compromised. Ozone can also provide primary disinfection, so the same technology can be used for two separate treatment objectives. **Capacity:** Implementation of ozone for T&O control allows the project to meet the capacity required for Phase 4 expansion (220 ML/d). By incorporating a technology in the treatment train that is able to provide a dual benefit (e.g., disinfection and taste & odour control), space needs for an additional treatment process are minimized and consequently, the overall footprint requirement is reduced. **Summary:** Ozonation as a T&O control technology allows the project to meet comfortably the criteria from a compliance, technical and capacity requirements perspective. ***Therefore, it will be considered as a feasible T&O control technology.***	✓	
UV-Advanced Oxidation (UV with Hydrogen Peroxide)	**Compliance:** UV-Advanced oxidation will continuously meet and exceed the treatment objectives established for the Burloak WPP. **Technical Feasibility:** UV is compatible with the existing practices at the plant and consequently would not represent any issues in terms of operational complexity, system reliability or operation and maintenance requirements. There is currently space within the chemical building that has been allocated for the future installation of hydrogen peroxide to be used with ozonation to provide advanced oxidation if needed. Thus, there was already planning for the future use of hydrogen peroxide on-site. UV irradiation will also provide primary disinfection, so the same technology can be used for two separate treatment objectives. **Capacity:** Implementation of UV with hydrogen peroxide provides the project with the ability to meet the capacity required for Phase 4 expansion (220 ML/d). By incorporating a technology in the treatment train that is able to provide a dual benefit (e.g., disinfection and taste & odour control), space needs for an additional treatment process are minimized and consequently, the overall footprint requirement is reduced. There is provision within the existing chemical building for the future installation of hydrogen peroxide storage and feed equipment to provide advanced oxidation as discussed above. However, the need for quenching of hydrogen peroxide with chlorine and/or GAC will add footprint as well as considerable additional costs. **Summary:** UV-Advanced oxidation as a T&O control technology allows the project to meet comfortably the criteria from a compliance, technical and capacity requirements perspective. ***Therefore, it will be considered as a feasible T&O control technology.***	✓	
Powdered Activation Carbon (PAC)	**Compliance:** There are no issues in terms of compliance. **Technical Feasibility:** Introduction of a new chemical results in increased operational complexity. Dust resulting from the small particles of PAC makes handling of the chemical difficult and not highly regarded amongst operators. Additional structures need to be built to house new chemical feeding and dosing systems affecting the footprint at the site.		×

Alternative Taste & Odour Control Technologies	Preliminary Screening Observations and Comments	Short-Listed	
		Yes	No
	High impact on residuals management, as residual generation increases when PAC is being used. This would have an impact on the solids loadings of the process wastewater, and potentially limit the ability to discharge to the storm sewer due to exceedance of TSS of 15 mg/L. Compatibility with the existing membrane plant and other types of membranes would need to be determined as it could potentially foul/stress the membranes. **Capacity:** Implementation of PAC for T&O control allows the project to meet the capacity required for Phase 4 expansion (220 ML/d). **Summary:** There are significant limitations offered by this technology in terms of technical issues. The overall impact to the residuals management facility due to the large quantities of sludge produced as well as the increased operational difficulty resulting from handling of this chemical are major considerations that render this option unfeasible. In addition, PAC could potentially foul/stress membranes if membrane filtration is selected as the preferred technology. As a result, PAC will not be considered as a feasible T&O control technology.		
Granular Activated Carbon (GAC)	**Compliance:** Operation of GAC contactors results in constant depletion of GAC adsorption capacity, which in turn may result in scenarios where the appropriate level of T&O control cannot be provided. **Technical Feasibility:** GAC contactors would be provided as stand-alone filters added to the treatment train. This would result in a new process adding complexity to existing operational, maintenance and monitoring practices at the plant. Design of GAC contactors would incorporate filtration and adsorption capabilities in a way that dual functionality is provided by removing particulate as well as removing T&O causing compounds and DBP precursors, so the same technology can be used for multiple end uses. **Capacity:** A deep filter/adsorber GAC contactor design would allow the project to meet the capacity required for Phase 4 expansion (220 ML/d). **Summary:** The continuous operation of the GAC filters results in constant depletion of GAC adsorption capacity, which in turn may result in scenarios where the appropriate level of T&O control cannot be provided. ***As such, the ability to continuously meet or exceed the proposed treatment objective for T&O and provide a multi-barrier approach could be compromised from a Region's compliance perspective due to the potential for the GAC capacity to be used up at times of T&O episodes, and thus, cannot be considered as an option for T&O control.***		x

Table 4 Preliminary Screening Results – Residuals Treatment Technologies

Alternative Residuals Treatment Technologies	Preliminary Screening Observations and Comments	Short-Listed	
		Yes	No
Sludge Clarification/Thickening Technologies			
Crude Sedimentation	**Technical Feasibility:** Performance and reliability of these systems is not affected by seasonal climatic conditions expected to be experienced; therefore, extreme changes in climate are not an issue. From an operational perspective, the sludge produced is fairly watery and can only be discharged to a sewer or lagoon. Additional thickening is required before sludge is transferred to a mechanical dewatering process. The need for additional thickening equipment results in added footprint currently constrained by existing site. This technology relies on gravity settlement of the sludge; therefore, the floor area of these tanks has to be large enough to provide adequate time for the solids to settle to the floor of the basins. As such, crude sedimentation requires a surface area significantly larger than that needed with other available high rate thickening technologies. This technology has a proven track record. **Summary:** Crude sedimentation would require a very large footprint to provide proper sludge settling. Besides crude sedimentation basins, an additional thickening system needing additional footprint will be required. ***Given the space limitations on-site and the large footprint requirement, this option is eliminated from further consideration.***		×
Gravity Sedimentation/ Thickening	**Technical Feasibility:** Performance and reliability of these systems is not affected by seasonal climatic conditions expected to be experienced; therefore, extreme changes in climate are not an issue. From an operational perspective, this technology also relies on gravity settlement of the sludge; however, as they are usually operated on a continuous basis, they perform better than crude sedimentation basins as they are able to reach a steady state operation. Based on typical hydraulic loadings for this system, the required footprint for gravity sedimentation/thickening as well as footprint required for ancillary equipment can fit within the existing site. However, when comparing gravity sedimentation/thickeners to plate settler sedimentation/thickeners (discussed below), this latter option is a similar technology that provides a comparable performance at a similar cost but with a smaller requirement for footprint as the use of the plate settlers allows for a much higher design loading rates. This technology has a proven track record. **Summary:** Gravity sedimentation/thickening technology is able to satisfy all screening criteria in terms of ability to operate under existing climatic conditions, required footprint, proven track record, and ease of operation. ***However, since available space within the site is such an important constraint in this project, it has been judged that better benefits would be obtained by using plate settlers' clarification/thickening; which is a similar technology that would provide similar performance at a comparable cost but with smaller footprint requirements. On this basis, gravity sedimentation/thickening technology is excluded and will not be considered a feasible clarification/thickening technology.***		×
Plate Settlers Clarification/Thickening	**Technical Feasibility:** Performance and reliability of these systems is not affected by seasonal climatic conditions expected to be experienced; therefore, extreme changes in climate are not an issue. From an operational perspective, this technology allows for a consistently good supernatant quality to be achieved, while also allowing the thickener to be designed at a high surface loading rate. The use of plate settlers within the clarification portion of the basins allows for much higher design loading rates. This means that a reduction in space requirements can be achieved, and in terms of sludge thickening, a thicker sludge can be produced. As such, the required footprint for this system as well as the footprint for ancillary equipment fits well within the existing site.	✓	

Alternative Residuals Treatment Technologies	Preliminary Screening Observations and Comments	Short-Listed	
		Yes	No
	This technology has a proven track record. **Summary:** Plate settlers' clarification/thickening technology is able to satisfy all screening criteria in terms of ability to operate under existing climatic conditions, required footprint, proven track record, and ease of operation. ***As such, plate settlers' clarification/thickening technology will be considered a feasible clarification/thickening technology.***		
Dissolved Air Flotation (DAF) Clarification/Thickening	**Technical Feasibility:** Performance and reliability of these systems is not affected by seasonal climatic conditions expected to be experienced; therefore, extreme changes in climate are not an issue. From an operational perspective, DAF clarifier/thickeners consist of more mechanical equipment than the other options, which results in intensified operational and maintenance requirements. The produced sludge is of very thick consistency which can be problematic when pumped to the sewer; however, it eliminates an additional thickening process required prior to pumping to a dewatering technology. The use of fine air bubbles to the liquid phase induces the solids-liquid separation in the system, which allows for a much higher design loading rates. This means that a reduction in space requirements can be achieved. As such, the required footprint for this system as well as the footprint for ancillary equipment fits well within existing site. This technology has a proven track record. **Summary:** DAF clarification/thickening technology is able to satisfy all screening criteria in terms of ability to operate under existing climatic conditions, required footprint, proven track record, and ease of operation. ***As such, DAF clarification/thickening technology will be considered a feasible clarification/thickening technology.***	✓	
Actiflo® Clarification/Thickening	**Technical Feasibility:** Performance and reliability of these systems is not affected by seasonal climatic conditions expected to be experienced; therefore, extreme changes in climate are not an issue. From an operational perspective, the raw waste tends to be watery; thus, additional thickening is required for dewatering. The need for additional thickening equipment results in added footprint currently constrained by the existing site. Since this technology relies on the use of polymers and micro-sand for performance, it hinders the recycling of the supernatant as a viable option for this project for the existing membrane treatment train (and future membrane treatment train if membrane filtration is determined to be the preferred filtration technology). The use of the micro-sand and the polymer allows the process to achieve a better performance while using high loading rates. This means that a reduction in space requirements can be achieved and that the required footprint for this system can be fit within the existing site. However, given that the raw waste tends to be watery, additional thickening is required for dewatering. The need for additional thickening equipment results in added footprint currently constrained by the existing site. This technology has a proven track record. **Summary:** The watery composition of the raw waste resulting from the Actiflo® Clarification/Thickening means that an additional thickening system is needed that will provide additional footprint. Since this technology relies on the use of polymers and micro-sand for performance, it hinders the recycling of the supernatant as a viable option for this project for the existing membrane treatment train. ***Given the space limitations on-site and the large footprint requirement as well as the potential for recycling of supernatant, this option is eliminated from further consideration.***		×
Sludge Dewatering and Drying Technologies			
Sand Drying Beds	**Technical Feasibility:** Under winter conditions, the low and wet temperatures will not allow for sludge dewatering in the shallow basins, thus, provision must be made to store sludge during these seasons. As a result, this technology would be rendered ineffective for dewatering/drying during the cold season. From an operational perspective, a large operational effort will be required to remove the dried sludge from the surface as the areas of the beds are expected to be relatively large.		×

Alternative Residuals Treatment Technologies	Preliminary Screening Observations and Comments	Short-Listed	
		Yes	No
	Based on the typical solids loadings, the area of the beds will be relatively large, which is inconsistent with existing area limitations onsite. This technology is not commonly used in Canada due to the presence of long and cold winter months, thus, operators are not typically familiar with it. **Summary:** Sand drying beds as a dewatering/drying technology present significant limitations in terms of their ability to perform well under all weather conditions as well as the large footprint requirement. On this basis, sand drying beds will not be considered a feasible dewatering/drying technology.		
Solar Drying Beds	**Technical Feasibility:** Removal of water is expected to occur from decanting and solar evaporation from the beds. Given the cold weather conditions expected on site during the winter months, evaporation will not occur during the cold season. As a result, this technology would be rendered ineffective for dewatering/drying during the cold season. From an operational perspective, heavy machinery could be used to process sludge, so they are not as operator intensive as sand drying beds. The area of these beds is expected to be double than that of the sand drying beds, which is inconsistent with existing area limitations onsite. This technology is not commonly used in Canada due to the presence of long and cold winter months, thus, operators are not typically familiar with it. **Summary:** Solar drying beds as dewatering/drying technology present significant limitations in terms of their ability to perform well under all weather conditions as well as the large footprint requirement. On this basis, Solar drying beds will not be considered a feasible dewatering/drying technology.		x
Sludge Dewatering Lagoons	**Technical Feasibility:** The dewatering function of the sludge dewatering lagoons cannot be provided during the winter months; as a result, this technology would be rendered ineffective during the cold season. From an operational perspective, heavy machinery could be used to process sludge. As a result, sludge dewatering lagoons are not as operator intensive as sand drying beds. Sludge dewatering lagoons are sized to allow several months of storage of sludge, resulting in very large footprint requirements, which is inconsistent with existing area limitations onsite. This technology is not commonly used in Canada due to the presence of long and cold winter months, thus, operators are usually not familiar with this type of technology. **Summary:** Sludge dewatering lagoons as dewatering/drying technology present significant limitations in terms of their ability to perform well under all weather conditions as well as the large footprint requirement. On this basis, sludge dewatering lagoons will not be considered a feasible dewatering/drying technology.		x
Freeze/Thaw Lagoons	**Technical Feasibility:** Freeze/thaw lagoons are most suitable for locations that experience long and cold winters as this maximizes the time for sludge freezing to occur. During the remainder of the year, the lagoons operate as conventional sand drying beds; therefore, performance of these types of lagoons will not be affected by expected climatic conditions. In order to achieve successful operation of the lagoons, the complete freezing of each layer must be guaranteed before a subsequent layer is added to the basins in winter time. Halton winters are not long enough to make this technology viable for this project. The accumulated sludge is removed annually after the thaw in late winter; therefore, sufficient storage area in the lagoons must be provided to allow the solids to accumulate during the spring, summer and autumn months. The large footprint required for these lagoons is inconsistent with existing area limitations onsite.		x

Alternative Residuals Treatment Technologies	Preliminary Screening Observations and Comments	Short-Listed	
		Yes	No
	Successful operation of these lagoons has been reported for a number of water treatment plants in Canada where weather conditions are appropriate. **Summary:** Freeze/Thaw lagoons as a dewatering/drying technology are not a viable technology for this project since the Halton winters are not long enough to ensure complete freezing of the layers. Additionally, this technology presents significant limitations in terms of the large footprint requirement. On this basis, freeze/thaw Lagoons will not be considered a feasible dewatering/drying technology.		
Centrifuges	**Technical Feasibility:** Performance and reliability of these systems is not affected by seasonal climatic conditions expected to be experienced; therefore, extreme changes in climate are not an issue. From an operational perspective, centrifuges generally achieve higher solids concentrations than other dewatering technologies (e.g. beds and lagoons) with a resulting sludge cake of good consistency for sludge haulage and disposal. Centrifuges also require small amount of operation attention when operation conditions are stable and operational requirements can be modified through changes in polymer dosages. The footprint required by centrifuges is relatively small, which is consistent with existing area limitations onsite. Experience operating the equipment is required to optimize performance; however, centrifuges are widely used in water treatment residuals management applications across Canada. **Summary:** Centrifuges as a dewatering/drying technology is able to satisfy all screening criteria in terms of ability to operate under existing climatic conditions, required footprint, proven track record, and ease of operation. ***As such, this technology will be considered a feasible dewatering/drying technology.***	✓	
Belt Filter Presses	**Technical Feasibility:** Performance and reliability of these systems is not affected by seasonal climatic conditions expected to be experienced; therefore, extreme changes in climate are not an issue. From an operational perspective, belt filter presses generally achieve sludge cake of good consistency for sludge haulage and disposal. Maintenance is relatively simple, and can be started and shut down quickly compared to centrifuges; however, belt washing at the end of each cycle can be time consuming and require large amounts of water, thus being labour intensive to operate. The footprint required by belt filter presses is relatively small, which is consistent with existing area limitations onsite. This technology has a proven track record. **Summary:** Belt filter presses as a dewatering/drying technology is able to satisfy all screening criteria in terms of ability to operate under existing climatic conditions, required footprint, proven track record, and ease of operation. ***As such, this technology will be considered a feasible dewatering/drying technology.***	✓	
Static Filter Presses (Plate and Frame)	**Technical Feasibility:** Performance and reliability of these systems is not affected by seasonal climatic conditions expected to be experienced; therefore, extreme changes in climate are not an issue. Plate and frame filter presses are among the most effective means to dry sludge, capable of producing sludge cakes suitable for landfill. However this technology only works in batch sequence and it is extremely labour intensive as operators need to ensure that the cake is released properly from the presses at the end of every batch. Static filter presses require relatively large footprints, which is not competitive when compared to other dewatering/drying technologies that require small footprint (e.g. centrifuges and belt filter presses). Its application is very common in Europe and Asia but rare in Canada as result of less expensive Canadian sludge tipping fees when compared to Europe and Asia, which generally results in the adaptation of other technologies for economical reasons.		×

Alternative Residuals Treatment Technologies	Preliminary Screening Observations and Comments	Short-Listed	
		Yes	No
	Summary: Static filter presses as dewatering/drying technology present significant limitations for this project in terms of their operational complexity as well as the lack of track proven record in Canada. On this basis, static filter presses will not be considered a feasible dewatering/drying technology.		
Membrane Filtration Technology			
Secondary Membrane Filtration	**Technical Feasibility:** Performance and reliability of these systems is not affected by seasonal climatic conditions expected to be experienced; therefore, extreme changes in climate are not an issue. This process reduces the amount of wastewater (liquid or solid) to be discharged off-site as the treated wastewater can be recycled to the head of the plant or discharged into the distribution system (with UV disinfection), thus increasing the overall plant treatment efficiency . From an operational perspective, operators would be able to directly apply their knowledge and practices from the existing membrane system. The resulting dilute liquid waste (~0.5% of total plant raw water) would be discharged to the sanitary sewer. Membranes use extremely high loading rates and require the smallest footprint from all thickening technologies. Considering the constraints onsite in terms of available area, this option provides high benefits. Technology already exists on-site for the main process treatment, providing technology familiarity to the operators and sharing of processes. **Summary:** Secondary membrane filtration technology is able to satisfy all screening criteria in terms of ability to operate under existing climatic conditions, required footprint, proven track record, and ease of operation. ***As such, this technology will be considered as a feasible residual technology.***	✓	