16.0 WATER SUPPLY

16.1 Sources

The project will require both potable domestic water for drinking, fish processing, and process water for salmon rearing. Based on the changing environmental needs of salmon through their life cycle, process water will include freshwater and a larger component of saltwater sources. Freshwater sources are proposed to include an on-site groundwater extraction well network, additional off-site supply from the BWD, and on-site surface water withdrawal from Belfast Reservoir Number One. The proposed 250 gallons per minute (gpm) surface water withdrawal rate represents 50% less than 500 gpm historically used for almost a century when this reservoir was the primary drinking water supply for Belfast. Saltwater is proposed to be obtained from Belfast Bay through a seawater intake and pipeline. Collectively, the project is anticipated to use approximately 1,735,200 gallons of freshwater per day (1,205 gpm) and 5,652,000 gallons of saltwater per day (3,925 gpm) on a continuous basis at full operational capacity. The anticipated water usage distribution is summarized below in **Table 16-1**.

Table 16-1: **Anticipated Project Water Usage at Full Operational Capacity**

Planned Use	Composition	Source	Usage Rate
Domestic	Freshwater	Belfast Water District Municipal Supply	238 gpm 342,720 gpd
Process	Freshwater	Belfast Water District Municipal Supply	262 gpm 377,280 gpd
Process	Freshwater	On-Site Groundwater Well Network	455 gpm 655,200 gpd
Process	Freshwater	Belfast Reservoir Number One Surface Water Withdrawal	250 gpm 360,000 gpd
Process	Saltwater	Belfast Bay Ocean Pipeline	3,925 gpm 5,652,000 gpd

gpm = gallons per minute; gpd = gallons per day.

Usage rates for freshwater sources were selected based on hydrogeologic investigations, research, and modeling detailed in the 2019 Hydrogeologic Investigation Report by Ransom Consulting, Inc. included previously in Section 15 as **Appendix 15-A**. The BWD has the ability to provide the project up to 500 gpm as stipulated in the signed January 29, 2018 Water Supply and Purchase Agreement between Nordic and BWD (**Appendix 16-A**), the March 7, 2019 Capacity to Serve letter from BWD (**Appendix 16-B**), and as approved by the Maine Public Utilities Commission (**Appendix 16-C**). The anticipated surface water withdrawal of 250 gpm is based on rules set forth in Maine Department of Environmental Protection (MEDEP) Chapter 587 allowing for a withdrawal of 70 gpm plus inflows to Belfast Reservoir Number One (also known as the Lower Reservoir). In order to account for inflows into Belfast Reservoir Number One in the planning process, a rate of 250 gpm is presented in **Table 16-1** as a conservative estimate of the baseflow of the Little River. This rate is derived from the estimated 5% duration flow of the Little River. For a detailed discussion of the hydrology of the Little River watershed, the proposed surface water withdrawal, the BWD resources, and the proposed groundwater withdrawal please refer to **Appendix 15-A**.

The saltwater needs for the facility will be drawn from Penobscot Bay using two parallel 30-inch diameter pipelines which extend approximately 6,400-feet from the shore access point to the intake point. The saltwater intake structures will be located about 10-feet above the seafloor and will feature 1-inch screen mesh to prevent entrainment of larger particulates or sea life. The pipelines will transport saltwater to a pump station located beneath the water treatment plant. Refer to drawings **CS101-CS104**, **CS301**, **CS501-CS505** and **M-100**, included herein as **Appendix 16-D**, for pipeline and pump station design details. Further description of the construction of the intake water system can be found in Section 1.

The water usage rates presented above in **Table 16-1** are anticipated to be reliable and sustainable water supply sources at the proposed usage rates. However, should water supply sources, particularly groundwater and surface water sources, require changes to the proposed withdrawal rates during operation (e.g. inflow to Belfast Reservoir Number One falls well below estimated baseflow), the project has been designed with the flexibility to account for decreased fresh process water by increasing saltwater intake rates and increasing the salinity of the process water. Similarly, as discharge from the Little River into Belfast Reservoir Number One increases above baseflow, groundwater withdrawals can be slowed and more of the total process water can be supplied by surface water. This flexibility provides considerable operation leeway to allow for system maintenance (e.g. well maintenance or repairs) and hydrologic variability (e.g. decreased surface water inflows) without undue risk to overall facility production.

16.2 Treatment

The Intake Water Treatment Plant (IWTP) is placed above the pumping station and receives both freshwater and seawater from all four sources for treatment. The IWTP is designed and installed for full Phase 2 build out, with a total flow capacity of about 5,130 gallons per minute (gpm), divided into 3,925 gpm seawater and 1,205 gpm freshwater in order to provide enough capacity for operations. It should be noted that for the freshwater intake design capacity of approximately 1,205 gpm only a maximum of 455 gpm will be drawn from the on-site wells. For the purpose of clarity **Figure 16-1** is included below showing the proposed piping and instrumentation diagram (P&ID) for the intake water treatment system.

16.2.1 Well and Surface Water Treatment System Description

The treatment system being considered is for the freshwater drawn from the bedrock wells and the surface water drawn from the lower reservoir, the municipal freshwater is subjected to a different treatment process described later. The well and surface water treatment system consists of four key functions:

- **Aeration**: removal of N_2/CO_2 gas super-saturation and oxidize metal ions (Fe, Al etc.) for precipitation and removal in subsequent fine filtration steps.
- **Filtration**: Removal of fine particles and precipitated metals.
- **Ozonation**: Color removal to ensure high UV-transmittance for correct dosing in the UV sterilization.
- **Sterilization**: UV-C sterilization of intake water, 250-300 mJ/cm2 @ UVT > 85%.

Water will be drawn from the bedrock aquifer via a system of 3 wells, with an estimated maximum withdrawal of 250 gpm, 175 gpm, and 30 gpm respectively, given a total well water withdrawal of 455 gpm. Further details of the study conducted to arrive at these estimates can be found in the hydrogeologic investigation report conducted by Ransom Consulting, Inc. and included in this permit application (**Appendix 15-A**). The drawdown of each well will be monitored throughout operation to ensure excessive depletion of the bedrock aquifer does not occur; furthermore, a plan to monitor private wells on neighboring properties has been proposed; however, the extent of this monitoring will depend on owner participation.

The intake well water will be combined with the withdrawn surface water prior to entering the first filtration step. The intake freshwater will be passed through a 10-micron drum filter. Downstream of the drum filter the flow rate, temperature, and pH will be measured. The water will be pumped into two degassing/aeration towers to effectively remove excess carbon dioxide and nitrogen gas from the water phase as well as oxidize iron and manganese. After the aeration/degassing, water is filtered through fixed-bed filters for fine particle removal with automated backwash systems in place. Redundancy in filter sizing is incorporated to enable full capacity with one filter taken out for backwashing and cleaning. Following removal of solids and metals, the water will be treated with ozone in a concrete contact chamber with baffles as a security against a shift in the water resource that could cause coloration that would reduce the down-stream UV-sterilization step.

Post UV treatment, the treated well and surface water is combined with the treated municipal water and distributed between two buffer tanks. Prior to entering each of the buffer tanks the water will again be monitored for proper temperature, flow rate, and composition. The buffer tanks are plumbed inline, one with an approximate size of 100 m^3 containing only treated freshwater, and the other approximately 550 m^3 containing a mixture of treated freshwater and saltwater. From these tanks the water is distributed between the smolt and module buildings.

16.2.2 Municipal Water Treatment System Description

Municipal water from the BWD will be divided up between three major uses: process water for the Smolt and Grow-out Modules, domestic water for fish processing and packaging, and domestic water for personnel use. **Figure 16-1** shows the municipal water that is diverted for use as process water in the salmon-growing process. It is assumed that the entering city water is of drinking and food grade quality, however the temperature, flow rate, and pH of the entering municipal water will still be measured to verify no interruptions in its capacity or quality. The process municipal water will further be treated using an activated carbon filter for removal of chlorine, which is highly detrimental to the salmon. It is important to note that the municipal water to be used for the fish processing and employee use will not be subjected to chlorine removal and aside from the aforementioned monitoring will not be subject to additional treatment.

16.2.3 Seawater Treatment System Description

The saltwater pumped in from the pipeline intake structure will be subjected to a multiphase treatment process to ensure proper water quality and biosecurity. Referring again to **Figure 16-1** inlet seawater initially goes through a 10-micron drum filter, similar to that utilized for the freshwater intake, in order to remove fine particulates and increase water clarity. Following this initial filtration, the saltwater temperature, flow rate, and pH is measured to ensure quality and capacity is met. Like with the freshwater treatment system, the saltwater is passed through an ozonation unit to improve water clarity prior to being subjected to UV-treatment to sterilize the incoming water and prevent the passage of any harmful microorganisms into the process.

The treated saltwater passes through a mixing unit where it is combined with a portion of the treated freshwater to control the process water salinity. The combined salt/freshwater mixture is sent into an inline buffer tank, as previously described, which has a residence time of approximately 30 minutes before passing on to the smolt and grow-out facilities.

16.3 Distribution

The distribution of the water from the buffer tanks will be based on facility needs. The smolt units will require pure freshwater initially, with the salinity increasing as the salmon grow from eggs to smolt. The grow-out module units will utilize a balanced fresh/saltwater mixture that will be closely monitored to ensure cleanliness and consistency. The processing facility, administration building, and all plumbing for human use and consumption will be the primary use of municipal water, as the municipal chlorination disinfection treatment will be beneficial in these applications and ensure food grade standards are met. While some municipal water will be dechlorinated and diverted to the freshwater buffer tank for process use, all municipal water lines for personnel use will be isolated from the process lines. As with all aforementioned water sources, the municipal water entering the facility will be monitored closely to ensure expected cleanliness and quality.

The distribution of water throughout the facility from the buffer tanks will be almost entirely subterranean, and therefore at low risk of damage or contamination from environmental or human impacts. Should the water lines become damaged, broken, or blocked the area of concern will be quickly isolated from the rest of the system and necessary maintenance or replacement will be conducted. Reincorporation into the distribution system of any damaged or broken line will only occur when proper water quality is confirmed, which will be determined through flushing and regular sampling. Further detail of the water distribution layout for the facility can be seen in utility drawings **CU100-CU109, CU301-CU304, CU501-CU505,** and **CU601**, included herein as **Appendix 16-E**.

16.4 Maintenance

Maintenance of the water treatment and distribution system will be multifaceted and specific to each application. Throughout the extraction and treatment processes the water will be sampled and assessed using common metrics so that no source contaminants or equipment malfunction impacts the system. In the event of source contamination or interruption the inlet flow will either be greatly reduced or halted until it is deemed safe for regular operation to resume. Likewise, in addition to routine maintenance, contingency plans for each treatment unit will be implemented to address failures in the system. Careful monitoring and equipment redundancies will be implemented to mitigate risk of water quality degradation or process interruption.

The saltwater intake pipeline design recognizes the importance of maintaining an adequate flow of clean seawater to the facility. The proposed seawater intake structure’s inlets will be positioned approximately 10-feet above the seafloor. Each intake will include a removable top and inlet section comprised of a screened chamber that has a connection to the supporting base to allow removal of the top section for servicing or cleaning. When the connection is released, the top portion can be lifted from the water for maintenance and cleaning. The design also has provisions to remove marine growth accretion or settled solids from the intake pipes to maintain flow capacity. A pigging method will be routinely used to clean the seawater intake pipes and the effluent line. Pigging involves a device, referred to as the ‘pig,’ a bullet-shaped synthetic material with a diameter similar to the pipe bore. An ice pig comprised of injecting an ice slurry may also be used as an alternative. To maintain the pipe, the pig is inserted into the pipe at the pump station via chambers referred to as the “pig launcher” then water pressure is applied to propel the pig to the opposite end of the pipe where it exits and is retrieved. Material accumulation within the pipe is scrubbed from the pipe walls by the moving pig and the flow of water bypassing around the pig’s perimeter. Redundancy of the intake piping allows water to flow to the facility during these routine maintenance procedures.

16.5 Subsurface Wastewater Disposal

On-site subsurface wastewater disposal is not proposed as part of this development. Domestic wastewater will be disposed through the municipal sewer system and production wastewater will be discharged to Belfast Bay following treatment, as detailed in Section 17.

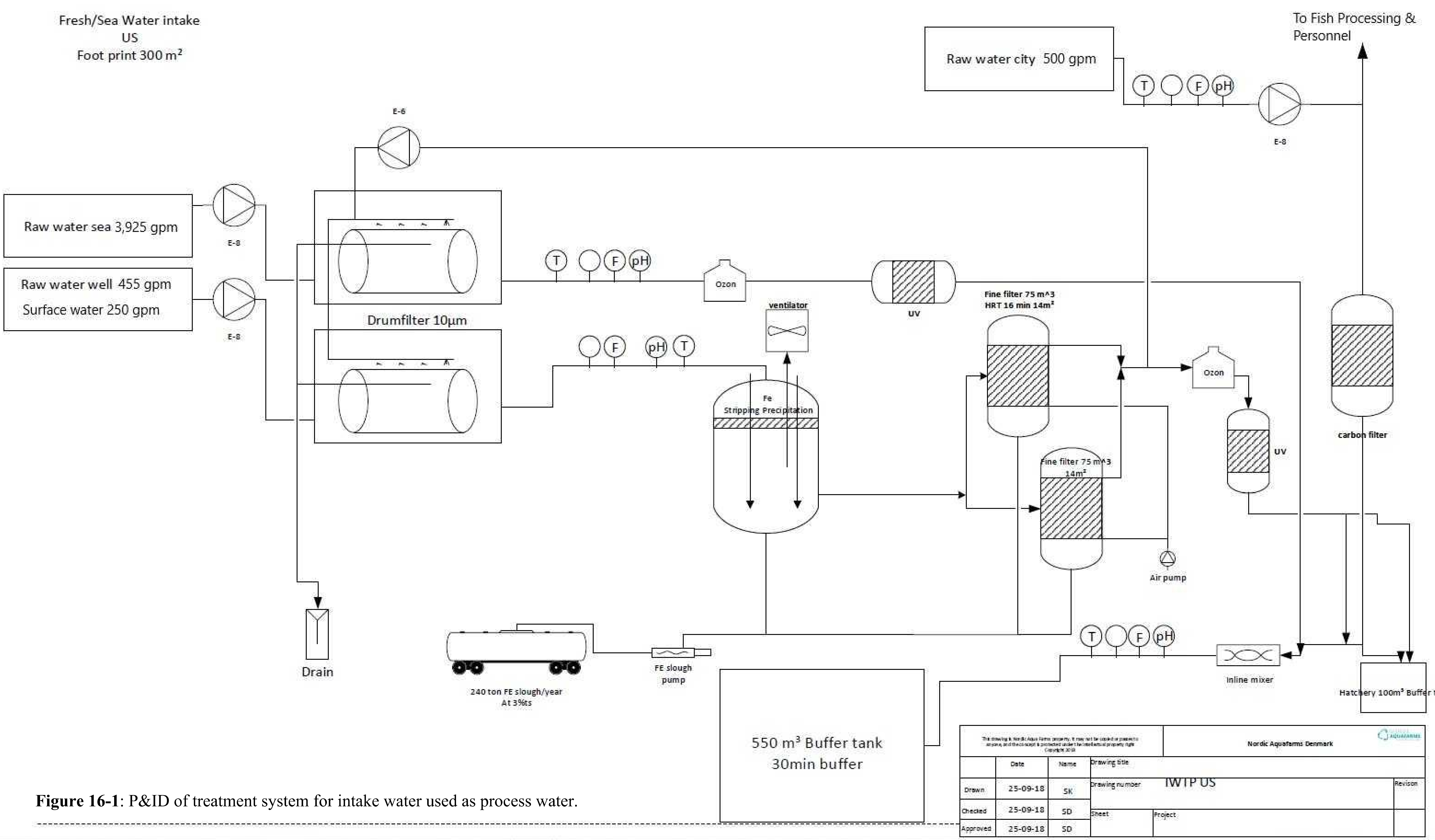

Figure 16-1: P&ID of treatment system for intake water used as process water.

APPENDIX 16-A

Water Supply and Purchase Agreement

APPENDIX 16-B

Capacity to Serve Letter

APPENDIX 16-C

State of Maine Public Utilities Commission Order

APPENDIX 16-D

Seawater Pipeline Engineering Drawings

Ransom Consulting, Inc.

APPENDIX 16-E

Utilities Engineering Drawings

Ransom Consulting, Inc.