

Fact Sheet for State Waste Discharge Permit ST0005174

Schenk Packing Co., Inc.

Permit Effective Date: XX, XX, 2021

Date of Public Notice of Draft: December 22, 2020

Purpose of this fact sheet

This fact sheet explains and documents the decisions the Department of Ecology (Ecology) made in drafting the proposed State Waste Discharge Permit for Schenk Packing Co., Inc. (Schenk) that will allow discharge of wastewater to ground via land application spray-fields located at the SE ¼ of the NW ¼ of Section 18, and part of the W ½ of NW ¼ of SE ¼ of Section 18, Township 32N, Range 4E, W.M.

Latitude: 48.261783 degrees North

Longitude: -122.349017 degrees West

State law requires any industrial facility to obtain a permit before discharging waste or chemicals to waters of the state, which includes groundwater.

Ecology makes the draft permit and fact sheet available for public review and comment at least thirty (30) days before issuing the final permit. Copies of the fact sheet and draft permit for Schenk Packing Co., Inc., State Waste Discharge permit ST0005174, are available for public review and comment from December 22, 2020 until the close of business January 21, 2021. For more details on preparing and filing comments about these documents, please see **Appendix A - Public Involvement Information**.

Schenk Packing Co., Inc. reviewed the draft permit and fact sheet for factual accuracy. Ecology corrected any errors or omissions about the facility's location, history, product type or production rate, and discharges or receiving water prior to publishing this draft fact sheet for public use.

After the public comment period closes, Ecology will summarize substantive comments and our responses to them. Ecology will include our summary and responses to comments to this fact sheet as **Appendix E - Response to Comments**, and publish it when we issue the final State Waste Discharge permit. Ecology generally will not revise the rest of the fact sheet. The full document will become part of the legal history contained in the facility's permit file.

Summary

Schenk operates a beef slaughterhouse and packing operation approximately 1.6 miles northeast of the city of Stanwood in Snohomish County, Washington. Schenk is a classified as a complex slaughterhouse which slaughters and processes up to 250 head

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of dairy and range cows for packaged meat products. Schenk has operated this meat packing facility near Stanwood since 1966.

Wastewater from the plant is treated and irrigated onto an adjacent 53-acre land treatment site. Processes at Schenk include size reduction, hamburger grinding, and other operations associated with preparation of large cuts of meat. The largest quantities of liquid waste is generated from the kill floor resulting from cleaning and wash down during working hours and from cleanup after production hours.

The facility recently upgraded its treatment equipment during the term of the previous permit. The new permit includes the design criteria for the upgraded system and requires effluent monitoring and site management for pollution control similar to the previous permit. This permit adds requirements to monitor the vadose zone (soils above the groundwater table) to investigate subsurface pollutant transport and flow patterns as well as the possible need for groundwater monitoring in the future.

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I. Introduction

The Legislature defined Ecology's authority and obligations for the Wastewater Discharge Permit Program in the Water Pollution Control law, chapter 90.48 RCW (Revised Code of Washington).

Ecology adopted rules describing how it exercises its authority under this law:

- State waste discharge program (chapter 173-216 WAC).
- Water quality standards for groundwater of the state of Washington (chapter 173-200 WAC).
- Submission of plans and reports for construction of wastewater facilities (chapter 173-240 WAC).

These rules require any industrial facility owner/operator to obtain a State Waste Discharge Permit before discharging wastewater to state waters. They also help define the basis for limits on each discharge and for performance requirements imposed by the permit.

Under the State Waste Discharge Permit Program and in response to a complete and accepted permit application, Ecology generally prepares a draft permit and accompanying fact sheet, and makes it available for public review before final issuance. If the volume of the discharge has not changed or if the characteristics of the discharge have not changed, Ecology may choose not to issue a public notice. When Ecology publishes an announcement (public notice), it tells people where they can read the draft permit, and where to send their comments, during a period of thirty days. However, the provisions of *WAC 173-216-090(5)* specify that in those cases in which a permit is proposed to be reissued with no substantial changes, Ecology is not required to publish such notices. In accordance with the above-referenced regulation, and in accordance with procedures set forth in the Department of Ecology's *Water Quality Permit Writer's Manual, chapter XIV (2011)*, Ecology did not publish a public notice for the reissuance of this permit as the additional monitoring requirements make this reissuance more stringent than the existing permit.

II. Background Information

Table 1 - General Facility Information

Facility Information	
Applicant	Schenk Packing Co., Inc.
Facility Name and Address	Schenk Packing Co., Inc. 8204 – 288 th Street NW Stanwood, WA 98292
Contact at Facility	Name: John Lenz Title: Waste Treatment Manager Telephone #: (360) 629-3939
Responsible Official	Name: Steven Lenz Title: Controller/Owner Address: 8204 – 288 th Street NW, Stanwood, WA 98292 Telephone #: (360) 629-3939
Industry Type	Slaughterhouse
Type of Treatment	Flotation Skimmer and Settling Tank, Extended Aeration
SIC Codes	2011
NAIC Codes	311612
Fee Category	Food Processing: 50,000 - <100,000 gpd
Facility Location	Latitude: 48.257317 degrees North Longitude: -122.344573 degrees West
Legal Description of Application Area	Section, township, range The SE ¼ of the NW ¼ of Section 18, and part of the W ½ of NW ¼ of SE ¼ of Section 18, Township 32N, Range 4E, W.M.

Figure 1. Facility Location Maps



A. Facility description

History

Schenk operates a beef slaughterhouse and packing operation approximately 1.6 miles northeast of the city of Stanwood in Snohomish County, Washington (Appendix D, Figure 1). Schenk is a complex slaughterhouse which slaughters and processes dairy and range cows and some bulls for packaged meat products. Schenk has operated this meat packing facility near Stanwood since 1966. The discharge is an existing discharge and the permit is under renewal to land-apply the treated wastewater.

Industrial processes

The plant processes up to 250 head of cattle per day, over a 52-week season, with approximately 210 full time workers. On an average, 72,500 head are processed during an average year of 290 production days. Wastewater from the plant is treated and irrigated onto an adjacent 53-acre land treatment site. Processes at Schenk include size reduction, hamburger grinding, and other operations associated with preparation of large cuts of meat. The largest quantities of liquid waste is generated from the kill floor resulting from cleaning and wash down during working hours and from cleanup after production hours.

Installation of an auger and modifications to the cleaning room eliminated water use by allowing manure to be loaded into a truck directly without the need for wash down. A cover over the loading area has reduced the introduction of storm water. Paunch manure and blood along with the manure from the holding area and cleaning room are sent offsite for composting. Hides are also sent offsite for processing, as are the internal organs and bones. The only secondary products to receive additional treatment onsite are livers and kidneys, which are cooled in a cold water bath to remove heat.

Also, storm water from roof drainage and administrative parking lots has been diverted away from the treatment system, further reducing loading. Storm water from the by-product trailer loading area is directed to the wastewater pond for treatment.

Wastewater treatment processes (prior to land treatment)

Liquid waste from the processing facility flows through drains to a drum screen that separates and removes solids. The wastewater is then pumped to a holding tank. Wastewater from the holding tank is pumped through a dissolved air flotation (DAF) device where a liquid coagulant and flocculent are added to cause solid particles to

coalesce. Air bubbles are then added to raise the coalesced particles to the top of the DAF where a skimming rake removes them. The wastewater then flows to the primary irrigation lagoon. Liquid waste from the cattle wash-down is pumped to a separate holding tank. This liquid waste will be sent to a digester in Monroe or can be pumped to the DAF. *Pseudomonas* and *Bacillus* microbacteria are injected into the outflow from the DAF to further breakdown fat, oil, and grease. A schematic of this system is shown in Appendix D, Figure 2.

Approximately 3,000 to 4,000 pounds per day of solids are mixed with the paunch manure and hauled to a topsoil operation for composting. The wastewater is screened and further treated in series through two recirculating aerated lagoons, the first has a capacity of 1.9 million gallons and the second has a capacity of 2.3 million gallons. The lagoons are unlined and excavated into a low permeability till stratum.

A baffle was added to divide the primary lagoon into two areas, one approximately one-third of the total lagoon area and the other one about two-thirds of the total area. Two 10-horsepower 2.0 Triton Aerators were added to the primary lagoon. The influent enters the smaller baffled area where it is mixed without aeration by a mixer to provide anaerobic conditions for denitrification. Influent and recirculated flows from the secondary lagoon are pumped into this anaerobic portion of the primary lagoon. A portion of the treated effluent flows through the baffle into the larger treatment area of the primary lagoon. Aeration and mixing are provided by two 25-horsepower floating surface aerators and two 10-horsepower surface aerators in the second part of the primary lagoon.

Detention times based on flows of 80,000 gpd are 7.9 days for the anaerobic part of the primary lagoon, and 15.8 days for the aerated part of the lagoon. The secondary lagoon is also baffled to separate it into two treatment areas. The first area is approximately one-quarter the total area and the second area is approximately three-quarters the total area. The smaller baffled area is aerated and mixed by one 7.5-HP aerator/mixer and one 5.0-HP Aire-02 Triton aerator, which was added in January 2008. A pump and recirculation pipeline returns some of the flow from this portion of the secondary lagoon downstream of the floating aerators back to the anaerobic part of the primary lagoon.

A portion of the treated effluent passes through the baffle into the main area of the secondary lagoon where two 15-HP floating surface aerator/mixers, one 3-HP aerator/mixer, and one ½-HP pond mixer aerate the wastewater. Detention time in the secondary lagoon again based on flows of 80,000 gpd is 29 days.

Nitrification is carried out under controlled process conditions by aerating the wastewater sufficiently to assure the conversion of the ammonia in the wastewater to the nitrite-nitrate forms. The following denitrification process reduces the oxidized

nitrogen compounds (nitrites and nitrates) to nitrogen gas and nitrogen oxides, thereby reducing the nitrogen content of the wastewater as the gases escape from the liquid. See Appendix D, Figure 3, for a plan view of the treatment lagoons. This diagram is updated from that contained in the previous permit because both the primary pond and secondary pond were subdivided by baffles to double the respective treatment capacity and increase efficiency of nitrogen removal. This process has improved wastewater treatment.

Land treatment and distribution system (spray-field)

Schenk has been land-applying meat packer processing wastewater since 1985. In 2000, the acreage for land application was increased from 40 to 45 acres. In 2020, the acreage for land application was increased from 45 to 53 acres.

National Resource Conservation Service data for Snohomish County indicate that the majority of the site (approximately 80 percent) is Tokul gravelly loam, with the remaining 20 percent being Pastik silt loam. These two soil types are silt, sand, and gravelly loams (2013). Soil make-up was verified by five soil borings performed by the applicant's consultant, who identified sandy loam and gravelly sandy loam over the site to a depth of three feet. USGS interpretation identifies Vashon till as the surficial geology at the site. Vashon till deposits mantle broad upland areas and are covered by recessional outwash in valleys and low areas. The till consists of a non-sorted mixture of clay, silt, sand, pebbles, cobbles, and boulders but includes some lenses of stratified material.

Surface drainage is to the northwest of the site, eventually to Douglas Creek. There are three water supply wells within a mile of the site. All are located near 300th Street NW, well over 500 feet away from the spraying site, and are located uphill of the application area. Zoning of the wastewater application site is agricultural. Surface slopes are gentle generally to the west in the spray discharge areas.

Wastewater from the secondary lagoon is currently spray irrigated on a mixture of poplar, fir/alder, and harvested pasturelands.

1. Poplar Plantation acreage was increased from 10 acres in 1999 to 18 acres in 2000. The additional area was previously in cedar, fir, and alder trees and was part of the original irrigation area.
2. Harvested Pasture (orchard grass) acreage covers 24 acres. One cut of grass for hay and two cuts for green chop are taken off the site per year. It is estimated that 7.0 tons/acre are harvested. Based on an average nitrogen concentration reported from other sites, it has been assumed that the

harvested grass has a nitrogen concentration of 4.05 %. This equates to 445 pounds per acre (lb./ac) of nitrogen being removed through harvesting.

3. Fir/Alder Plantation acreage was reduced from 11 acres in 1999 to 3 acres in 2000. During 2000, selective removal of trees was continued, targeting wind-blown trees and maturing trees.
4. Fir/Alder Plantation acreage was reduced from 3 acres to 1.5 acres in 2020. This acreage was tilled and new top-soil was added to prepare for grass harvest.
5. Poplar Plantation acreage was reduced from 18 acres to 0.5 acres in 2020. This acreage was tilled and new top-soil was added to prepare for grass harvest.
6. An 8 acre field adjacent to field area 1 was purchased and prepped for grass harvest in 2020. The conversion of Fir/Alder and Poplar acreage and the addition of 8 acres of land grew the Harvested Pasture (orchard grass) acreage from 24 to 51 acres in 2020.

The irrigation method currently in use on the poplar plantation consists of a series of 66 double-headed mist sprinklers set at 30 to 50 feet spacing in six lines for a total length of 2,405 feet. The pasture and fir/alder plantation uses 243 impact sprinklers in 38 lines with a total length of 14,741 feet. Irrigation management currently adopted for the hay and trees is the same, but will be modified to vary the rate of application based on the crop. During each irrigation cycle, a lateral is irrigated for an average of six hours set time. The return period between set times is approximately 14 to 24 days.

Solid wastes

All solid wastes are either mixed with paunch manure and hauled offsite to a topsoil operation for composting, or hauled away by Seattle Rendering as described under the industrial process section above.

Groundwater

Under the state's anti-degradation regulation WAC 173-200-030, groundwater of a higher quality than the groundwater criteria must be protected and contaminants that will reduce the existing water quality are prohibited from entering the groundwater. Background groundwater quality has not been evaluated. As nitrate is the primary contaminant of concern for this waste stream, a conservative estimate for nitrogen in the percolate below the spray-field is used. Percolate nitrogen of three milligrams per liter total nitrogen is the level assumed in the design calculations for land treatment to protect existing groundwater quality.

B. Wastewater characterization

Schenk reported the concentration of pollutants in the discharge in their permit renewal application and in monthly discharge monitoring reports. Appendix D, Figure 4, shows the wastewater discharge characterization sampled from the point where it is withdrawn from the secondary pond and pumped to the land application sites for the years 2003 through 2012.

Total nitrogen is a measure of organic nitrogen, ammonia, nitrate, and nitrite. Total Kjeldahl nitrogen (TKN) measures the amount of ammonia and organic nitrogen.

Biochemical oxygen demand (BOD) is a measure of how much oxygen bacteria and other microbes will consume to biodegrade the organic matter in the applied wastewater. More simply, it is an indirect measure of the biodegradability of the organic matter in the waste. If the BOD loading is too great to the spray-field, the soil will become anaerobic, and the crop and treatment process will fail. The five-day BOD levels (BOD₅) at Schenk have been measured at reduced levels since the 1990s, ranging between 62 and 610 mg/L per year from 2003 through 2012, with an overall average of 32 mg/L BOD₅ concentration is also associated with both TSS and dissolved organic material concentrations and is therefore a good indicator of the overall efficiency of the Schenk treatment system.

Oil and grease is a major pollutant in the raw waste stream of slaughterhouses. The source of grease is primarily from the kill floor. Grease correlates well with BOD in the raw waste, but not in the treated wastes, where grease is much more effectively reduced during treatment than is BOD (see EPA categorical limits comparisons in Table 4, below).

Fecal coliform bacteria are used as an indicator of potential pollution from residual manure and generally indicate the presence of pathogenic viruses and bacteria from intestinal tracts of warm-blooded animals. Fecal coliform bacteria may also come from wildlife, such as ducks and geese, which may use the lagoons.

Potentially the greatest concern in the use of spray-fields is the total dissolved solids content. Total dissolved solids contained in wastewaters of most meat packers contain both organic and inorganic matter. The amount of dissolved solids will vary to a large extent with the type of in-plant operations and housekeeping practices. The inorganic dissolved solids are particularly important because they are relatively unaffected by biological treatment processes. Dissolved solids affect the ionic nature of groundwater and are usually nutrients for bacteria and protozoans.

The following tabulated data also includes Ecology inspection monitoring results. The data in Table 2 represents the quality of the wastewater discharged during the last permit cycle (2014 to 2018). The wastewater prior to land application is characterized as follows:

Table 2 - Land Application Wastewater Characterization

Parameter	Units	# of Samples	Average Value	Minimum Value	Maximum Value
Application Rate	inches/month	58	0.05	0.04	0.06
Biochemical Oxygen Demand (BOD ₅)	mg/L	60	151	23	680
Flow	gpd	58	61,454	42,883	73,842
Hydraulic Loading Rate	inches/day/acre	58	1.53	1.09	1.87
Nitrate/Nitrite	mg/L	60	9.81	0.154	35.47
Oil and Grease	mg/L	56	5.98	1.1	19
pH	standard units	60	7.01	6.93	7.18
TDS	mg/L	60	666	190	900
TKN	mg/L	60	42.57	9.75	130
Fecal Coliform	Colonies/100/mL	58	17	9	2,613

The data presented in Table 3 and Table 4 represents historical soil results from the Area 4 Grass/Hay spray-field.

Table 3 - Soil Characterization, 0 – 12 inch depth

Parameter	Units	# of Samples	Average Value	Minimum Value	Maximum Value
Calcium	mg/Kg	6	5.35	2.9	7.9
Magnesium	mg/Kg	6	2.15	1.31	2.93
Potassium	mg/Kg	6	197.17	159	240
Sodium	mg/Kg	6	0.303	0.11	0.6
Ammonia	mg/Kg	6	8.85	6	13.7
Nitrate/nitrite	mg/Kg	6	8.98	< 1	19.6
Phosphorous	mg/Kg	6	930	180	1,720
Sulfate	mg/Kg	6	7.67	< 1	18
Cation Exchange Capacity	meq/100 gm	6	19.02	14.9	22.3
Exchangeable Sodium Percent	Percent	6	1.62	0.5	2.9
Moisture Content	Percent	6	26.2	21.6	36.3
Organic Matter	mg/Kg	6	5.77	4.41	6.9
pH	SU	6	5.75	4.41	6.9
Specific Conductivity	µmhos/cm	6	0.143	0.07	0.2
TKN	mg/Kg	6	2,056	1,259	3,056

Table 4 - Soil Characterization, 36 – 48 inch depth

Parameter	Units	# of Samples	Average Value	Minimum Value	Maximum Value
Calcium	mg/Kg	6	3.25	1.7	4.9
Magnesium	mg/Kg	6	1.59	0.94	2.79

Parameter	Units	# of Samples	Average Value	Minimum Value	Maximum Value
Potassium	mg/Kg	6	176	115	427
Sodium	mg/Kg	6	0.313	0.07	0.06
Ammonia	mg/Kg	6	2.03	1.2	2.7
Nitrate/nitrite	mg/Kg	6	3	1.3	7.4
Phosphorous	mg/Kg	6	543.33	140	1,550
Sulfate	mg/Kg	6	7.5	< 1	23
Cation Exchange Capacity	meq/100 gm	6	11.43	5.6	14.6
Exchangeable Sodium Percent	Percent	6	3.07	< 0.5	5.2
Moisture Content	Percent	6	16.73	10.8	22.6
Organic Matter	mg/Kg	6	2.05	1.26	2.88
pH	SU	6	5.93	5.7	6.2
Specific Conductivity	µmhos/cm	6	0.11	0.08	0.2
TKN	mg/Kg	6	549.17	324	870

C. Summary of compliance with previous permit issued June 30, 2014

The previous permit placed effluent limits on total nitrogen at 60 lbs./acre/month and 435 lbs./acre/year.

Schenk has generally complied with the effluent limits and permit conditions throughout the duration of the permit issued on June 30, 2014. Schenk had a total of eight violations of which six were for late or missing DMRs. Ecology assessed compliance based on its review of the facility's information in the Ecology Permitting and Reporting Information System (PARIS), discharge monitoring reports (DMRs) and on inspections.

Starting in April of 2016 Snohomish County Surface Water Management measured unusual flows and elevated specific conductivity and fecal coliform in routine samples collected from Douglas Creek downstream of the facility. An investigation into Schenk Packing as the possible source was started later that year. As part of an on-site inspection a Notice of Violation was issued for penetrations in a concrete retaining wall and other pipes that had the potential to discharge contaminated storm water to Douglas Creek.

A follow-up inspection in 2018 identified run-off from spray fields as a potential source of discharge to the Snohomish County MS4 system. Issues with this possible source are addressed in this new permit.

D. State environmental policy act (SEPA) compliance

State law exempts the issuance, reissuance or modification of any wastewater discharge permit from the SEPA process as long as the permit contains conditions

that are no less stringent than federal and state rules and regulations (RCW 43.21C.0383). The exemption applies only to existing discharges, not to new discharges.

III. Proposed Permit Limits

State regulations require that Ecology base limits in a state waste discharge permit on the:

- Technology and treatment methods available to treat specific pollutants (technology-based). Dischargers must treat wastewater using all known, available, reasonable methods of prevention, control, and treatment (AKART). Ecology has developed guidance describing technology-based (AKART) criteria for industrial/commercial systems that discharge to ground; (Ecology, 1993; 2004).
- Operations and best management practices necessary to meet applicable water quality standards to preserve or protect existing and future beneficial uses of the groundwater.
- Groundwater quality standards (Ecology, 1996).
- Applicable requirements of other local, state and federal laws.

Ecology applies the most stringent of technology and water quality-based limits to each parameter of concern and further describes the proposed limits below.

The permit includes a mass-based limitation on the quantity of total nitrogen applied to the spray-field. This limitation is designed to protect the quality of the groundwater. An approved engineering report will be required to include specific design criteria for any modifications made at this facility and to evaluate impacts of BOD and oil and grease on infiltration, aerobic conditions, and soil conditions/chemistry. Water quality-based limitations used in determining the limitation on the quantity of total nitrogen land-applied are based upon compliance with the groundwater quality standards (chapter 173-200 WAC).

The limits in this permit reflect information received in the application and from supporting reports (engineering, hydrogeology, monitoring, and irrigation/crop management). Ecology evaluated the permit application and determined the limits needed to comply with the rules adopted by the State of Washington. Ecology does not develop effluent limits for all reported pollutants. Some pollutants are not treatable at the concentrations reported, are not controllable at the source, and are not listed in regulation.

Ecology does not usually develop permit limits for pollutants not reported in the permit application but which may be present in the discharge. The permit does not authorize the discharge of these non-reported pollutants. During the five-year permit term, the facility's effluent discharge conditions may change from those conditions reported in the permit

renewal application. The facility must notify Ecology if significant changes occur in any constituent. Until Ecology modifies the permit to reflect additional discharges of pollutants, a permitted facility could be violating its permit.

A. Design criteria

Under WAC 173-216-110 (4), flows and waste loadings must not exceed approved design criteria. The permittee established design criteria for the facility's treatment system upgrade in the engineering report dated June 28, 2018, prepared by Stuart Ward, General Manager of Process Engineered Water Equipment, LLC in Camas Washington. The table below includes design criteria from the report.

The current water quality parameters have been supplied by the customer. These parameters are used for the process design and equipment specification. The average values are listed below:

Parameter	Influent	Unit
Flow	100,000	gpd ^a
TSS ^b	2,500	mg/L ^c
COD ^d	TBD ^e	mg/L
BOD ^f	3,500	mg/L
FOG ^g	500	mg/L
pH	6 - 9	SU ^h
Temperature	60 to 95	°F ⁱ
Operation	24/7/365	hrs./days per wk./days per yr.
a	gpd = gallons per day.	
b	TSS = Total suspended solids.	
c	mg/L = milligrams per liter.	
d	COD = Chemical oxygen demand.	
e	TBD = To be determined.	
f	BOD = Biological oxygen demand.	
g	FOG = Fats, oils, and grease.	
h	SU = Standard units.	
i	°F = degrees Fahrenheit.	
Note:	TSS, BOD and FOG are estimated from industry data.	

Flow, TSS, BOD, and FOG values from above are incorporated in the permit as monthly average design criteria in Condition S13.

B. Technology-based effluent limits

Waste discharge permits issued by Ecology specify conditions requiring the facility to use AKART before discharging to waters of the state (RCW 90.48).

Land treatment requirements

Schenk must meet the following permit limits to satisfy the requirement for AKART:

- Application of wastewater by means of spray irrigation must not exceed agronomic rates (as defined in Ecology's groundwater implementation guidance) for total nitrogen and water. Wastewater application rates for other wastewater constituents must protect the background groundwater quality.
- Apply total nitrogen and water to the spray-fields as determined by an Ecology approved and current irrigation and crop management plan.
- Operate the land treatment system to protect the existing and future beneficial uses of the groundwater and not cause a violation of the groundwater standards.

Categorical limits based on the simple slaughterhouse category

Categorical limits issued by EPA under 40 CFR 432 Sub-Part B (Complex Slaughterhouses) are applicable to on-site slaughter and subsequent meat, meat product, or by-product processing of carcasses of animals which results in a discharge to surface water. This regulation defines best practicable control technology (BPT) and the best available control technology (BAT) for the slaughterhouse industry. Although Schenk does not discharge to surface water, the treatment systems evaluated by EPA to establish the limits are the same as used at Schenk and are a level of control achievable for the slaughterhouse or meat packing category. EPA evaluated extended aeration with activated sludge to treat nitrogen and BOD through nitrification and denitrification. Schenk uses the same technology. Since Schenk does not discharge to surface water, the standards do not directly apply, but can be used as a basis for setting AKART limits.

Although these standards do not apply, categorical limits are still valuable in determining the treatment system performance that is required by technological controls alone.

Table 5 - EPA BPT Categorical Limits

Parameter	Maximum Daily ^a	Maximum Monthly Average ^a
BOD ₅	0.42	0.21
Fecal Coliform	(^b)	(^c)
TSS	0.50	0.25
Oil and Grease ^d	0.16	0.08
Ammonia (as N)	0.48	0.24
^a	Pounds per 1000 lbs. (or g/kg) live weight killed (LWK.).	
^b	Maximum of 400 most probable number (MPN) or colony forming units (CFU) per 100 mL at any time.	
^c	No maximum monthly average limitation.	
^d	May be measured as hexane extractable material (HEM).	

Assuming 1,500 pounds per head, 210 head killed per day, Schenk production is approximately 315,000 pounds live weight killed per day. Assuming a monthly average of daily flow values of 90,000 gpd results in the following categorical limits:

Table 6 - Potential Technology-Based Effluent Limits for Surface Water Discharges

Effluent Limits			Schenk Discharges
Parameter	Maximum Daily	Average of Daily Values for 30 Consecutive Days	Average of Daily Values for 30 Consecutive Days
BOD ₅	176 mg/L	88 mg/L	195 mg/L – 2014 137 mg/L – 2015 222 mg/L – 2016 117 mg/L – 2017 84.5 mg/L – 2018
TSS	210 mg/L	105 mg/L	Not Sampled
Oil and Grease	67 mg/L	34 mg/L	4.63 mg/L – 2014 5.99 mg/L – 2015 10.95 mg/L – 2016 4.72 mg/L – 2017 2.4 mg/L – 2018
Ammonia	201 mg/L	101 mg/L	40.8 mg/L – 2014 ^a 42.16 mg/L – 2015 ^a 88.71 mg/L – 2016 ^a 45.43 mg/L – 2017 ^a 44.79 mg/L – 2018 ^a
^a	Values represent total Nitrogen.		

Based on the values above, Schenk's plant operates close to the technology standards for the industry. The above does not take into account the additional treatment provided by land application to the spray fields. As this discharge is not to surface water the high BOD₅ loading is less of a concern than the nitrate loading for potential impacts to groundwater.

C. Groundwater quality-based effluent limits

In order to protect existing groundwater quality and preserve the designated beneficial uses of Washington's groundwater's including the protection of human health, WAC 173-200-100 states that waste discharge permits shall be conditioned in such a manner as to authorize only activities that will not cause violations of the groundwater quality standards. The goal of the groundwater quality standards is to maintain the highest quality of the State's groundwater's and to protect existing and future beneficial uses of the groundwater through the reduction or elimination of the discharge of contaminants to groundwater [WAC 173-200-010(4)]. Ecology achieves this goal by:

- Applying all known available and reasonable methods of prevention, control and treatment (AKART) to any discharge.
- Applying the anti-degradation policy of the groundwater standards.
- Establishing numeric and narrative criteria for the protection of human health and the environment in the groundwater quality standards.

Anti-degradation policy

The state of Washington's groundwater quality standards (GWQS) requires preservation of existing and future beneficial uses of groundwater through the anti-degradation policy, which includes the concepts of anti-degradation, AKART, and the public interest. Anti-degradation is not the same as non-degradation (see below).

Anti-degradation

Anti-degradation applies to the calculation of permit limits in groundwater when background (see below) contaminant concentrations are less than criteria in the GWQS. When contaminant concentrations in existing groundwater are less than the criteria values, Ecology considers the background concentrations as the water quality criteria. In this situation, discharges to groundwater must not degrade the existing water quality. Under extraordinary circumstances Ecology has discretion to allow the concentrations of contaminants at the point of compliance to exceed background concentrations but not exceed criteria in the GWQS. If the preferred treatment alternative predicts that discharges to groundwater will result in contaminant concentrations that fall between background concentrations and the criteria, then Ecology may use its discretion to allow a discharge to exceed background concentrations but not exceed criteria in the GWQS. If the preferred alternative will meet background contaminant concentrations, background concentrations become the permit limits. Permit limits must protect groundwater quality by preventing degradation beyond the GWQS criteria. If discharges will result in

exceedance of the criteria, facilities must apply additional treatment before Ecology can permit the discharge.

Non-degradation

Non-degradation applies to permit limits in groundwater when background contaminant concentrations already exceed criteria in the GWQS. Non-degradation means that discharges to groundwater must not further degrade existing water quality. In this case, Ecology considers the background concentrations as the water quality criteria and imposes the criteria as permit limits. To meet the non-degradation policy, the facility must prepare an AKART engineering analysis that demonstrates that discharges to groundwater will not result in increasing background concentrations. Ecology must review and approve the AKART engineering analysis.

You can obtain more information on anti-degradation and non-degradation by referring to the *Implementation Guidance for the Groundwater Quality Standards (Implementation Guidance)*, Ecology Publication #96-02 (available <https://fortress.wa.gov/ecy/publications/Documents/9602.pdf>)

Background water quality

Background water quality is determined by a statistical calculation of contaminant concentrations without the impacts of the proposed activity. The calculation requires an adequate amount of groundwater quality data and determining the mean and standard deviation of the data, as described in the *Implementation Guidance* (ECY 96-02). Following the procedure in the *Implementation Guidance* (ECY 96-02), Ecology then defines background water quality for most contaminants as the 95 percent upper tolerance limit. This means that Ecology is 95 percent confident that 95 percent of future measurements will be less than the upper tolerance limit. There are a few exceptions to the use of the upper tolerance limit. For pH, Ecology will calculate both an upper and a lower tolerance limit resulting in an upper and lower bound to the background water quality. If dissolved oxygen is of interest, Ecology will calculate a lower tolerance limit without an upper tolerance limit.

As no groundwater monitoring is required under this permit, the applicable groundwater criteria as defined in chapter 173-200 WAC and in RCW 90.48.520 for this discharge do not apply.

Ecology is requiring a vadose study for the land treatment site to investigate if land applied wastewater is traveling laterally in the sub-surface and potentially discharging at a downhill location.

The permittee completed a hydrogeologic investigation and concluded that groundwater monitoring was not practical. In lieu of groundwater monitoring, point of discharge monitoring is required at the aeration lagoon wet well. Monitoring of spray-field soils is also required in the permit. In addition, a conservative estimate for total nitrogen in the percolate below the spray-field is used. Percolate nitrogen of three milligrams per liter total nitrogen (3 mg/L-N) is the level assumed in the design calculations for land treatment to be sufficient to protect existing groundwater quality.

The table below includes the groundwater quality based enforcement limits for the discharge. Two consecutive exceedances of an enforcement limit for the same parameter constitutes a violation.

Table 7 - Groundwater Quality-Based Effluent Limits

Parameter	Field Type	Monthly Average Concentration ^a	Daily Maximum Concentration ^b	Annual Maximum Loading ^c
Total Nitrogen ^d	Grass/Hay	81 mg/L	134 mg/L	328 lbs./acre/yr.
Total Nitrogen	Poplar			343 lbs./acre/yr.
Total Nitrogen	Fir/Alder			61 lbs./acre/yr.
pH	All	6.5 – 8.5 SU ^e	6.5 – 8.5 SU	
Total Coliform	All	200 CFU/100 mL ^f	400 CFU/100 mL	
^a	Monthly average concentration is the average of the total nitrogen concentration in wastewater applied to the spray-fields for the month.			
^b	Daily maximum concentration is the highest daily value for total nitrogen concentration in wastewater applied to the spray-fields for the month.			
^c	Annual maximum nitrogen loading is based on a rolling 12-month total, calculated each month by summing the current month plus the previous 11 months total nitrogen results. This moving total must not exceed the lbs. N/acre/yr. shown for each field type.			
^d	Total nitrogen is sum of ammonia-N, total kjeldahl nitrogen (TKN), and nitrite + nitrate.			
^e	SU = Standard units.			
^f	CFU/100 mL = Colony forming units per 100 milliliters.			

The above groundwater quality-based effluent limits are derived from site-specific information on the hydraulic loading and nutrient concentrations of the wastewater to be land applied. The following subsections provide details of how the above limits are determined.

Hydraulic loading

The hydraulic loading rate based on soil permeability is calculated using methods described in the EPA publication, “*Land Treatment of Municipal Wastewater Effluents*” (2006). As discussed in Section A above there are two soil types

underlying the land treatment areas. Results from 2018 infiltration testing show the Tokul gravelly loam with an infiltration rate 20 to 40 percent slower than the Pastik Silt Loam. Constant head and falling head infiltration rates for the Tokul soil are 3.7 inches per hour (in/hr.) and 2.4 in/hr., respectively. For the Pastik soils the rates are 9.1 and 11.3, respectively. Permeability rates for these soils yields average infiltration rates between 3,288 inches per year (in/yr.) for the Pastik soils and 34.7 in/yr. for the Tokul soils. The EPA guidance recommends a safety factor of 4 to 10 percent of the maximum rate. Using the conservative 4% value yields an infiltration rates between 131.5 and 1.38 in/yr.

The Schenk hydraulic loading is computed using the average monthly precipitation at Stanwood (WSU, 2019) for the years 2006 through 2018.

Additional hydraulic loading calculations based on natural precipitation, wastewater volume generated, nitrogen uptake, and nitrogen leaching are shown in Appendix D Figure 6. Comparison of these hydraulic loading rates shows, with the exception of the Fir/Alder spray-field, that wastewater volume is not the limiting factor when compared to soil permeability or nitrogen concentration.

Nitrogen loading

Two different loading rates based on nitrogen uptake and concentrations are also derived from the EPA 2006 document (Appendix D, Figure 6). Improvements to the treatment system beginning in March 1998 reduced nitrogen loading to the spray-fields. To avoid the over application of nitrogen to fields with low nitrogen uptake crops (e.g. fir) discharge limits have been broken out by each field type for this permit reissuance.

Crop nitrogen uptake factors for poplar and fir are from EPA 2006, while the uptake for the grass/hay was determined based on a harvest rate of 7 tons per acre and a dry weight nitrogen content of 1.47 percent (also from EPA, 2006). The overall average of reported monthly total nitrogen results from 2003 to 2012 (as TKN plus nitrate/nitrite) is used in the concentration calculation. Results show that nitrogen loading is limited by the concentration in wastewater.

Area loading

Limitation based on application area is calculated for the two nitrogen loading rates calculated above, as well as the raw nitrogen crop uptake case. Results show that the hydraulic loading rate based on crop uptake is the limiting area. Results of all three areas are show in Appendix D, Figure 6.

The calculations for the limiting case in each of the above loading categories are shown in Appendix D, Figures 7 through 9. Even though Schenk has made improvements to decrease nitrogen and other pollutant loading from the wastewater, over application of some crop types may occur. Ecology will define nitrogen application rates for each field to avoid over application. Ecology has taken this more conservative approach to assure protection of ground water quality because:

1. Schenk is land applying their wastewater year-round, rather than limiting application only during the growing season, and has not constructed synthetic-lined lagoons for winter storage of wastewater.
2. Schenk has not been required to evaluate background ground water quality conditions.
3. Schenk may be required to implement ground water monitoring in this permit.

The improved results do however support a rolling annual maximum loading limit as the enforceable effluent limitation to protect ground water quality, and Schenk's mass loading rates have remained safely below these limits.

EPA guidance states that; "Concentration limits are designed to encourage a facility to operate its plant efficiently at all times by ensuring that facilities cannot cut back on their treatment efficiency to discharge at a high concentration while maintaining compliance with the loading limits." "Effluent limits expressed as mass (pounds or kilograms per day) create an opportunity for using inefficient operation of a treatment process, so a permit writer should consider concentration limits (milligrams per liter) in addition to the mass limits." (See Appendix D, Figure 10, Mass vs. Concentration.) The proposed effluent rate is a mass loading rate. To prevent a short-term slug discharge to ground water, a monthly average concentration limit is included in Condition S1. The derivation of the effluent concentration limits are shown in Appendix D.

D. Comparison of effluent limits with the previous permit issued on June 30, 2003

Two new requirements are added to this permit renewal; they are not part of the June 30, 2003 permit. To gain a better understanding on the nutrient uptake properties of the different crop types where wastewater is land applied, Ecology is requiring the initiation of a soil monitoring program for the treatment sites. This monitoring will collect and provide information on the movement of constituents of concern in the wastewater through the soil profile.

Also new to this permit is the requirement for the facility to conduct a hydrogeologic study. The goal of this study is to confirm that discharge limits continue to be protective of groundwater quality.

Table 8 - Comparison of Previous and Proposed Limits

		Current Effluent Limits: Outfall # 001			Proposed Effluent Limits: Outfall # 001		
Parameter	Field Type	Average Monthly ^a	Maximum Daily ^b	Maximum Annually ^c	Average Monthly	Maximum Daily	Maximum Annually
Flow ^d				None	80,000	85,000	None
Total Nitrogen	Grass / Hay	88 mg/L	177 mg/L	389 lbs./acre/yr.	81 mg/L	134 mg/L	328 lbs./acre/yr.
Total Nitrogen	Poplar			337 lbs./acre/yr.			343 lbs./acre/yr.
Total Nitrogen	Fir / Alder			61 lbs./acre/yr.			61 lbs./acre/yr.
pH ^e	All	None	None		6.5	8.5	
Total Coliform ^f	All	None	None		200	400	
^a Average Monthly concentration is the average of all daily values for the reporting month.							
^b Maximum Daily concentration is the highest daily value for the reporting month.							
^c Maximum Annually for nitrogen loading is based on a rolling 12-month total, calculated each month by summing the previous 12 months total nitrogen discharged. This moving total must not exceed the lbs. N/acre/yr. shown for each field type.							
^d Flow values are in gallons per day (gpd).							
^e pH values are in Standard Units (SU). Values are also minimum and maximum and are the same for both Maximum Daily and Average Monthly.							
^f Total Coliform values are in colony forming units per 100 milligrams (of water) (CFU/100 mg).							

Table 9 - Proposed Early Warning Values

		Current Early Warning Values: Outfall # 001		Proposed Early Warning Values: ^a Outfall # 001	
Parameter	Field Type	Average Monthly ^b	Maximum Daily ^c	Average Monthly ^b	Maximum Daily ^c
Ammonia	All	None	None	201	101
Application Rate ^d	All	None	None	0.06	0.07
Hydraulic Loading ^e	All	None	None	2.09	2.72
BOD	All	None	None	88	176
Nitrate + Nitrite	All	None	None	29	66
Oil & Grease	All	None	None	8.2	13.2
TKN	All	None	None	58	111
Total Suspended Solids	All	None	None	210	105
Total Dissolved Solids	All	None	None	801	923
^a All values are in milligrams per liter (mg/L) unless noted otherwise.					
^b Average Monthly concentration is the average of all daily values for the reporting month.					
^c Maximum Daily concentration is the maximum allowable for any single day during a reporting month.					
^d Application Rate values are in inches (of water) per day (inches/day).					
^e Hydraulic Loading values are in inches (of water) per month (inches/month).					

Table 10 - Additional Proposed Early Warning Values

		Proposed Early Warning Values: ^a Outfall # 001	
Parameter	Field Type	Average Monthly ^b	Maximum Daily ^c
Application Rate ^d (inches/day)	Fir/Alder	0.49	0.87
	Grass/Hay	1.03	2.71
	Poplar	0.19	0.33
	1 (Grass/Hay) ^e	0.71	0.77
	2 (Fir/Alder)	0.36	0.47
	3 (Grass/Hay)	0.56	0.89
	4 (Grass/Hay)	0.37	0.48
	5A (Poplar)	0.40	0.60
	5B (Grass/Hay)	0.65	1.21
	5C (Fir/Alder)	0.58	0.99
	5D (Poplar)	0.36	0.56
	6 (Grass/Hay)	0.57	0.80
	7 (Grass/Hay)	0.31	0.55
	7B (Poplar)	0.47	0.58
	8 (Grass/Hay)	1.07	3.19
	9 (Grass/Hay)	0.44	0.73
	10 (Fir/Alder)	0.78	0.86
Flow ^f (gpd)	Fir/Alder	30,748	62,150
	Grass/Hay	59,650	70,580
	Poplar	3,200	6,458
	1 (Grass/Hay)	78,318	85,117
	2 (Fir/Alder)	38,167	53,952
	3 (Grass/Hay)	62,805	100,836
	4 (Grass/Hay)	71,115	103,522
	5A (Poplar)	6,564	10,009
	5B (Grass/Hay)	32,766	59,362
	5C (Fir/Alder)	19,235	33,193
	5D (Poplar)	6,417	10,080
	6 (Grass/Hay)	9,960	14,162
	7 (Grass/Hay)	71,175	89,008
	7B (Poplar)	9,612	15,811
	8 (Grass/Hay)	16,364	49,843
	9 (Grass/Hay)	28,037	46,117

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		Proposed Early Warning Values: ^a Outfall # 001	
Parameter	Field Type	Average Monthly ^b	Maximum Daily ^c
	10 (Fir/Alder)	56,481	62,005
Hydraulic Loading ^f (gpd)	Fir/Alder	19.39	34.74
	Grass/Hay	9.82	25.77
	Poplar	24.75	50.26
	1 (Grass/Hay)	51.93	56.44
	2 (Fir/Alder)	27.60	39.40
	3 (Grass/Hay)	40.21	64.56
	4 (Grass/Hay)	16.09	23.43
	5A (Poplar)	172.54	263.11
	5B (Grass/Hay)	118.64	214.93
	5C (Fir/Alder)	151.20	260.92
	5D (Poplar)	146.22	229.69
	6 (Grass/Hay)	264.13	372.25
	7 (Grass/Hay)	8.32	14.91
	7B (Poplar)	185.63	305.35
	8 (Grass/Hay)	544.42	1,658.23
	9 (Grass/Hay)	57.10	93.93
	10 (Fir/Alder)	88.78	97.46
a	All values are in milligrams per liter (mg/L) unless noted otherwise.		
b	Average Monthly concentration is the average of all daily values for the reporting month.		
c	Maximum Daily concentration is the maximum allowable for any single day during a reporting month.		
d	Application Rate values are in inches (of water) per day (inches/day).		
e	Text in parenthesis is the crop for that field.		
f	Flow values are in gallons per day (gpd).		
g	Hydraulic Loading values are in inches (of water) per month (inches/month).		

IV. Monitoring Requirements

Ecology requires monitoring, recording, and reporting (WAC 173-216-110) to verify that the treatment process functions correctly, the discharge meets groundwater criteria and that the discharge complies with the permit's effluent limits.

If a facility uses a contract laboratory to monitor wastewater, it must ensure that the laboratory uses the methods and meets or exceeds the method detection levels required by the permit. The permit describes when facilities may use alternative methods. It also describes what to do in certain situations when the laboratory encounters matrix effects. When a facility uses an alternative method as allowed by the permit, it must report the test method, DL, and QL on the discharge monitoring report or in the required report.

A. Lab accreditation

Ecology requires that facilities must use a laboratory registered or accredited under the provisions of chapter 173-50 WAC, Accreditation of Environmental Laboratories, to prepare all monitoring data (with the exception of certain parameters).

B. Irrigated wastewater monitoring

Ecology details the proposed monitoring schedule under Special Condition S2.A. Specified monitoring frequencies take into account the quantity and variability of the discharge, the treatment method, past compliance, significance of pollutants, and cost of monitoring.

C. Vadose zone monitoring

Ecology details the proposed monitoring schedule under Special Condition S2.B. Vadose zone monitoring shall occur daily at locations downhill from any field irrigated that day. An additional reading shall be made at these same locations as early as practicable the following day, but must be before any new wastewater is applied.

After one year of vadose zone monitoring, including through one wet season (October to April), vadose zone monitoring stations will be evaluated for continued use. Stations that consistently show saturated or near saturated conditions will have groundwater monitoring wells installed at them. Vadose monitoring may continue at these locations as determined by Ecology and the Permittee.

Vadose zone monitoring locations that consistently show dry or only slightly wet conditions may have monitoring stopped. Any such request to cease monitoring must be made in writing by the Permittee following Permit Special Condition S2.I.

Vadose zone monitoring stations that fall between these two extremes will continue to be monitored. However, monitoring frequency may be reduced as determined by Ecology and the Permittee. Again any reduction in monitoring frequency, agreed or otherwise, must be made in writing by the Permittee following Permit Special Condition S2.I.

D. Groundwater monitoring

Groundwater monitoring will be necessary for any vadose zone monitoring location that, after the initial year of monitoring, shows moisture content at the soil/till boundary at saturated or near saturated conditions. At such a location, a monitoring well will be installed to collect samples of indicated groundwater.

Initial sample frequency will be established after well installation and will depend on the amount of water the well collects. Depth of water shall be measured daily until sufficient volume is accumulated to allow for collection and analysis of all parameters.

After ten successful sampling events Ecology will evaluate the data and may reduce the monitoring frequency. The reduced sampling frequency will be determined by any seasonal variation shown by the initial data, but in no case shall it be less than quarterly.

E. Soil monitoring

Ecology details the proposed monitoring schedule under Special Condition S2.D. Soil sampling will be performed once a year preferably in September, as this will be close to the end of the growing season. Four (4) composite samples shall be collected for each crop type spray-field for a total of 12 samples total. Each crop spray-field type shall have one composite for each one-foot increment to a total depth of four feet (increments to be 0-12 in., 12-24 in., 24-36 in., and 36-48 in.). Each depth sample shall be composite of soils collected at the center and at four random locations within the spray-field. The sampling process envisioned should be similar to the following:

1. Select four random locations in one of the Grass/Hay spray-fields (e.g., Area 1).
2. Using a hand auger or shovel collect one to two pounds of soil from 0-12 inches at location 1.

3. Repeat for each of the remaining three random locations and the center of the spray-field.
4. Place all the soils collected from 0-12 in into a large bowl.
5. Mix thoroughly.
6. Place a portion of the 0-12 in composited soils into the required sample jar(s).
7. Repeat steps 2 through 6 for each of the remaining depths (12-24 in., 24-36 in., and 36-48 in.) at Area 1 (as example).
8. Repeat steps 1 through 7 at one of the Poplar spray-fields and one of the Fir/Alder spray-fields.
9. As example: using a standard 4-in ID x 6-in long hand auger (all depths are approximate)
 - Go to the center of Area 4
 - Auger from 0 to 3 inches
 - Discard material
 - Auger from 3 to 9 inches
 - Place material in a clean container [preferably a large clean mixing bowl]
 - Auger from 9 to 15 inches
 - Discard material
 - Auger from 15 to 21 inches
 - Place material in a second clean container
 - Auger from 21 to 27 inches
 - Discard material
 - Auger from 27 to 33 inches
 - Place material in a third clean container
 - Auger from 33 to 39 inches
 - Discard material
 - Auger from 39 to 45 inches
 - Place material in a fourth clean container
 - Repeat the above for each of the remaining four locations selected in Area 4
 - When all five locations in Area 4 have been sampled; take all the soil collected from 3 to 9 inches (five containers worth) and place in a single large bowl
 - Mix the soils thoroughly
 - Fill the requisite sample jars for the analysis listed in Permit Condition S2.B
 - Repeat all the above at Poplar Area 7 and again at Fir/Alder Area 5c.

It is anticipated that for this permit cycle composite sampling of the Grass/Hay spray-fields will rotate each year to include samples from each Grass/Hay spray-field (Areas 1, 3, 4, 8, and 9). Composite sampling of the Fir/Alder spray-fields can alternate

between Areas 2, 5c, and 10. Composite sampling from the Poplar spray-fields should include the center of Area 7 each year and then random locations from within Areas 5a, 5b, 5d, 6, 7, and 7b. (As an example: for Poplar sampling; permit year 1 would sample the center of Area 7 and four additional locations [randomly selected] within Area 7. Permit year 2 would sample the center of Area 7 and one randomly selected location from each of Area 5a, 5b, 5d, and 6. Permit year 3 would restart the process in Area 7 sampling the same locations done in permit year 1. And so on.) Because the Poplar Spray-field Areas 5a, 5b, 5d, 6, 7, and 7b are small in comparison to Area 7, the collection of samples from Area 7 each year provides a means of normalization for the data.

The facility and Ecology use the soil monitoring data to monitor and evaluate wastewater application rates and to determine if salts and nutrients are flushing through the root zone and leaching to the groundwater. The presence and concentration of certain wastewater related parameters in the soils (e.g., nitrogen and salts) can indicate over application of wastewater. The facility must follow the analytical methods provided in *Soil, Plant and Water Reference Methods for the Western Region* (2003).

A general soil investigation was conducted by Schenk for the entire acreage of the spray-field site. The predominant soil type on the spray-field is Tokul Gravelly Loam with some Pastik Silt Loam. The minimum permeability horizon in Tokul Gravelly Loam is 0.6 inches per hour, which yields a conservative hydraulic loading limit of 14.4 inches per month. Hydraulic loading based on soil permeability is not the limiting factor in the Schenk land application area. Hydraulic loading based on nitrogen limits is the limiting factor in the Schenk land application area.

V. Other Permit Conditions

A. Reporting and record keeping

Ecology based Special Condition S3 on its authority to specify any appropriate reporting and recordkeeping requirements to prevent and control waste discharges (WAC 173-216-110).

The permit requires the Permittee to maintain adequate capacity to treat the flows and waste loading to the treatment plant (WAC 173-216-110[4]). For significant changes in loadings to the treatment works, the permit requires a new application and an engineering report (WAC 173-216-110[5]).

B. Irrigation and crop management plans

Ecology requires the irrigation and crop management plan to support the engineering report(s) and operations and maintenance manual. This plan must include a consideration of wastewater application at agronomic rates as required by Special Condition S1 and should describe and evaluate various irrigation controls.

Plans must comply with the requirements for an irrigation and crop management plan given in Ecology's guidance, *Guidelines for Preparation of Engineering Reports for Industrial Wastewater Land Application Systems*. (1993).

C. Operations and maintenance

Ecology requires dischargers to take all reasonable steps to properly operate and maintain their wastewater treatment system in accordance with state regulations (WAC 173-240-080 and WAC 173-216-110). The facility has prepared and must submit an update of an operation and maintenance (O&M) manual for the wastewater facility.

Implementation of the procedures in the operation and maintenance manual ensures the facility's compliance with the terms and limits in the permit and ensures the facility provides AKART to the waste stream.

D. Solid waste control plan

This proposed permit requires this facility to update the approved solid waste control plan designed to prevent solid waste from causing pollution of waters of the state. The facility must submit the updated plan to Ecology for review. You can obtain an Ecology guidance document, which describes how to develop a Solid Waste Control Plan, at: [Developing a Solid Waste Control Plan](#).

E. Vadose zone monitoring investigation

This permit cycle requires the Permittee to undertake a vadose zone monitoring investigation. The goal of this investigation is to conclusively determine what, if any, fields that receive treated wastewater are experiencing interflow and potentially contributing to unusual flow and coliform hits in Douglas Creek. Vadose zone monitoring is proposed for the subsurface at the soil/till boundary, downhill of all fields that border other properties.

This study will be initiated with the preparation of a scope of work (SOW) that will be reviewed and approved by Ecology. The SOW will generally follow the "*Guidelines for Preparation of Engineering Reports for Industrial Wastewater Land Application*

Systems," (Ecology 1993). Once approved the Permittee will move ahead with completion of the SOW.

Monitoring of installed vadose zone monitoring equipment will initially be daily for one year, and at least through one wet period (October to April). Daily monitoring will entail the recording of all available parameters, including moisture content, from all installed vadose zone monitoring devices. It is likely that only those locations downhill from a field irrigated that day will be read.

F. Best management practices

Best management practices (BMPs) are the actions identified to manage, prevent contamination of stormwater/groundwater. BMPs include schedules of activities, prohibitions of practices, maintenance procedures, and other physical, structural and/or managerial practices to prevent or reduce the pollution of waters of the state. BMPs also include treatment systems, operating procedures, and practices used to control plant site runoff, spillage or leaks, sludge or waste disposal, and drainage from raw material storage.

G. Best management practices – land treatment site

Best management practices (BMPs) are the actions identified to manage, prevent contamination of stormwater/groundwater. BMPs include schedules of activities, prohibitions of practices, maintenance procedures, and other physical, structural and/or managerial practices to prevent or reduce the potential to pollute waters of the state from the land application of wastewater.

H. General conditions

Ecology bases the standardized general conditions on state law and regulations. They are included in all individual industrial state waste discharge permits issued by Ecology.

VI. Permit Issuance Procedures

A. Permit modifications

Ecology may modify this permit to impose numerical limits, if necessary to comply with water quality standards for groundwater, based on new information from sources such as inspections, effluent monitoring, outfall studies, and effluent mixing studies.

Ecology may also modify this permit to comply with new or amended state regulations.

B. Proposed permit issuance

This proposed permit meets all statutory requirements for Ecology to authorize a wastewater discharge. The permit includes limits and conditions to protect human health and aquatic life, and the beneficial uses of waters of the state of Washington. Ecology proposes to issue this permit for a term of 5 years.

VII. References for Text and Appendices

EPA

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Appendix A--Public Involvement Information

Ecology proposes to reissue a permit to Schenk Packing Company, Inc. The permit includes wastewater discharge limits and other conditions. This fact sheet describes the facility and Ecology's reasons for requiring permit conditions.

Schenk Packing Co., Inc. reviewed the draft permit and fact sheet for factual accuracy. Ecology corrected any errors or omissions about the facility's location, history, product type or production rate, and discharges or receiving water prior to publishing this draft fact sheet for public use.

Ecology placed a Public Notice of Application on March 29, 2019 and April 5, 2019 in the Everett Herald to inform the public about the submitted application and to invite comment on the issuance of this permit.

Ecology will place a Public Notice of Draft on December 22, 2020 in the Everett Herald to inform the public and to invite comment on the proposed draft State Waste Discharge permit and fact sheet.

The notice:

- Told where copies of the draft Permit and Fact Sheet are available for public evaluation (a local public library, the closest Regional or Field Office, posted on our website).
- Offered to provide the documents in an alternate format to accommodate special needs.
- Urged people to submit their comments, in writing, before the end of the Comment Period
- Told how to request a public hearing of comments about the proposed state waste discharge permit.
- Explained the next step(s) in the permitting process.

You may obtain further information from Ecology by telephone, 425-649-7201, or by writing to the address listed below.

Water Quality Permit Coordinator
Department of Ecology
Northwest Regional Office 3190 160th Avenue SE
Bellevue, WA 98008-5452

The primary author of this permit and fact sheet is Christopher Martin.

Appendix B--Your Right to Appeal

You have a right to appeal this permit to the Pollution Control Hearing Board (PCHB) within 30 days of the date of receipt of the final permit. The appeal process is governed by chapter 43.21B RCW and chapter 371-08 WAC. "Date of receipt" is defined in RCW 43.21B.001(2) (see glossary).

To appeal you must do the following within 30 days of the date of receipt of this permit:

- File your appeal and a copy of this permit with the PCHB (see addresses below). Filing means actual receipt by the PCHB during regular business hours.
- Serve a copy of your appeal and this permit on Ecology in paper form - by mail or in person. (See addresses below.) E-mail is not accepted.

You must also comply with other applicable requirements in chapter 43.21B RCW and chapter 371-08 WAC.

ADDRESS AND LOCATION INFORMATION

Street Addresses	Mailing Addresses
Department of Ecology Attn: Appeals Processing Desk 300 Desmond Drive SE Lacey, WA 98503	Department of Ecology Attn: Appeals Processing Desk PO Box 47608 Olympia, WA 98504-7608
Pollution Control Hearings Board 1111 Israel RD SW STE 301 Tumwater, WA 98501	Pollution Control Hearings Board PO Box 40903 Olympia, WA 98504-0903

Appendix C--Glossary

AKART -- The acronym for “all known, available, and reasonable methods of prevention, control and treatment.” AKART is a technology-based approach to limiting pollutants from wastewater discharges, which requires an engineering judgment and an economic judgment. AKART must be applied to all wastes and contaminants prior to entry into waters of the state in accordance with RCW 90.48.010 and 520, WAC 173-200-030(2)(c)(ii), and WAC 173-216-110(1)(a).

Alternate point of compliance -- An alternative location in the groundwater from the point of compliance where compliance with the groundwater standards is measured. It may be established in the groundwater at locations some distance from the discharge source, up to, but not exceeding the property boundary and is determined on a site specific basis following an AKART analysis. An “early warning value” must be used when an alternate point is established. An alternate point of compliance must be determined and approved in accordance with WAC 173-200-060(2).

Ammonia -- Ammonia is produced by the breakdown of nitrogenous materials in wastewater. Ammonia is toxic to aquatic organisms, exerts an oxygen demand, and contributes to eutrophication. It also increases the amount of chlorine needed to disinfect wastewater.

Annual average design flow (AADF) -- The average of the daily flow volumes anticipated to occur over a calendar year.

Average monthly discharge limit -- The average of the measured values obtained over a calendar months' time.

Background water quality -- The concentrations of chemical, physical, biological or radiological constituents or other characteristics in or of groundwater at a particular point in time up gradient of an activity that has not been affected by that activity, [WAC 173-200-020(3)]. Background water quality for any parameter is statistically defined as the 95% upper tolerance interval with a 95% confidence based on at least eight hydraulically up gradient water quality samples. The eight samples are collected over a period of at least one year, with no more than one sample collected during any month in a single calendar year.

Best management practices (BMPs) -- Schedules of activities, prohibitions of practices, maintenance procedures, and other physical, structural and/or managerial practices to prevent or reduce the pollution of waters of the state. BMPs include treatment systems, operating procedures, and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage. BMPs may be further categorized as operational, source control, erosion and sediment control, and treatment BMPs.

BOD₅ -- Determining the five-day Biochemical Oxygen Demand of an effluent is an indirect way of measuring the quantity of organic material present in an effluent that is utilized by

bacteria. The BOD₅ is used in modeling to measure the reduction of dissolved oxygen in receiving waters after effluent is discharged. Stress caused by reduced dissolved oxygen levels makes organisms less competitive and less able to sustain their species in the aquatic environment. Although BOD₅ is not a specific compound, it is defined as a conventional pollutant under the federal Clean Water Act.

Bypass -- The intentional diversion of waste streams from any portion of a treatment facility.

Chlorine -- A chemical used to disinfect wastewaters of pathogens harmful to human health. It is also extremely toxic to aquatic life.

Compliance inspection-without sampling -- A site visit for the purpose of determining the compliance of a facility with the terms and conditions of its permit or with applicable statutes and regulations.

Compliance inspection-with sampling -- A site visit for the purpose of determining the compliance of a facility with the terms and conditions of its permit or with applicable statutes and regulations. In addition it includes as a minimum, sampling and analysis for all parameters with limits in the permit to ascertain compliance with those limits; and, for municipal facilities, sampling of influent to ascertain compliance with the 85 percent removal requirement. Ecology may conduct additional sampling.

Composite sample -- A mixture of grab samples collected at the same sampling point at different times, formed either by continuous sampling or by mixing discrete samples. May be "time-composite" (collected at constant time intervals) or "flow-proportional" (collected either as a constant sample volume at time intervals proportional to stream flow, or collected by increasing the volume of each aliquot as the flow increased while maintaining a constant time interval between the aliquots).

Continuous monitoring -- Uninterrupted, unless otherwise noted in the permit.

Date of receipt -- This is defined in RCW 43.21B.001(2) as five business days after the date of mailing; or the date of actual receipt, when the actual receipt date can be proven by a preponderance of the evidence. The recipient's sworn affidavit or declaration indicating the date of receipt, which is unchallenged by the agency, constitutes sufficient evidence of actual receipt. The date of actual receipt, however, may not exceed forty-five days from the date of mailing.

Detection limit -- The minimum concentration of a substance that can be measured and reported with 99 percent confidence that the pollutant concentration is above zero and is determined from analysis of a sample in a given matrix containing the pollutant.

Distribution uniformity -- The uniformity of infiltration (or application in the case of sprinkle or trickle irrigation) throughout the field expressed as a percent relating to the average depth infiltrated in the lowest one-quarter of the area to the average depth of water infiltrated.

Early warning value -- The concentration of a pollutant set in accordance with WAC 173-200-070 that is a percentage of an enforcement limit. It may be established in the effluent, groundwater, surface water, the vadose zone or within the treatment process. This value acts as a trigger to detect and respond to increasing contaminant concentrations prior to the degradation of a beneficial use.

Enforcement limit -- The concentration assigned to a contaminant in the groundwater at the point of compliance for the purpose of regulation, [WAC 173-200-020(11)]. This limit assures that a groundwater criterion will not be exceeded and that background water quality will be protected.

Engineering report -- A document that thoroughly examines the engineering and administrative aspects of a particular domestic or industrial wastewater facility. The report must be signed by a professional engineer, and contain the appropriate information required in WAC 173-240-060 or 173-240-130.

Fecal coliform bacteria -- Fecal coliform bacteria are used as indicators of pathogenic bacteria in the effluent that are harmful to humans. Pathogenic bacteria in wastewater discharges are controlled by disinfecting the wastewater. The presence of high numbers of fecal coliform bacteria in a water body can indicate the recent release of untreated wastewater and/or the presence of animal feces.

Grab sample -- A single sample or measurement taken at a specific time or over as short a period of time as is feasible.

Groundwater -- Water in a saturated zone or stratum beneath the surface of land or below a surface water body.

Industrial wastewater -- Water or liquid-carried waste from industrial or commercial processes, as distinct from domestic wastewater. These wastes may result from any process or activity of industry, manufacture, trade or business; from the development of any natural resource; or from animal operations such as feed lots, poultry houses, or dairies. The term includes contaminated storm water and, also, leachate from solid waste facilities.

Maximum daily discharge limit -- The highest allowable daily discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. The daily discharge is calculated as the average measurement of the pollutant over the day.

Maximum day design flow (MDDF) -- The largest volume of flow anticipated to occur during a one-day period, expressed as a daily average.

Maximum month design flow (MMDF) -- The largest volume of flow anticipated to occur during a continuous 30-day period, expressed as a daily average.

Method detection level (MDL) -- See Detection Limit.

pH -- The pH of a liquid measures its acidity or alkalinity. It is the negative logarithm of the hydrogen ion concentration. A pH of 7 is defined as neutral and large variations above or below this value are considered harmful to most aquatic life.

Point of compliance -- The location in the groundwater where the enforcement limit must not be exceeded and a facility must comply with the Groundwater Quality Standards. Ecology determines this limit on a site-specific basis. Ecology locates the point of compliance in the groundwater as near and directly down gradient from the pollutant source as technically, hydrogeologically, and geographically feasible, unless it approves an alternative point of compliance.

Quantitation level (QL) -- Also known as Minimum Level of Quantitation (ML) – The lowest level at which the entire analytical system must give a recognizable signal and acceptable calibration point for the analyte. It is equivalent to the concentration of the lowest calibration standard, assuming that the lab has used all method-specified sample weights, volumes, and cleanup procedures. The QL is calculated by multiplying the MDL by 3.18 and rounding the result to the number nearest to (1, 2, or 5) $\times 10^n$, where n is an integer (64 FR 30417).

ALSO GIVEN AS:

The smallest detectable concentration of analyte greater than the Detection Limit (DL) where the accuracy (precision & bias) achieves the objectives of the intended purpose. (Report of the Federal Advisory Committee on Detection and Quantitation Approaches and Uses in Clean Water Act Programs Submitted to the US Environmental Protection Agency, December 2007).

Reasonable potential -- A reasonable potential to cause a water quality violation, or loss of sensitive and/or important habitat.

Responsible corporate officer -- A president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy- or decision-making functions for the corporation, or the manager of one or more manufacturing, production, or operating facilities employing more than 250 persons or have gross annual sales or expenditures exceeding \$25 million (in second quarter 1980 dollars), if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures (40 CFR 122.22).

Soil scientist -- An individual who is registered as a Certified or Registered Professional Soil Scientist or as a Certified Professional Soil Specialist by the American Registry of Certified Professionals in Agronomy, Crops, and Soils or by the National Society of Consulting Scientists or who has the credentials for membership. Minimum requirements for eligibility are: possession of a baccalaureate, masters, or doctorate degree from a U.S. or Canadian institution with a minimum of 30 semester hours or 45 quarter hours professional core courses in agronomy, crops or soils, and have 5,3,or 1 years, respectively, of professional experience working in the area of agronomy, crops, or soils.

Solid waste -- All putrescible and non-putrescible solid and semisolid wastes including, but not limited to, garbage, rubbish, ashes, industrial wastes, swill, sewage sludge, demolition and construction wastes, abandoned vehicles or parts thereof, contaminated soils and contaminated dredged material, and recyclable materials.

State waters -- Lakes, rivers, ponds, streams, inland waters, underground waters, salt waters, and all other surface waters and watercourses within the jurisdiction of the state of Washington.

Storm water -- That portion of precipitation that does not naturally percolate into the ground or evaporate, but flows via overland flow, interflow, pipes, and other features of a storm water drainage system into a defined surface water body, or a constructed infiltration facility.

Technology-based effluent limit -- A permit limit based on the ability of a treatment method to reduce the pollutant.

Total coliform bacteria -- A microbiological test, which detects and enumerates the total coliform group of bacteria in water samples.

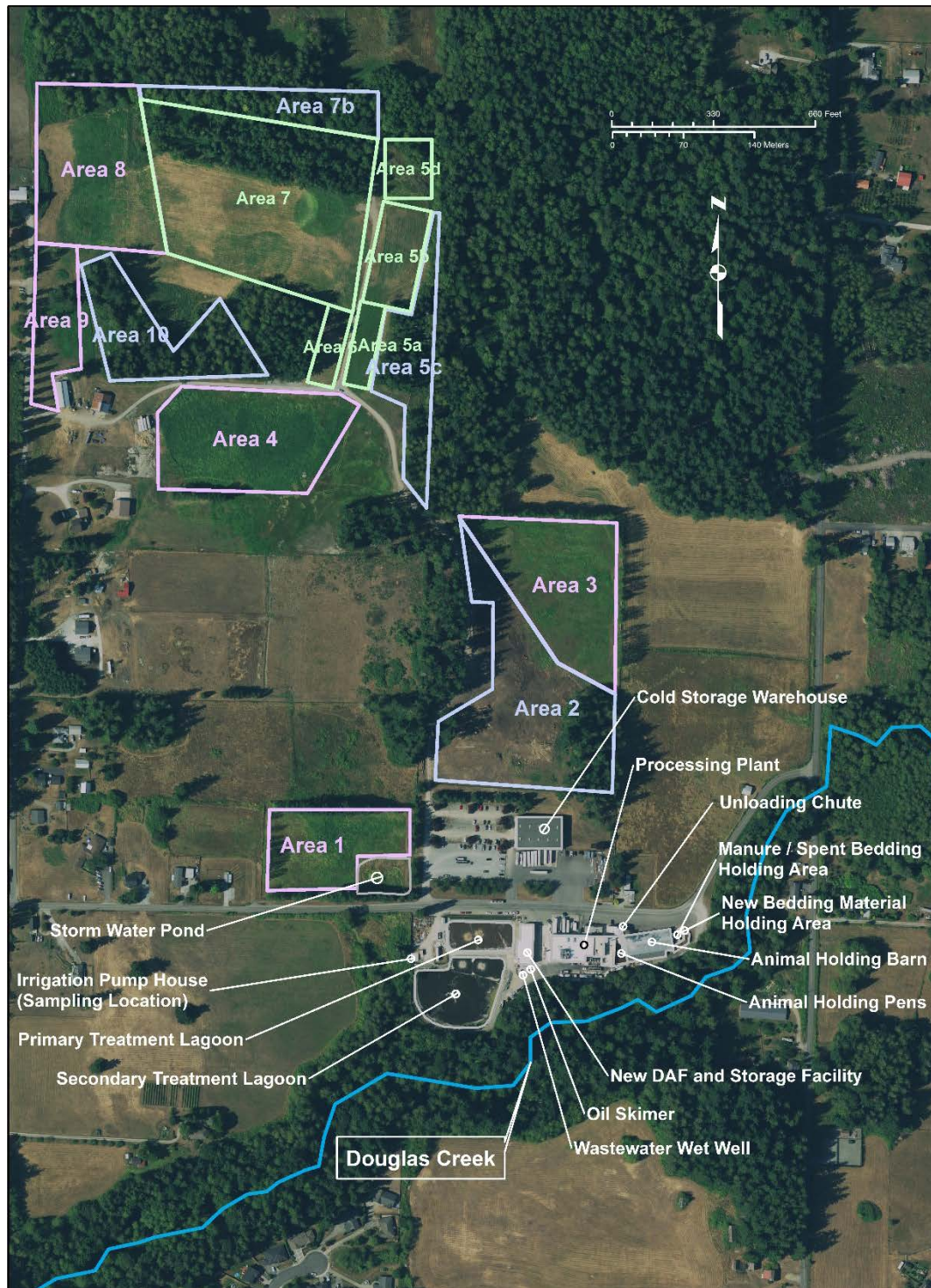
Total dissolved solids -- That portion of total solids in water or wastewater that passes through a specific filter.

Total suspended solids (TSS) -- Total suspended solids are the particulate material in an effluent. Large quantities of TSS discharged to receiving water may result in solids accumulation. Apart from any toxic effects attributable to substances leached out by water, suspended solids may kill fish, shellfish, and other aquatic organisms by causing abrasive injuries and by clogging the gills and respiratory passages of various aquatic fauna. Indirectly, suspended solids can screen out light and can promote and maintain the development of noxious conditions through oxygen depletion.

Upset -- An exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limits because of factors beyond the reasonable control of the Permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, lack of preventative maintenance, or careless or improper operation.

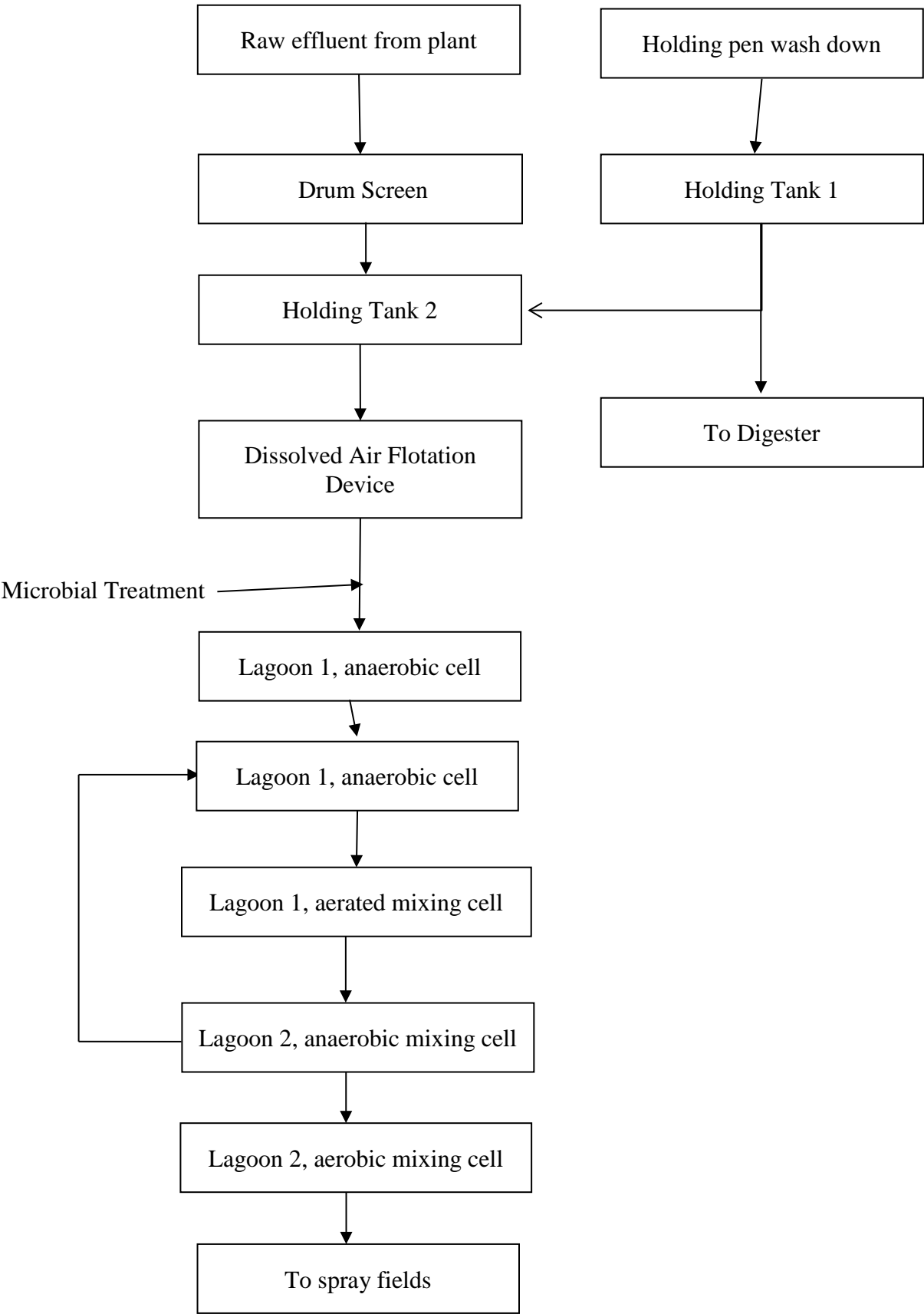
Appendix D--Technical Calculations

Figure 2 - Facility Layout



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Figure 3 - Schenk Nitrification/Denitrification Treatment Process



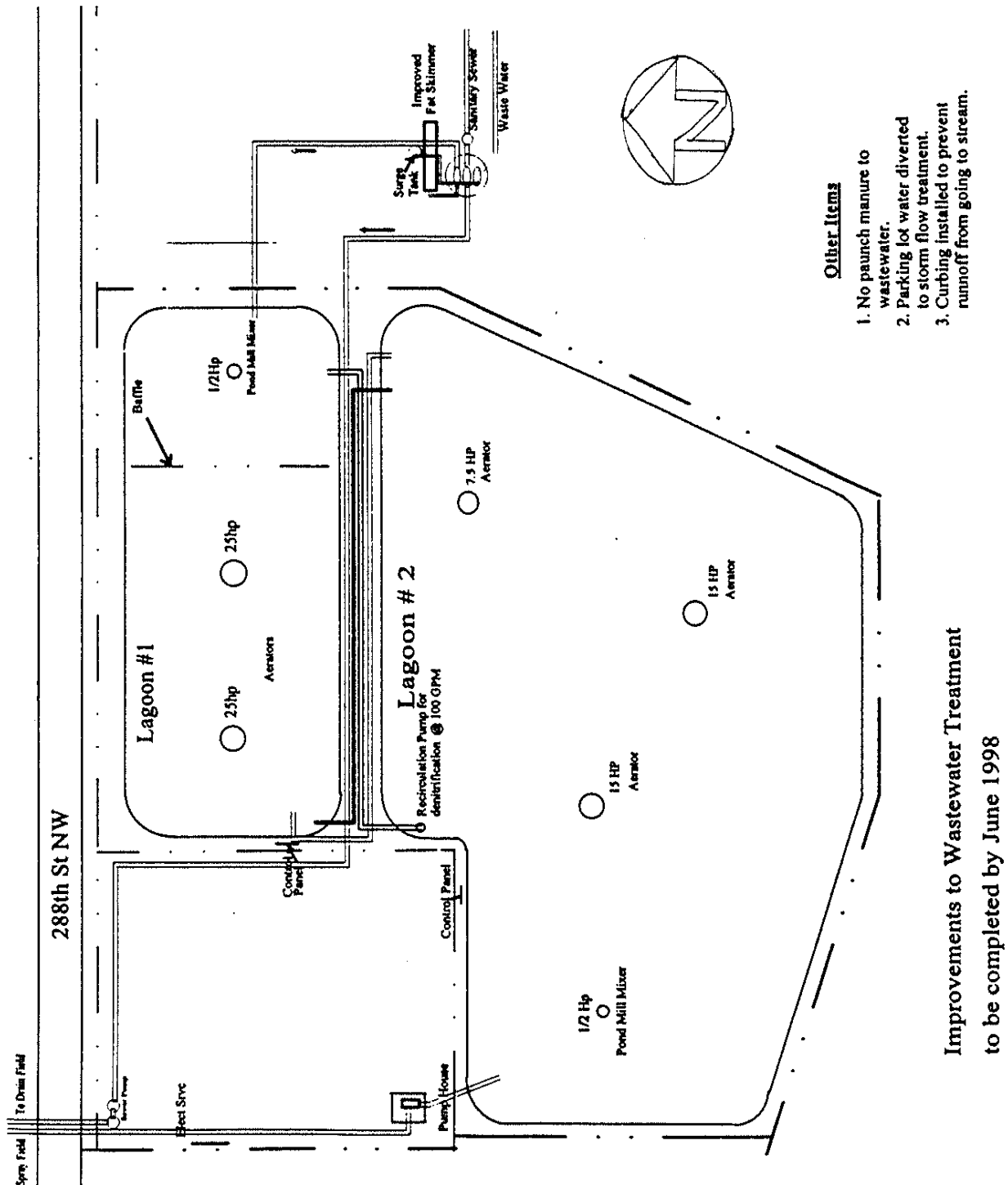


Figure 4 - Schenk Packing Wastewater Treatment System

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Table D-11 - Wastewater Discharge Monitoring Data Prior to Land Application

PARAMETER	UNITS	YEAR	January	February	March	April	May	June	July	August	September	October	November	December	AVERAGE	MINIMUM	MAXIMUM
Flow (to spray field)	gpd	2009	85,627	84,980	85,831	87,458	89,205	89,860	92,239	95,951	90,062	90,133	88,787	85,961	88,841	84,980	95,951
Flow (to spray field)	gpd	2010	85,920	84,498	85,894	86,129	86,081	85,867	85,863	86,805		86,813	86,887	84,983	85,976	84,498	86,887
Flow (to spray field)	gpd	2011	85,636	74,032	81,218	85,061	85,458	85,778	86,815	85,174	86,774	86,353	87,044	86,862	84,684	74,032	87,044
Flow (to spray field)	gpd	2012	77,364	87,333	86,411	87,235	87,015	86,194	87,320	87,898	86,363	87,058	88,787	85,950	86,244	77,364	88,787
Flow (to spray field)	gpd	2013	86,411	86,759	85,671	86,686	73,634	84,618	81,532			66,102.6	66,607.9	66,622.6	78,464	66,103	86,759
Flow (to spray field)	gpd	2014	73,842.5	72,886.9	71,417.8	71,949.9	69,354.2	68,291.0	70,517.4	66,624.1	65,578.2	68,647.2	62,564.9	67,510.9	69,099	62,565	73,843
Flow (to spray field)	gpd	2015	68,275.7	68,897.7	63,780.7	69,410.9	63,662.1	66,768.1	68,647.9	59,169.9	64,604.0	27,762.9	56,005.9	56,723.9	61,142	27,763	69,411
Flow (to spray field)	gpd	2016	63,613.6	59,291.1	50,431.6	63,042.8	51,529.7	51,866.9	29,017.7	56,452.2	49,599.8	56,597.0	58,856.1	54,409.8	53,726	29,018	63,614
Flow (to spray field)	gpd	2017	57,283.7	49,712.0	42,883.1	54,396.0	54,984.5	55,301.5	59,945.3	52,798.5	55,277.3	52,912.7	51,352.6	45,020.8	52,656	42,883	59,945
Flow (to spray field)	gpd	2018	62,667.6	60,680.1	58,237.9	64,914.5	66,772.4	65,021.2	62,085.5	72,915.5	69,935.3	72,481.3	62,066.3	63,883.2	65,138	58,238	72,916
Hydraulic Loading	(in / month)	2009	2.17	1.95	2.18	2.15	2.26	2.21	2.34	2.43	2.21	2.29	2.18	2.18	2.21	1.95	2.43
Hydraulic Loading	(in / month)	2010	2.18	1.94	2.18	2.11	2.18	2.11	2.18	2.2		2.2	2.13	2.16	2.14	1.94	2.20
Hydraulic Loading	(in / month)	2011	2.17	1.7	2.06	2.09	2.17	2.11	2.2	2.16	2.13	2.19	2.14	2.2	2.11	1.70	2.20
Hydraulic Loading	(in / month)	2012	1.96	2.07	2.19	2.14	2.21	2.12	2.22	2.23	2.12	2.21	2.18	2.18	2.15	1.96	2.23
Hydraulic Loading	(in / month)	2013	1.73	1.58	1.62	1.70	1.62	1.64	1.74	1.50	1.59	0.70	1.38	1.44	1.95	1.63	2.19
Hydraulic Loading	(in / month)	2014	1.61	1.41	1.28	1.55	1.24	1.27	0.74	1.39	1.22	1.44	1.45	1.38	1.72	1.54	1.87
Hydraulic Loading	(in / month)	2015	1.45	1.14	1.09	1.34	1.33	1.36	1.46	1.34	1.36	1.34	1.26	1.14	1.52	0.7044	1.74
Hydraulic Loading	(in / month)	2016	1.59	1.39	1.48	1.59	1.69	1.60	1.58	1.85	1.72	1.84	1.52	1.62	1.33	0.7363	1.61
Hydraulic Loading	(in / month)	2017	1.73	1.58	1.62	1.70	1.62	1.64	1.74	1.50	1.59	0.70	1.38	1.44	1.301	1.09	1.46
Hydraulic Loading	(in / month)	2018	1.61	1.41	1.28	1.55	1.24	1.27	0.74	1.39	1.22	1.44	1.45	1.38	1.62	1.39	1.85
BOD ₅	(mg/L)	2009	290	370	94	260	120	47	81	64	70	49	91	140	140	47	370
BOD ₅	(mg/L)	2010	200	240	62	64	100	76	56	47		28	54	92	93	28	240
BOD ₅	(mg/L)	2011	390	310	330	130	97	50	63	67	200	63	88	200	166	50	390
BOD ₅	(mg/L)	2012	40	390	160	220	150	91	47	44	41	63	150	140	128	40	390
BOD ₅	(mg/L)	2013	200	480	390	110	240	130	43			64	120	130	190.7	43	480
BOD ₅	(mg/L)	2014	570	680	140	140	100	160	75	90	170	73	57	87	195.17	57	680
BOD ₅	(mg/L)	2015	140	160	120	160	140	66	90	64	260	230	140	73	136.92	64	260
BOD ₅	(mg/L)	2016	410	440	300	180	190	170	320	170	91	140	180	75	222.17	75	440
BOD ₅	(mg/L)	2017	77	70	150	120	160	130	53	132	52	322	83	51	116.67	51	322
BOD ₅	(mg/L)	2009	7.2	7.2	7.2	7.1	7.1	7.1	7.1	7.2	7.0	7.1	7.0	7.2	7.1	7.0	7.2

PARAMETER	UNITS	YEAR	January	February	March	April	May	June	July	August	September	October	November	December	AVERAGE	MINIMUM	MAXIMUM
pH	(SU)	2010	7.1	7.1	7	7.1	7.2	7.1	7.1	7.1		7.1	7.2	7.3	7.1	7.0	7.3
pH	(SU)	2011	7.1	7.1	7	7	7	7.1	7.1	7.1	7	7.1	7	7	7.1	7.0	7.1
pH	(SU)	2012	7	7	7	7	7	7	7	7	7.2	7	7	7	7.0	7.0	7.2
pH	(SU)	2013	7	7	7	7	7	7	7	6.93		7.01	6.91	6.995	6.99	6.91	7.01
pH	(SU)	2014	6.99	7.07	7	7.02	7.02	7.02	7.03	7.01	6.99	7.01	6.99	7.02	7.01	6.93	7.07
pH	(SU)	2015	7.02	6.99	7.13	7.01	6.99	7.03	7.02	6.99	7.01	6.99	6.99	7.02	7.02	6.99	7.13
pH	(SU)	2016	7.01	7.03	6.99	7.01	6.99	6.99	7.01	6.99	7.1	6.97	6.99	7.03	7.01	6.97	7.1
pH	(SU)	2017	7.03	6.99	6.97	6.98	6.93	6.99	7.03	6.99	6.99	6.99	6.99	6.99	6.99	6.93	7.03
pH	(SU)	2018	7.03	7.03	7.09	6.99	6.99	6.98	7.18	6.93	6.99	6.98	6.99	6.99	7.02	6.98	7.18
pH	(SU)	2013	7	7	7	7	7	7	7	7.01	6.99	7.01	6.91	6.995	6.99	6.91	7.01
TKN	(mg/L)	2009	53.000	42.750	22.050	14.500	10.200	7.300	19.000	16.000	10.050	7.250	8.950	20.500	19.30	7.25	53.00
TKN	(mg/L)	2010	21	14.9	13.9	14.1	18.2	11.35	13.75	23		4.75	5.9	24.6	15.04	4.75	24.60
TKN	(mg/L)	2011	87.5	19.5	18.5	8.95	6.75	6.35	9.7	25.5	61	12	5.35	13.5	22.88	5.35	87.50
TKN	(mg/L)	2012	14	43	24.5	21.5	20	9.75	7.3	23.5	54.5	29	21.5	21	24.13	7.30	54.50
TKN	(mg/L)	2013	32.5	56	42	33	45	59	43			25.5	12.1	33	38.11	12.1	59
TKN	(mg/L)	2014	37.05	34.5	23	36	19.5	29.3	18	56.5	43.5	19.5	26	48.5	32.61	18	56.5
TKN	(mg/L)	2015	16.5	29.5	29.5	31	29	37	60.5	70.5	13.5	33	9.75	32.5	32.69	9.75	70.5
TKN	(mg/L)	2016	34	96.5	106.45	73.5	130	125	126	126	96.5	65.5	28.5	18.25	85.52	18.25	130
TKN	(mg/L)	2017	34.5	42.3	52.5	39.5	42.5	39	50.45	53.05	17.4	50.3	15.45	20.35	38.11	15.45	53.05
TKN	(mg/L)	2018	28.35	26.95	55.85	18.7	11.2	16.75	22.95	10.73	12.7	15.815	40.25	26.7	23.91	10.73	55.85
Nitrate plus Nitrite	(mg/L)	2009	24.260	19.383	25.615	26.195	15.100	14.510	16.100	4.000	16.535	25.600	24.635	26.580	19.88	4.00	26.58
Nitrate plus Nitrite	(mg/L)	2010	21.025	20.02	13.185	14.205	15.03	2.16	9.785	7.245		12.565	1.349	19.35	12.36	1.35	21.03
Nitrate plus Nitrite	(mg/L)	2011	22.8	53.87	48.16	27.441	21.95	16.425	13.69	7.69	8.05	9.525	19.645	34.655	23.66	7.69	53.87
Nitrate plus Nitrite	(mg/L)	2012	17.685	44.425	4.855	1.095	10.6	14.75	8.9	0.485	2.778	6.27	9.155	20.264	11.77	0.49	44.43
Nitrate plus Nitrite	(mg/L)	2013	9.575	0.204	4.695	0.76	1.945	0.84	1.265			14.21	20.75	23.2	7.74	0.204	23.2
Nitrate plus Nitrite	(mg/L)	2014	17.37	16.93	16.265	1.63	7.72	4.72	2.5	1.11	11.375	8.705	3.755	6.15	8.19	1.11	17.37
Nitrate plus Nitrite	(mg/L)	2015	23.915	16	14.745	15	4.41	1.31	0.47	0.95	6.76	6.725	5.3	18.09	9.47	0.47	23.92
Nitrate plus Nitrite	(mg/L)	2016	15.985	0.364	0.555	0.58	0.84	1.035	0.6095	1.38	0.465	2.33	3.51	10.6845	3.19	0.364	15.99
Nitrate plus Nitrite	(mg/L)	2017	8.13	1.88	2.333	2.915	1.52	0.265	0.154	4.4085	10.67	2.08	26.69	26.785	7.32	0.154	26.79
Nitrate plus Nitrite	(mg/L)	2018	35.47	19.765	29.495	32.11	18.295	13.205	1.265	12.545	16.365	21.42	11.175	34.47	20.88	6.195	35.47

PARAMETER	UNITS	YEAR	January	February	March	April	May	June	July	August	September	October	November	December	AVERAGE	MINIMUM	MAXIMUM
TOTAL NITROGEN2	(mg/L)	2009	77.26	62.13	47.67	40.70	25.30	21.81	35.10	20.00	26.59	32.85	33.59	47.08	39.17	20	77.26
TOTAL NITROGEN2	(mg/L)	2010	42.03	34.92	27.09	28.31	33.23	13.51	23.54	30.25		17.32	7.25	43.95	27.397	7.25	43.95
TOTAL NITROGEN2	(mg/L)	2011	110.30	73.37	66.66	36.39	28.70	22.78	23.39	33.19	69.05	21.53	25.00	48.16	46.54	21.53	110.3
TOTAL NITROGEN2	(mg/L)	2012	31.69	87.43	29.36	22.60	30.60	24.50	16.20	23.99	57.28	35.27	30.66	41.26	35.901	16.2	87.43
TOTAL NITROGEN2	(mg/L)	2013	42.08	56.20	46.70	33.76	46.95	59.84	44.27	0.00	0.00	39.71	32.85	56.20	45.85	32.85	59.84
TOTAL NITROGEN2	(mg/L)	2014	54.42	51.43	39.27	37.63	27.22	34.02	20.50	57.61	54.88	28.21	29.76	54.65	40.798	20.5	57.61
TOTAL NITROGEN2	(mg/L)	2015	40.42	45.50	44.25	46.00	33.41	38.31	60.97	71.45	20.26	39.73	15.05	50.59	42.16	15.05	71.45
TOTAL NITROGEN2	(mg/L)	2016	49.99	96.86	107.01	74.08	130.84	126.04	126.61	127.38	96.97	67.83	32.01	28.93	88.71	28.93	130.84
TOTAL NITROGEN2	(mg/L)	2017	42.63	44.18	54.83	42.42	44.02	39.27	50.60	57.46	28.07	52.38	42.14	47.14	45.43	28.07	57.46
TOTAL NITROGEN2	(mg/L)	2018	63.82	46.72	85.35	50.81	29.50	29.96	29.15	23.28	29.07	37.24	51.43	61.17	44.79	23.28	85.35
Total Fecal Coliform	(Colonies per 100mL)	2009	20	210	100	360	40	10	10	40	40	40	10	50	78	10	360
Total Fecal Coliform	(Col. per 100mL)	2010	230	10	220	230	640	90	10	10		10	10	70	139	10	640
Total Fecal Coliform	(Col. per 100mL)	2011	90	30	80	20	10	30	100	70	260	30	60	20	67	10	260
Total Fecal Coliform	(Col. per 100mL)	2012	10	30	510	140	90	30	20	40	290	250	70	130	134	10	510
Total Fecal Coliform	(Col. per 100mL)	2013	510	160	240	30	10	170	310			40	100	120	169	10	510
Total Fecal Coliform	(Col. per 100mL)	2014	10	40	10	9	9	9	20	9	10	9	9	9	12.75	9	40
Total Fecal Coliform	(Col. per 100mL)	2015	10	90	9	9	9	270	10	20	70	10	10	20	44.75	9	270
Total Fecal Coliform	(Col. per 100mL)	2016	80	110	200	90	10	10	9	9	9	60	9	10	50.5	9	200
Total Fecal Coliform	(Col. per 100mL)	2017	10	9	9	9	9	9	9	9	9	9	9	9	9.08	9	10
Total Fecal Coliform	(Col. per 100mL)	2018	9	9	10	9	9	2,613	327	1,314	383	723	24,196	10,462	3,338.67	9	24,196
TDS	(mg/L)	2009	680	420	790	680	740	770	780	830	800	630	670	640	703	420	830
TDS	(mg/L)	2010	710	710	720	730	670	690	760	820		660	640	640	705	640	820
TDS	(mg/L)	2011	770	780	740	700	710	670	650	690	740	720	650	620	703	620	780
TDS	(mg/L)	2012	730	760	740	730	670	720	740	850	760	770	570	570	718	570	850
TDS	(mg/L)	2013	490	820	700	1,300	720	720	720			660	660	650	744	490	1300
TDS	(mg/L)	2014	660	680	680	680	670	660	640	700	670	680	630	680	669.17	630	700
TDS	(mg/L)	2015	680	620	650	610	580	660	690	720	710	560	660	650	649.17	560	720
TDS	(mg/L)	2016	720	680	620	780	720	600	700	900	650	770	540	490	680.83	490	900
TDS	(mg/L)	2017	620	190	610	640	640	720	760	710	670	640	696	634	627.5	190	760
TDS	(mg/L)	2018	728	677	680	647	661	726	699	779	744	754	652	704	704.25	647	779
Oil and Grease	(mg/L)	2009	7.0	10.0	7.7	5.3	4.8	5.6	11.1	4.7	7.7	8.3	6.8	7.5	7.2	4.7	11.1

PARAMETER	UNITS	YEAR	January	February	March	April	May	June	July	August	September	October	November	December	AVERAGE	MINIMUM	MAXIMUM
Oil and Grease	(mg/L)	2010	6.3	6.7	7.1	7.2	5.4	6.7	5.5	6.5		8.3	6.2	6.9	6.6	5.4	8.3
Oil and Grease	(mg/L)	2011	7.6	7.6	6.4	6.6	3.1	9.5	5.3	5.3	10.4	4.8	4.4	11.4	6.9	3.1	11.4
Oil and Grease	(mg/L)	2012	5.9	5.3	6.8	6.6	5.7	3.9	13.4	12.8	4.9	5.2	4.6	8.3	7.0	3.9	13.4
Oil and Grease	(mg/L)	2013	9.8	14	6.8	7.6	7	5.6	1.8			2.6	11	6	7.74	1.8	14
Oil and Grease	(mg/L)	2014	1.4	7.1	12	8.4	5.5	4.8	3.2	6.9	5.5	1.3	1.3	4.2	4.63	1.3	8.4
Oil and Grease	(mg/L)	2015	4	6.7	6	7.8	7.3	3.6	4.6	3.4	5.4	9.4	5.1	7.4	5.99	3.4	9.4
Oil and Grease	(mg/L)	2016	14	8	7.2	11	12	8.5	15	19	10	14	2.6	5.3	10.95	2.6	19
Oil and Grease	(mg/L)	2017	13	5.5	12	4.6	2.5	5.8	3.4	1.5	1.8	6.6	4.3	3.4	4.72	1.5	13
Oil and Grease	(mg/L)	2018	2.6	3.2	4.2	3.4	0	0	0	0	1.6	1.1	1.1	2.1	2.4	1.1	4.1
Total Nitrogen (as N)	(lbs./acre/month)	2009	37.83	28.24	21.92	19.69	12.90	10.84	18.51	10.97	13.47	16.93	16.50	23.14	19.25	10.84	37.83
Total Nitrogen (as N)	(lbs./acre/month)	2010	20.65	15.86	13.30	13.49	16.36	6.42	11.55	15.01		8.60	4.13	21.36	13.34	4.13	21.36
Total Nitrogen (as N)	(lbs./acre/month)	2011	54.01	29.05	30.96	17.13	14.02	10.81	221.96	16.16	33.15	10.63	12.04	23.92	21.96	10.63	54.01
Total Nitrogen (as N)	(lbs./acre/month)	2012	14.02	40.84	14.50	10.91	15.22	11.69	8.09	16.68	27.37	17.56	15.06	20.28	17.68	8.09	40.84
Total Nitrogen (as N)	(lbs./acre/month)	2013	20.541	26.082	22.873	16.193	19.765	28.018	20.636	16.681		15.009	12.107	21.408	20.26	12.11	28.02
Total Nitrogen (as N)	(lbs./acre/month)	2014	22.977	19.354	16.034	14.981	11.46	8.3	2.61	1.31	12.07	9.71	3.95	7.11	10.82	1.31	22.98
Total Nitrogen (as N) ^A	(lbs./acre/month)	2015 ^B	4.45	4.16	5.45	0.79	3.38	3.84	1.03	1.08	0.37	0	1.34	1.08	2.45	0.37	5.45
Total Nitrogen (as N)	(lbs./acre/month)	2016 ^B	1.46	1.93	2.41	2.24	8.71	2.54	0	3.9	9.99	6.11	3.87	0.42	17.04	5.98	27.26
Total Nitrogen (as N)	(lbs./acre/month)	2017 ^B	5.21	3.64	0.93	5.69	1.42	5.97	5.05	0.69	0.59	2.12	0.74	1.65	13.01	3.46	25.97
Total Nitrogen (as N)	(lbs./acre/month)	2018 ^B	9.98	1.7	3.68	2.14	1.51	4.04	2.81	1.47	3.63	5.19	8.99	8.33	3.96	0.42	9.99
Total Nitrogen (as N)	(lbs./acre/month)	2015 ^C	18.65	20.09	19.12	19.71	15.45	16.77	25.27	27.26	8.19	7.24	5.98	20.73	32.58	9.98	55.53
Total Nitrogen (as N)	(lbs./acre/month)	2016 ^C	24.03	42.05	42.04	31.98	55.53	43.53	24.88	52.14	25.05	29.18	10.62	9.98	20.58	9.13	32.62
Total Nitrogen (as N)	(lbs./acre/month)	2017 ^C	14.4	13.93	14.34	12.63	14.51	12.96	17.89	20.78	10.69	17.52	13.12	12.51	2.81	0.59	5.97
Total Nitrogen (as N)	(lbs./acre/month)	2018 ^C	26.57	17	24.23	18.78	11.76	9.13	9.47	7.16	9.4	14.25	17.01	13.09	14.61	10.69	20.78
Total Nitrogen (as N)	(lbs./acre/month)	2015 ^D	13.83	12.43	13.93	14.5	9.24	12.38	25.97	23.9	7.12	6.11	3.46	13.2	13.62	7.11	18.66
Total Nitrogen (as N)	(lbs./acre/month)	2016 ^D	13.17	20.41	20.68	21.59	20.88	31.97	19.34	32.62	30.92	14.95	11.25	9.13	4.46	1.47	9.98
Total Nitrogen (as N)	(lbs./acre/month)	2017 ^D	16.17	9.18	14.33	14.12	15.02	11.76	18.66	15.54	7.11	15.9	12.32	13.37	14.82	7.16	26.57
Total Nitrogen (as N)	(lbs./acre/month)	2018 ^D	20.08	13.65	38.13	20.24	12.22	14.13	12.77	14.46	14.99	18.71	19.98	37.01	19.698	12.22	38.13
Total Nitrogen (as N)	(lbs./acre/yr.)	2009	255.17	247.17	245.55	243.83	236.604	229.91	236.89	231.79	230.45	234.07	229.19	230.96	237.63	229.19	255.17
Total Nitrogen (as N)	(lbs./acre/yr.)	2010	213.78	201.399	192.78	186.58	190.03	185.603	178.65	182.68		166.16	153.79	152.01	182.13	152.01	213.78
Total Nitrogen (as N)	(lbs./acre/yr.)	2011	185.37	198.56	216.21	219.85	217.52	221.91	11.61	223.12	250.99	253.03	260.93	263.49	227.74	185.37	263.49
Total Nitrogen (as N)	(lbs./acre/yr.)	2012	223.499	235.28	218.83	212.61	213.22	214.69	211.16	211.68	201.27	208.2	211.22	207.58	214.105	201.27	235.28

PARAMETER	UNITS	YEAR	January	February	March	April	May	June	July	August	September	October	November	December	AVERAGE	MINIMUM	MAXIMUM
Total Nitrogen (as N)	(lbs./acre/yr.)	2013	214.11	199.35	207.72	213.009	217.55	233.88	246.43			238.37	235.42	207.58	224.24	199.35	246.43
Total Nitrogen (as N)	(lbs./acre/yr.)	2014	238.98	232.26	225.42	224.203	215.898	190.28	164.88	145.55	157.62	167.33	156.27	236.55	189.16	145.55	238.98
Total Nitrogen (as N) ^A	(lbs./acre/yr.)	2015 ^B	134.32	115.499	101.595	86.35	74.75	67.13	59.86	58.33	57.39	45.32	36.95	151.27	72.63	34.08	134.32
Total Nitrogen (as N)	(lbs./acre/yr.)	2016 ^B	157.53	145.63	135.61	123.92	118.13	111.43	99.05	76.98	63.07	62.06	59.82	34.08	129.05	45.62	205.54
Total Nitrogen (as N)	(lbs./acre/yr.)	2017 ^B	252.12	242.59	223.11	208.12	187.95	173.04	146.12	127.47	95.44	66.64	52.43	56.78	191.99	169.58	218.29
Total Nitrogen (as N)	(lbs./acre/yr.)	2018 ^B	173.46	158.99	153.49	141.3	128.69	117.71	108.76	91.57	79.66	77.74	70.83	42.83	100.83	56.78	157.53
Total Nitrogen (as N)	(lbs./acre/yr.)	2015 ^C	45.62	61.26	76.22	90.48	105.14	118.53	139.96	166.19	173.3	180.17	186.15	66.84	262.26	67.61	391.43
Total Nitrogen (as N)	(lbs./acre/yr.)	2016 ^C	67.61	108.2	148.31	177.88	231.17	265.99	288.33	340.47	361.62	380.81	385.32	205.54	324.99	256.89	404.18
Total Nitrogen (as N)	(lbs./acre/yr.)	2017 ^C	48.1	56.82	67.52	79.22	88.04	99.58	111.5	127.23	137.23	154.16	165.16	391.43	151.49	42.83	252.12
Total Nitrogen (as N)	(lbs./acre/yr.)	2018 ^C	80.04	87.06	109.59	124.69	134.31	141.93	147.36	151.71	159.64	170.26	182.08	176.93	109.29	48.10	176.93
Total Nitrogen (as N)	(lbs./acre/yr.)	2015 ^D	218.29	212.07	205.91	201.29	190.82	187.75	196.95	195.58	175.44	173.36	169.58	186.18	184.59	175.73	191.75
Total Nitrogen (as N)	(lbs./acre/yr.)	2016 ^D	404.18	400.56	379.19	358.74	347.64	324.08	299.89	307.63	286.41	276.31	258.38	176.8	114.09	66.84	173.46
Total Nitrogen (as N)	(lbs./acre/yr.)	2017 ^D	191.45	186.23	186.63	186.41	188.8	186.05	191.75	189.4	175.73	180.94	175.74	256.89	139.57	80.04	186.18
Total Nitrogen (as N)	(lbs./acre/yr.)	2018 ^D	197.93	185.01	206.14	202.15	195.59	197.96	201.6	206.59	214.42	223.73	229.46	175.99	209.17	185.01	249.46
C:N Ratio		2009	3.754	5.955	1.972	6.389	4.743	2.155	2.308	3.200	2.633	1.492	2.710	2.974	3.36	1.49	6.39
C:N Ratio		2010	4.759	6.873	2.289	2.261	3.009	5.625	2.379	1.554		1.617	7.449	2.093	3.63	1.55	7.45
C:N Ratio		2011	3.536	4.225	4.950	3.572	3.380	2.195	2.693	2.019	2.896	2.927	3.521	4.153	3.34	2.02	4.95
C:N Ratio		2012	1.262	4.461	5.451	9.737	4.902	3.714	2.901	1.834	0.716	1.786	4.893	3.393	3.75	0.72	9.74
C:N Ratio		2013	4.753	8.540	8.352	3.258	5.112	2.172	0.971			1.612	3.653	2.313	4.07	0.9714	8.54
C:N Ratio		2014	10.474	13.222	3.566	3.720	3.674	4.703	3.659	1.562	3.098	2.588	1.916	1.592	4.48	1.56	13.22
C:N Ratio		2015	3.464	3.516	2.712	3.478	4.190	1.723	1.476	0.896	12.833	5.790	9.302	1.443	4.24	0.8957	12.83
C:N Ratio		2016	8.202	4.542	2.804	2.430	1.452	1.349	2.527	1.335	0.938	2.064	5.623	2.592	2.99	0.9385	8.202
C:N Ratio		2017	1.806	1.584	2.736	2.829	3.635	3.311	1.047	2.297	1.853	6.147	1.970	1.082	2.52	1.05	6.15
C:N Ratio		2018	0.454	3.297	1.793	1.378	0.780	2.637	1.098	1.933	2.374	1.638	3.228	2.174	1.899	0.4544	3.297
A	Per Permit requirements beginning in 2015 total nitrogen is reported by field type.																
B	Values are for Fir/Alder.																
C	Values are for Grass Hay.																
D	Values are for Poplar.																

Table D-12 - Values used in S1 as permit limits and early warning values

Parameter	Average Monthly	Daily Maximum	Unit	Derivation
Flow	80,000	85,000	gpd ^a	Permit application
Total Nitrogen	81	134	mg/L ^b	Table D-21
Total Nitrogen – Grass/Hay		328 ^c	lbs./ac./yr. ^d	Table D-22
Total Nitrogen – Poplar		343 ^c	lbs./ac./yr.	Table D-22
Total Nitrogen – Fir/Alder		61 ^c	lbs./ac./yr.	Previous permit
pH	6.5 – 8.5		SU ^e	GWQS ^f
Total Coliform Bacteria	200	400	CFU/100 mL ^g	Industry Standard
Ammonia	201	101	mg/L	Table 6
Application Rate	0.06	0.07	inches/day	Table D-21
Hydraulic Loading Rate	2.09	2.72	inches/month	Table D-21
BOD ^h	88	176	mg/L	Table 6
Nitrate + Nitrite	29	66	mg/L	Table D-21
Oil & Grease	8.4	15	mg/L	Table D-21
TKN ⁱ	58	111	mg/L	Table D-21
TSS ^j	210	105	mg/L	Table 6
TDS ^k	801	823	mg/L	Table D-21
a	gpd = gallons per day.			
b	mg/L = milligrams per liter.			
c	Value is for a rolling 12-month annual maximum.			
d	lbs./ac./yr. = pounds per acre per year.			
e	SU = Standard units.			
f	GWQS = Groundwater Quality Standards (WAC 173-200).			
g	CFU/100 mL = Colony forming units per 100 milliliters.			
h	BOD = Biological oxygen demand.			
i	TKN = Total Kjeldahl Nitrogen.			
j	TSS = Total suspended solids.			
k	TDS = Total dissolved solids.			

Table D-13 - Table of Calculated Hydraulic and Nitrogen Loading Rates

METHOD	UNITS	GRASS/HAY	POPLAR	FIR/ALDER	TOTAL
Hydraulic Loading					
Natural ^a	in/yr. ^b				308.66
Leaching ^c	in/yr.				321.08
Wastewater volume ^d	in/yr.	22.25	19.93	6.55	19.21
Wastewater volume ^e	in/yr.	27.08	14.38	4.88	20.27
TSD (Daily Max) ^f	in/yr.	23.91	65.85	34.74 ^g	32.64
TSD (Average Monthly) ^h	in/yr.	9.24	29.89	19.39	25.08
Current ⁱ	in/yr.	17.99	23.60	17.48	59.06
Nitrogen Loading					
Uptake ^j	lb./ac/yr. ^k	356.87	321.18	237.91	305.32
Concentration ^l	lb./ac/yr.	321.47	170.72	57.91	240.62
TSD (Daily Max)	lb./ac/yr.	328.37	343.92	210.85	338.75
TSD (Average Monthly)	lb./ac/yr.	204.82	242.53	147.13	242.31
Current	lb./ac/yr.	275	360	267	901
Area for Nitrogen Balance					
Uptake	ac ^m	31.17	2.06	3.37	41.22
Concentration	ac	30.40	1.67	1.86	31.43
Application Area ⁿ	ac	35.25	3.54	4.15	45.99
Application Area ^o	ac	25.95	3.52	8.58	39.23
Current	ac	30.32	14.99	3.37	48.68
Bold Type indicates the values used in the permit.					
a	Natural = The result is calculated using only natural conditions (precipitation and evapotranspiration). (Data from 1996 to 2018.)				
b	in/yr. = inches per year.				
c	Leaching = The result is calculated for a leachate nitrate concentration of 3 mg/L.				
d	Wastewater volume = The result is calculated from reported wastewater application. (Based on spray volume data from April 2016 through July 2019 and Permittee reported field areas.)				
e	Same as d above, but uses ArcGIS measured field areas.				
f	TSD (Daily Max) = Values are calculated from the 95 percent daily maximum results of the TSD for WQ Limits and WQ Limits-CROP workbooks, discussed later in this appendices.				
g	The TSD result for Poplar hydraulic loading are much higher because they receive an equal amount of irrigated wastewater, but have a much smaller application area (2.1 acres as opposed to 7.7 acres for Fir/Alder and 26 acres for Grass/Hay).				
h	TSD (Average Monthly) = Values are calculated from the 95 percent average monthly results of the TSD for WQ Limits and WQ Limits-CROP workbooks, discussed later in this appendices.				
i	Current = the value in the current permit issued on 2012.				
j	Uptake = Calculation is based on average nitrogen uptake as reported in EPA (1981) and converted to lbs./ac/yr. and ArcGIS measured field areas.				
k	lb./ac/yr. = pounds per acre per year.				
l	Concentration = The result is calculated from the average total nitrogen concentration in wastewater for data from 2014 through 2018 and ArcGIS measured field areas.				
m	ac = acres.				
n	Application Area = Calculated from the average daily flow for the 2014-2018 period.				
o	Application Area = Calculated from the measured total flow for the period 2014-2018 period.				

**Figure 5- Hydraulic Loading Rate Based on Application Volume
and Application Area (derived from equation 8-3
of EPA, 2006)**

This equation is performed for each field type

Hydraulic Loading Rate

$$L_w = \frac{Q}{A}$$

Where,

L_w = wastewater hydraulic loading rate, in units of length over time (L/t) (in/yr.)

Q = wastewater application volume, in units of length cubed over time (L^3/t) ($in^3/yr.$)

A = wastewater application area, in units of length squared (L^2) (in^2)

For the Grass/Hay field (number in parenthesis is the value in units as reported/measured);

$Q = 4.41E9 \text{ in}^3/yr.$ (19,085,082 gal/yr.)

$A = 1.62E8 \text{ in}^2$ (25.95 ac)

Yielding an $L_w = 27.08 \text{ in/yr.}$ for the Grass/Hay fields.

For the Poplar plantation area;

$Q = 3.17E8 \text{ in}^3/yr.$ (1,136,524 gal/yr.)

$A = 1.82E7 \text{ in}^2$ (2.91 ac)

Yielding an $L_w = 14.38 \text{ in/yr.}$ for the Poplar plantation areas.

For the Fir/Alder areas;

$Q = 2.63E8 \text{ in}^3/yr.$ (1,373,841 gal/yr.)

$A = 6.51E7 \text{ in}^2$ (10.37 ac)

Yielding an $L_w = 4.88 \text{ in/yr.}$ for the Fir/Alder areas.

Loading rate calculation for the entire application area (39.23 acres) gives a total L_w of 20.27 in/yr.

**Figure 6- Nitrogen Loading Rate Based on Total Nitrogen
Concentration in Wastewater (from EPA, 2006)**

This equation is performed for each field type

$$L_N = L_W * C_p * F$$

Where,

L_N = nitrogen hydraulic loading rate, in units of mass over length squared (area) over time ($M/L^2/t$) (lb./ac/yr.).

L_W = wastewater hydraulic loading rate, in units of length over time (L/t) (in/yr.)

C_p = total nitrogen concentration in the land applied wastewater, in units of mass over volume (M/V) (mg/L).

$C_p = 52.38$ mg/L

F = conversion factor (mg/L - lb./gal, in - ac).

$F = 0.227$.

For the Grass/Hay field;

$$L_W = 27.08 \text{ in/yr.}$$

Yielding an $L_N = 321.47$ lb./ac(/yr.) for the Grass/Hay fields.

For the Poplar plantation area;

$$L_W = 14.38 \text{ in/yr.}$$

Yielding an $L_N = 321.18$ lb./ac(/yr.) for the Poplar plantation areas.

For the Fir/Alder areas;

$$L_W = 4.88 \text{ in/yr.}$$

Yielding an $L_N = 57.91$ lb./ac(/yr.) for the Fir/Alder areas.

Nitrogen loading rate calculated for the entire application area (39.23 acres) with an average wastewater loading (L_W) of 20.27 in/yr. gives a total L_N of 240.62 lb./ac/yr.

Figure 7 - Land Area Requirements (from EPA, 2006)

The hydraulic loading rate is the volume of wastewater that the soil can transmit away from the infiltration surface such that it does not interfere with the addition of more wastewater.

By this definition the larger the hydraulic loading the more wastewater can be applied. Therefore, to be conservative we will determine the land area necessary using the lowest determined hydraulic loading rate.

This equation is performed for each field type

$$A_w = \frac{Q}{U \cdot C_p}$$

Where,

A_w = field area, in units of area (A) (acres)

Q = annual wastewater flow (discharge), in units of volume (length cubed) over time ($V[L^3]$) / t ($\text{in}^3/\text{yr.}$).¹

U = crop uptake factor, in units of mass over length squared (area) over time ($M/L^2/t$) (lb./ac/yr.).

C_p = total nitrogen concentration in the land applied wastewater, in units of mass over volume (M/V) (mg/L).

$C_p = 52.38 \text{ mg/L}$

This value is converted to common units of lb./gal ($C_p = 0.000437 \text{ lb./gal}$).

For this the Grass/Hay field (number in parenthesis is the value in units as reported/measured):

$Q = 4.41\text{E}9 \text{ in}^3/\text{yr.}$ (19,085,082 gal/yr.)

$U = 267.65 \text{ lb./ac/yr.}$ ²

Yielding an $A = 31.17$ acres for the Grass/Hay field.

For the Poplar plantation area;

$Q = 3.17\text{E}8 \text{ in}^3/\text{yr.}$ (1,136,524 gal/yr.)

$U = 240.89 \text{ lb./ac/yr.}$ ²

Yielding an $A = 2.06$ acres for the Poplar plantation areas.

For the Fir/Alder areas;

$Q = 2.63\text{E}8 \text{ in}^3/\text{yr.}$ (1,373,841 gal/yr.)

$U = 178.44 \text{ lb./ac/yr.}$ ²

Yielding an $A = 3.37$ acres for the Fir/Alder areas.

¹ Wastewater volumes are from application data from April 2016 to July 2018.

² Uptake factors are from EPA, 2006 Tables 4-6 (grass/hay) and 4-11 (poplar and fir).

Figure 8 - Mass vs. Concentration (from Ecology Water Quality Permit Writer's Manual, revised 2018, Chap. 4 p 67)

1.4 Mass vs. Concentration

Effluent limits expressed as mass (pounds or kilograms per day) create an opportunity for inefficient operation of a treatment process. A permit writer should consider using concentration limits (milligrams per liter) in addition to the mass limits.

An example would be a company that has effluent limits for pollutant X of 390 pounds/day daily maximum and 260 pounds/day monthly average. These limits are based on annual production of widgets. The annual average flow is 0.9 MGD and the maximum daily flow is 1.6 MGD.

During periods of reduced production and flow (0.5 MGD) the company is able to reduce the efficiency of their treatment apparatus and still meet the monthly average mass limit of 260 pounds/day.

Under Average Production and Flow (0.9 MGD)

$$260 \text{ LBS/DAY} / [(8.34)(0.9 \text{ MGD})] = 35 \text{ mg/L}$$

Under Reduced Production and Flow (0.5 MGD)

$$260 \text{ LBS/DAY} / [(8.34)(0.5 \text{ MGD})] = 62 \text{ mg/L}$$

The number 8.34 in the formulas above is a conversion factor to get from pounds per million gallons to milligrams per liter. The first formula for Average Production and Flow with the units expressed as follows:

$$\frac{260 \bullet lb}{day} \times \frac{1 \bullet MG \bullet mg}{8.34 \bullet lb \bullet l} = \frac{34.64 \bullet mg}{l}$$

Unit cancellation results in mg/L. Note that MGD (millions of gallons per day), is expressed as MG divided by day(s) so day(s) will cancel correctly.

To determine a daily maximum concentration using the above equation as

$$C_N = \left(\frac{L_N}{Q} \right) / C$$

Where,

- C_N = daily maximum concentration, in units of mass over volume (M/V) (mg/L)
- L_N = nitrogen loading rate, in units of mass over time (M/t) (lb./yr.)³
- Q = annual wastewater flow (discharge), in units of volume over time (V/t) (gal/yr.)
- C = conversion factor from lb./gal to mg/L

For this permit:

- L_N = 33,251 lb./yr.
- Q = 21,595,477 gal/yr.
- C = 8.34E-6

Yielding a C_N = 185.996 mg/L, which is rounded to 186 mg/L for practical purposes.

³ This is obtained by multiplying the calculated total nitrogen loading rate (in lb./ac/yr.) by the total acreage of application area (in acre) to get a value in lb./yr.

Determination of Permit Limits

Ecology has several tools available to assist with the calculation of limits for inclusion in permits. Each tool uses a slightly different method of calculation to arrive at a unique limit value and each tool has certain strengths and weaknesses. Two of the methods available (PermitCalcDec2016V1.1_GW [PermitCalc] and TSDCalc11 for GW [TSDCalc]) use data for effluent, receiving water, and water quality criteria; while the third method (TSD for WQ Limits) is a direct calculation method using all available effluent or groundwater data. PermitCalc and TSDCalc were originally written for discharges to surface water, but have been modified to calculate groundwater limits. Modifications include: adding parameters with groundwater quality standards to the list of available parameters and changing values for existing parameters from the surface water to the groundwater standard; changing the calculation of dilution factor from that used for surface water to that used for groundwater; removal of "acute" and "chronic" criteria and substitution with a single line for groundwater criteria; and changing units from micrograms per liter ($\mu\text{g/L}$) to milligrams per liter (mg/L). The strength of both PermitCalc and TSDCalc are that they use information from the receiving waters to arrive at a limit value. A weakness for both is that they assume a log-normal distribution for the data set and use single values (average, maximum, or 95th percentile) in their calculations.

The TSD for WQ Limits tool's strength lies in the fact that it uses all available data to calculate a limit and allows for the application of the any normality distribution. The weakness lies with the fact that the limit value calculated from effluent values may not be protective of groundwater. This is due to using only effluent data in the calculations, thus there is no opportunity to add a dilution factor or perform a comparison to ambient groundwater conditions.

Because of the better data handling PermitCalc is used to determine which constituents show a reasonable potential to exceed groundwater limits. The TSD for WQ Limits spreadsheet is used to calculate effluent limits. Effluent limits are calculated using wastewater data from 1996 through 2019. Cumulative total nitrogen loading for each field type is calculated using data from 2015 through 2019.

Before any limit calculations are conducted the entire data set is subjected to basic descriptive statistical analyses. Each parameter for Outfall 001 (discharge to the spray fields) is evaluated for statistical outliers, seasonality, normality, and equality of variance. Tables D-15 and D-16 present the basic descriptive statistics for Outfall 001. All statistics are done using the Sanitas statistical software program by Sanitas Technologies, and the methods detailed in the EPA 530/R-09-007, [*Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities Unified Guidance*](#), March 2009 (Unified Guidance). All the data sets exceeded the number of data points for regular outlier determination. Therefore, outliers for the data sets are determined by breaking the data

sets into three groups. Group one has dates from 01/01/1996 through 12/31/2008, while group two covers 01/01/2008 through 12/31/2011. Group three is for dates from 11/2008 to 12/31/2019. Due to the change in reporting the cumulative total nitrogen this particular data set is split into three groups, 01/01/1996 through 12/31/2007, 1/1/2008 through 12/31/2014, and 01/01/2015 through 12/31/2019.

The statistical software used defaults to Tukey's method of outlier determination for data sets greater than 150 values. This method is based on removal of values above or below a calculated inter-quartile range (IQR). However, even with an IQR of 5 this method removed substantially more values than were removed by breaking the data set up into smaller groups. Tukey's method tagged 14 percent of all values as outliers for the complete data set and up to 40 percent for parameter specific data sets. This is opposed to the removal of 4 percent and 12 percent, respectively, for the split data set method.

Outliers are determined by the method set out in EPA G-89-00018, *Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities Interim Final Guidance*, April, 1989. Outlier normality is tested using the Shapiro-Wilk if $n \leq 10$ the Shapiro-Francia method if $10 < n < 100$, and the Chi-squared method if $n > 100$. All methods use an alpha of 0.1. If the calculated normality statistic is less than the critical Shapiro-Wilk or Shapiro-Francia value the data has a non-normal (non-parametric) distribution. For the Chi-squared method if the calculated normality statistic is greater than the critical value the data has a non-normal (non-parametric) distribution. Seasonality is tested using the Kruskal-Wallis test and the default of four seasons. If the calculated Kruskal-Wallis statistic is greater than the tabulated Chi-squared value, then seasonality is confirmed. If a parameter is determined to have seasonality the software program automatically deseasonalizes before conducting any further analysis. Normality of the data set is tested using the Ladder of Powers at an alpha of 0.1. The Ladder of Powers allows for testing of multiple statistical distributions at one time. Statistical distributions include normal, log-normal, square-root normal, cube-root normal, square normal, cube normal, x^4 normal, x^5 normal, and x^6 normal. Equality of variance is tested using Levene's Equality of Variance method.

Fecal coliform, total coliform, and pH did not have any outliers identified. Total Nitrogen in lbs./ac./yr. and TDS were the only parameters to have identified outliers in all three groupings. Application rate, flow, hydraulic loading, nitrate + nitrite, and TKN have outliers in two of the three groups, while BOD₅, nitrogen in both mg/L and lbs./ac./month, and oil & grease have only one group with an identified outlier.

Eleven outliers are identified in both application rate and flow rate data sets. The nine zero values (04/16 through 12/16/1999) are removed from the application rate data set and are not used in the calculation of a proposed effluent limit. Five day biological oxygen demand (BOD₅) had two outlier values identified. Flow analysis identified three

outliers. Hydraulic loading has the nine outliers identified. Outliers are identified on four dates for total nitrogen in pounds per acre per month (lb./ac./mo.), while the cumulative total nitrogen in lb./ac./year has six outliers. Two zero values are also removed from the lb./ac./mo. data set. One outlier is identified from the total nitrogen in milligrams per liter (mg/L) data set. Oil & Grease had 25 zero values removed from the data set used for the limit calculation, while the two identified outliers are kept. Total dissolved solids (TDS) had the most identified outliers at 12. Total Kjeldahl nitrogen has two outliers in the data set.

Seasonality is found in the 1996-2008 data set of application rate, BOD₅, flow, total nitrogen in mg/L and lb./ac./month, and TKN data. The 2006-2011 grouping found seasonality for BOD₅, nitrate + nitrite, total nitrogen in mg/L and lb./ac./month, and TKN. The 2008-2019 data set for BOD₅, total nitrogen in mg/L, and TDS also show seasonality. This does not affect the limit calculations as the software package used automatically adjusts for seasonality. Seasonality testing on the entire data set (from 01/01/1996 through 12/31/2019) showed seasonality for BOD₅, total nitrogen as lb./ac./month, total nitrogen in mg/L, TDS, and TKN.

Outfall 001 inequality in variance was determined for multiple data sets. The first group (1996 - 2008) for hydraulic loading, nitrate + nitrite, and pH both with outliers included and with outliers removed show unequal variances. The second data group (2006 - 2011) for application rate, flow, and oil and grease show an unequal variance, but only when outliers are removed from the data set. Cumulative total nitrogen in lb./ac./year has an unequal variance for the second data group both with and without outliers are included. Fecal coliform, total nitrogen in lbs./ac./month, and TKN with outliers also show unequal variances in the final data set (2008 - 2019). Total dissolved solids show unequal variance for this data set with outliers removed, while cumulative total nitrogen in lbs./ac./year have an unequal variance with outliers included and removed. It should be noted that testing for equality of variance the testing data compared the last three years of the data set against the preceding years.

Additional equality of variance testing on the entire data set (1996 - 2019) was conducted. Unequal variances were found for application rate, fecal coliform, flow, and nitrate + nitrite with outliers included. Application rate, nitrate + nitrite, and TKN also have unequal variances with outliers removed. In the case of nitrate+ nitrite and TKN the unequal variance is only with the first set of outliers removed though.

Ladder of Powers normality testing identified application rate, BOD₅, fecal coliform, flow, oil & grease, pH, TDS, TKN, and total coliform as non-normal for both outliers included and outliers removed. Ladder of Powers testing showed hydraulic loading with a normal distribution when outliers are included, but non-normal when the nine outliers are removed. Nitrate + nitrite has a square-root distribution both with outliers and when the two outliers are removed. The distribution for total nitrogen in mg/L fits both a cube-root

and a natural log distribution, again for both outliers included or the one outlier removed. Total nitrogen in lbs./ac./month has a square-root distribution when outliers are included, but is non-normal when the 41 outliers are removed. Total nitrogen in lbs./ac./yr. has a normal distribution both with the 23 outliers included or removed.

When reviewing Ladder of Powers testing when the data is split into Groups 1, 2 and 3 results are very different. This is related to the smaller data sets and fewer identified outlier values. Results of those evaluations showing a distribution are shown below in Table D-17, all other data sets are non-normal.

Probability plots for the different Ladder of Power normality's were visually inspected for all non-normal data to select the distribution with the best fit. This lead to the selection of the distributions used in the limit calculations and are shown in Table D-18. Both application rates, total nitrogen in lb./ac./yr., and pH had good fits with a normal distribution. BOD₅, fecal coliform, flow, hydraulic loading, total nitrogen in mg/L, TDS, and TKN all had a natural logarithm best fit. Nitrate+nitrite and total nitrogen in lb./ac./yr. data best fit a square-root distribution, while oil & grease best fit a cube-root distribution.

A similar approach was used for data from the separate fields (2015-2019 data). This applied only to flow, application rate, hydraulic loading, and total nitrogen in both lb.ac/month and lb./ac/yr.

Determination of Potential Effluent Permit Limits

To expand the statistical strength for limit calculation and as a form of sensitivity analysis, multiple scenarios are run for PermitCalc. The scenarios were run for each field type (grass, fir/alder, and poplar) and are common through each. The scenarios used for this permit are provided in the Table D-14 below.

**Table D-14. Permit Limit Calculation Scenarios – Outfall 001
(Infiltration Gallery)**

PermitCalcDec2016V1.1_GW				
Effluent ^a	Receiving Water ^b	Water Quality Criteria 1 ^c	Water Quality Criteria 2 ^d	Other
Outfall 001 Max	Outfall 001	Outfall 001	GWQS ^e	Default CV ^{f, g}
Outfall 001 Max	Outfall 001	Outfall 001	GWQS	Calculated CV ^h
Outfall 001 95%	Outfall 001	Outfall 001	GWQS	Calculated CV
Outfall 001 95%	Outfall 001	GWQS	GWQS	Calculated CV
Outfall 001 95%	Outfall 001 Daily TSD ^{i, j}	Outfall 001 Daily TSD	GWQS	Calculated CV
Outfall 001 95%	Up Gradient Monthly ^k TSD	Up Gradient Monthly TSD	GWQS	Calculated CV
Outfall 001 50%	Outfall 001	Outfall 001	GWQS	Calculated CV
^a	Effluent ≡ Outfall 001 value used for the effluent concentration (rows 14 and 15 in PermitCalc). Runs used data from 1996 to 2018.			

PermitCalcDec2016V1.1_GW				
Effluent ^a	Receiving Water ^b	Water Quality Criteria 1 ^c	Water Quality Criteria 2 ^d	Other
b	Receiving Water \equiv value used for receiving water in calculations (rows 16 and 17 in PermitCalc). This is the 90 th percentile value for Outfall 001 data from 1996 to 2018.			
c	Water Quality Criteria 1 \equiv the 95 th percentile value of the Outfall 001 data from 1996 to 2018.			
d	Water Quality Criteria 2 \equiv the groundwater quality standard. If the parameter does not have a standard, the 95 th percentile for that parameter from Outfall 001 data set may be substituted.			
e	GWQS \equiv Groundwater Quality Standard			
f	CV \equiv Coefficient of Variation.			
g	Default CV \equiv the default CV value in the PermitCalc worksheet of 0.6.			
h	Calculated CV \equiv CV value calculated for each parameter using the equation $CV = \bar{X}/\sigma$, where \bar{x} is the sample mean and σ is the sample standard deviation.			
i	TSD \equiv Technical Support Document. Refers to EPA document EPA/505/2-90-001.			
j	Daily TSD \equiv Daily 95% values calculated from the applicable TSD for WQ workbook.			
k	Monthly TSD \equiv Monthly 95% values calculated from the applicable TSD for WQ workbook.			

The different combinations of receiving water/ambient concentration, water quality, and coefficient of variation (CV) are done as a form of sensitivity analysis to see if changes in one results in a significant change in the calculated reasonable potential. Overall scenarios between each method yielded very similar results as to which constituents might pose a potential threat to groundwater quality.

PermitCalc was used to determine reasonable potential. Reasonable potential is determined from scenario 4 (the 95th percentile for the effluent and receiving water, the groundwater quality standards as the water quality standards, the calculated CV) and a calculated dilution attenuation factor of 1.1 for the grass fields, 1.04 for the fir/alder areas, and 1.07 for the poplar areas. Values for receiving water and background water quality criteria are set at the 90th and 95th percentile concentration, respectively, calculated from the 1996 – 2018 Outfall 001 data set.

Using the above inputs PermitCalc shows a reasonable potential to impact groundwater for all tested parameters except high pH (> 8.5). Each field type yielded the same results. Tested parameters are BOD5, fecal coliform, nitrate + nitrite, total nitrogen in mg/L, oil & grease, pH, TDS, and TSS.

The existing limit for flow will remain in effect. Limits using the TSD for WQ spreadsheet are calculated for all 14 reported parameters. Ecology determined that the PermitCalc spreadsheets tended to overestimate the resulting permit limit values. The TSD for WQ Limits workbook calculates limits for both a daily maximum and a

monthly average. For the permit limits and early warning value we use the more conservative monthly average value at the 95% level.

New limits for the 12-month rolling average for total nitrogen are set as calculated in Figure 7 above. New limits are also being established in this permit for application rate and hydraulic loading. New non enforceable early warning values (benchmarks) are set for BOD₅, fecal coliform, oil & grease, nitrate + nitrite, pH, and TKN are also proposed. Exceedance of an early warning value may indicate a potential problem that will require further evaluation. All constituents will continue to be monitored. Table D-19 shows the PermitCalc spreadsheet calculations using for the selected scenario discussed above. Table D-20 provides descriptions for variables shown in Table D-21 and D-22, which presents the TSD for WQ Limits groundwater results.

Table D-15. Descriptive Statistics for Outfall 001

Parameter	Count	Average ^a	Minimum	Maximum	Median	Geomean	Std Dev ^b	Variance	CV ^c	Percentile		
										50 th	90 th	95 th
Application Rate ^{d, e}	275	0.055227	0.012937	0.081827	0.05547	0.0533	0.012747	0.000167	0.23077	0.055447	0.07103	0.0715
BOD ₅	273	158.23	9	1,500	120	119.59	147.20	21,667.61	0.9303	120	309.8	411.2
C:N Ratio ^f	272	2.81	0.2802	13.22	2.34	2.27	1.976	3.904	0.703	2.34	4.96	6.31
Fecal Coliform ^g	236	349.53	9	24,196	30	45.71	1,820.15	3.31E+06	5.21	30	343.5	972.5
Flow ^h	275	67,523.66	15,804	99,980	68,138	65,188.17	15,542.99	2.42E+08	0.2302	68,138	86,792.6	87,370.5
Hydraulic Loading ⁱ	275	1.83	0.39	3.68	1.76	1.74	0.53942	0.29098	0.2947	1.76	2.49	2.72
Nitrate + Nitrite	275	23.63	0.1	95.65	17.69	11.601	21.55	464.47	0.9121	17.69	56.05	64.85
Total Nitrogen ^j	349	16.53	0.31	55.53	14.95	12.31	10.58	111.891	0.64003	14.95	30.76	36.14
Total Nitrogen ^k	318	205.103	34.08	404.18	201.399	186.22	81.2483	6,601.29	0.3961	201.399	317.82	354.79
Total Nitrogen	284	62.823	7.25	430.5	52.85	53.45	41.91	1,756.83	0.6672	52.85	110.37	125.78
Oil & Grease	210	6.65	1.1	34	5.6	5.79	3.798	14.42	0.5712	5.6	11.11	13.22
pH ^l	274	7.23	6.7	8.3	7.1	7.22	0.30924	0.09563	0.0428	7.1	7.7	7.94
^m											6.99	6.99
TDS ^x	243	742.17	140	1,300	720	724.22	144.45	20,864.88	0.1946	720	920	970
TKN ^y	275	38.67	3.92	430	21.8	24.78	45.642	2,083.22	1.18	21.8	96.5	120.24
a	All values are in milligrams per liter (mg/L) unless otherwise noted.											
b	Std Dev ≡ Standard Deviation.											
c	CV ≡ Coefficient of Variation.											
d	Values are in inches per day (in/day).											
e	Nine zero values removed from data set.											
f	Values are unitless.											
g	Values are in units of colony forming units per 100 milliliters (CFU/100 mL).											
h	Values are in units of gallons per day (gpd).											
i	Values are in units of inches per month (in/mo.).											
j	Values are in units of pounds per acre per month (lb./ac/mo.).											
k	Values are in units of pounds per acre per year (lb./ac/yr.).											
l	Values are in units of standard units (SU).											
m	Values represent the 10 th percentile and 5 th percentile, respectively.											

Table D-16. Descriptive Statistics for Outfall 001 2015 - 2019

Parameter	Count	Average	Minimum	Maximum	Median	Geomean	Std Dev ^a	Variance	CV ^b	Percentile		
										50 th	90 th	95 th
Total Nitrogen ^c	71	50.498	16.53	130.86	45.4	45.03	26.47	700.715	0.5242	45.4	85.35	116.83
Total Nitrogen ^{d,e}	187	12.76	0.31	55.53	12.07	8.599	9.87	97.33	0.7731	7.91	26.69	30.45
Total Nitrogen (Fir) ^{d,e}	57	3.96	0.31	16.07	3.63	2.66	3.48	12.099	0.8784	12.07	24.11	31.66
Total Nitrogen (Grass) ^d	59	18.21	5.42	55.53	14.51	15.76	10.89	118.4999	0.5977	3.63	8.82	10.03
Total Nitrogen (Poplar) ^d	59	16.21	3.46	38.13	14.48	14.65	7.36	54.22	0.4543	14.51	29.74	42.198
Total Nitrogen ^f	189	165.08	34.08	404.18	164.88	147.03	77.33	5,979.27	0.4684	14.48	24.31	32.04
Total Nitrogen (Fir) ^f	59	120.97	34.08	252.12	118.13	107.88	54.64	2,986.07	0.4517	164.88	253.07	333.91
Total Nitrogen (Grass) ^f	59	162.25	45.62	391.43	147.36	143.62	83.53	6,977.32	0.5148	118.13	177.24	209.62
Total Nitrogen (Poplar) ^f	59	207.13	89.87	404.18	191.75	195.54	72.59	5,268.87	0.3504	147.36	270.46	363.54
a	Std Dev \equiv Standard Deviation.											
b	CV \equiv Coefficient of Variation.											
c	Values are in milligrams per liter (mg/L)											
d	Values are in units of pounds per acre per month (lb./ac/mo.).											
e	All values with two zero values and eight outliers removed from data set.											
f	Values are in units of pounds per acre per year (lb./ac/yr.).											

Table D-17. Statistical Distributions for Outfall 001

Parameter	Outlier Statistic ^a	Ladder of Powers ^b	Outliers Removed ^{c, d}	Date Range ^e
Application Rate	x^6 ^f	Normal ^g or Square ^h	All values.	1996 – 2008 data set.
	Normal	Square or Cube ⁱ	Nine outliers removed.	1996 – 2008 data set.
BOD ₅	x^6	Natural log ^j	All values.	1996 – 2008 data set.
	Natural log	Natural log	Two outliers removed.	1996 – 2008 data set.
	Natural log	Natural log	All values.	2006 – 2011 data set.
	Natural log	Natural log	All values.	2008 – 2019 data set.
Flow	x^6	Normal or Square	All values.	1996 – 2008 data set.
	Non-normal ^k	Square or Cube	One outlier removed.	1996 – 2008 data set.
Hydraulic Loading	x^6	Square-root ^l or Cube-root ^m	All values.	1996 – 2008 data set.
	Natural log	Square-root, Cube-root, or Natural log	Six outliers removed.	1996 – 2008 data set.
	Non-normal	Square or Cube	All values.	2008 – 2019 data set.
	Normal	Normal, Square-root, Square, or Cube-root	Three outliers removed.	2008 – 2019 data set.
Nitrate + Nitrite	x^6	Normal	All values.	1996 – 2008 data set.
	Normal	Normal	Two outliers removed.	1996 – 2008 data set.
	Non-normal	Non-normal	All values.	2006 – 2011 data set.
	Natural log	Natural log	Two outliers removed.	2006 – 2011 data set.
	Non-normal	Square-root or Cube-root	All values. (No outliers identified in this data set.)	2008 – 2019 data set.
Nitrogen Total (mg/L) ⁿ	Non-normal	Square-root, Cube-root, or Natural log	All values.	1996 – 2008 data set.
	Natural log	Square-root, Cube-root, or Natural log	One outliers removed.	1996 – 2008 data set.
	Natural log	Square-root, Cube-root, or Natural log	All values. (No outliers identified in this data set.)	2008 – 2019 data set.
Nitrogen, Total (lbs./ac/month) ^o	Normal	Normal, Square-root, or Cube-root	All values. (No outliers identified in this data set.)	1996 – 2008 data set.
	x^6	Natural log	All values. (No outliers identified in this data set.)	2006 – 2011 data set.

Table D-17. Statistical Distributions for Outfall 001

Parameter	Outlier Statistic ^a	Ladder of Powers ^b	Outliers Removed ^{c, d}	Date Range ^e
Nitrogen, Total (lbs./ac/year) ^p	Non-normal	Normal or Square	All values.	2006 – 2011 data set.
	Normal	Normal, Square-root, Square, or Cube-root	One outliers removed.	2006 – 2011 data set.
	x^6	Normal	All values.	2008 – 2019 data set.
	x^6	Square	Twenty-two outliers removed.	2008 – 2019 data set.
Oil & Grease	Non-normal	Non-normal	All values.	2006 – 2011 data set.
	Natural log	Natural log	Two outliers removed.	2006 – 2011 data set.
TDS	Non-normal	Natural log	All values.	1996 – 2008 data set.
	Normal	Normal, Square-root, Square, Cube-root, or Natural log	Six outliers removed.	1996 – 2008 data set.
	Non-normal	Non-normal	All values.	2008 – 2019 data set.
	Natural log	Cube root, or Natural log	Three outliers removed.	2008 – 2019 data set.
TKN	Natural log	Cube root, or Natural log	All values. (No outliers identified in this data set.)	2008 – 2019 data set.
a	Outlier Statistic \equiv Data set normality for the outlier analyses used the Shapiro-Francia method for data sets greater than 10, and the Chi-Square method for data sets greater than 100. All methods used an alpha level of 0.1.			
b	Ladder of Powers \equiv Data set normality was determined using Ladder of Powers at the 0.01 alpha level. Statistic-listed software selected from testing of multiple distributions (normal, square-root, square, cube-root, cube, natural log, x^4 , x^5 , and x^6).			
c	Statistical outliers are determined automatically by the statistical software package using the method set out in EPA G-89-00018.			
d	This column states the number of outliers and/or zero values removed from the data set before statistical analysis.			
e	This column lists the data set date range.			
f	$x^6 \equiv$ The data set has a distribution best fit for values multiplied to the sixth power.			
g	Normal \equiv The data set is normally distributed.			
h	Square \equiv The data set has a distribution best fit obtained by taking the square of the values.			
i	Cube \equiv The data set has a distribution best fit obtained by taking the cube of the values.			
j	Natural log \equiv The data set has a natural log-normal distribution.			
k	Non-normal \equiv The data set has a non-normal distribution (non-parametric).			
l	Square-root \equiv A near normal distribution is obtained by taking the square-root of the values.			
m	Cube-root normal \equiv A near normal distribution is obtained by taking the cube-root of the values.			
n	mg/L \equiv milligrams per liter.			
o	lbs./ac/month \equiv pounds per acre per month.			
p	lbs./ac/year \equiv pounds per acre per year.			

Table D-18. Final Statistical Distributions for Outfall 001

Parameter	All Values ^a	Zero Values Removed ^b	Outliers and Zero Values Removed ^c	Units	Comments
Application Rate	Square ^d	Normal ^e	Normal	inches/day	Eleven zero values removed from data set. ^f
BOD ₅	Natural log ^g		Natural log	mg/L ^h	Two outliers removed from data set. ⁱ
Fecal Coliform ^j	Natural log		Natural log	CFU/100 mL ^k	No outliers removed from data set.
Flow	Natural log		Natural log	gpd ^l	Three outliers removed from data set. ^m
Hydraulic Loading	Normal		Normal	inches/month	Nine outliers removed from data set. ⁿ
Nitrate + Nitrite	Square-root ^o		Natural log	mg/L	Two outliers removed from the data set. ^p
Total Nitrogen	Square-root		Normal	lb./ac/month ^q	Forty-two outliers and two zero values removed from data set. ^r
Fir / Alder ^s	Natural log	Natural log	Natural log		Two zero values removed from data set. ^t
Grass / Hay ^u	Natural log		Natural log		No outliers removed from data set.
Poplar ^v	Cube-root ^w		Natural log		No outliers removed from data set.
Total Nitrogen	Normal		Normal	lb./ac/yr. ^x	Twenty-two outliers removed. ^y
Fir / Alder	Normal		Square-root		No outliers removed from data set.
Grass / Hay	Natural log		Natural log		No outliers removed from data set.
Poplar	Natural log		Natural log		No outliers removed from data set.
Total Nitrogen	Natural log		Normal	mg/L	One outlier removed from data set. ^z
Oil & Grease ^{aa}	Cube-root	Natural log	Normal	mg/L	Twenty-five zero values and two outliers removed from data set. ^{ab}
pH	Natural log		Natural log	SU ^{ac}	No outliers removed from data set.
TDS	Natural log		Normal	mg/L	Eleven outliers removed from data set. ^{ad}
TKN	Natural log		Natural log	mg/L	One outlier removed from data set. ^{ae}
a	All Values \equiv Data set includes all values reported. Includes zeros and outliers.				
b	Zero Values Removed \equiv Three data sets are evaluated with only the zero values removed. Outliers are included.				
c	Outliers and Zero Values Removed \equiv All zero values and identified outliers are removed from the data set.				
d	Square \equiv A near normal distribution is obtained by taking the square of the values.				
e	Normal \equiv The data set is normally distributed.				
f	Eleven zero values removed from Application Rate data set; nine values from 04/16/1999 to 12/16/1999, and two values on 08/01/2013 and 09/01/2013.				

Table D-18. Final Statistical Distributions for Outfall 001

Parameter	All Values ^a	Zero Values Removed ^b	Outliers and Zero Values Removed ^c	Units	Comments
g	Natural log \equiv The data set has a natural log-normal distribution.				
h	mg/L \equiv milligrams per liter.				
i	Outliers identified are value of 1,500 on 05/15/1996 and value of 9 on 09/15/2000.				
j	The Fecal Coliform data set includes 15 non-detect values. Non-detect data is not included in the statistical calculations, but the z-score is calculated based on the percentage of non-detect values present.				
k	CFU/100 mL \equiv Colony forming units per 100 milliliters.				
l	gpd \equiv gallons per day.				
m	Three outliers identified; 99,980 on 12/15/1997, 27,763 on 10/01/2015, and 27,018 on 07/01/2016.				
n	Nine outliers identified; values on 12/15/1997, 07/15 and 08/15/2000, 07/15, 08/15, and 09/15/2003, 01/15/2008, 10/01/2015, and 07/01/2016.				
o	Square-root \equiv A near normal distribution is obtained by taking the square-root of the values.				
p	Two outliers identified, value of 0.1 on 04/15/1996 and value of 83.395 on 05/15/2001.				
q	lbs./ac/month \equiv pounds per acre per month.				
r	Outliers identified: values on 01/15, 02/15, 03/15/2008; values on 01/15, 02/15, 03/15/, and 12/15/2009; values on 01/01, 02/01, 03/01/, 09/01, and 12/01/2011; values on 02/01, and 09/01/2012; values on 02/01, 03/01, and 06/01/2013; value on 01/01/2014 for all fields; values on 07/01 and 08/01/2015; 01/01 through 10/01/2016; 01/01 and 03/01/2018 for the Grass/Hay fields; values of 07/01/ and 08/01/2015; 04/01, 06/01, 08/01, and 09/01/2016; 03/01 and 12/01/2018; and 01/01/2019 for the Poplar fields.				
s	Fir / Alder \equiv Refers to all fields containing fir and alder trees, as reported by the Permittee.				
t	Two zero values are also removed from the Total Nitrogen, Fir/Alder (lb./ac/month) data set; 10/01/2015 and 07/01/2016.				
u	Grass / Hay \equiv Refers to all fields containing hay grass, as reported by the Permittee.				
v	Poplar \equiv Refers to all fields containing poplar trees, as reported by the Permittee.				
w	Cube-root normal \equiv A near normal distribution is obtained by taking the cube-root of the values.				
x	lbs./ac/year \equiv pounds per acre per year.				
y	Outliers identified: values on 02/15/2007; 04/15 through 11/15/2008 for all fields; 07/01 through 12/01/2016 for Grass/Hay fields; and 01/01/ through 08/01/2016 for Poplar fields.				
z	One outlier identified, value of 430.5 on 05/15/1996.				
aa	The Oil & Grease data set includes 26 non-detect values. Non-detect data is not included in the statistical calculations, but the z-score is calculated based on the percentage of non-detect values present.				
ab	Two values identified as outliers, value of 21 on 12/15/2007 and 34 on 08/15/2008.				
ac	SU \equiv Standard units.				
ad	Eleven outliers were identified; value of 319 on 12/15/2000, 390 on 05/15/2001 and 147 on 11/15/2001, 140 on 12/15/2006, 1,300 on 09/15/2007, 420 on 02/15/2009, 1,300 on 04/01/2013, and 190 on 02/01/2017.				
ae	One outlier, value of 430 on 05/15/1996, identified as an outlier.				

Table D-19. Reasonable Potential Calculations for Outfall 001

Facility		Schenk Packing - COMBINED								General		1.1
Water Body Type		Freshwater								Human Health Carcinogenic		1.1
Rec. Water Hardness		** Enter Hardness on DFCalc Tab **								Human Health Non-Carcinogenic		1.0

Pollutant, CAS No. & NPDES Application Ref. No.		Biological Oxygen Demand	FECAL COLIFORM and E. COLI	NITRATE/NITRITE (N)	NITROGEN, TOTAL [includes; ammonia, nitrate (as N), nitrite (as N), & organic nitrogen]	OIL AND GREASE	pH	pH	SOLIDS, TOTAL DISSOLVED AND SALINITY			
Effluent Data	# of Samples (n)	273	236	275	284	210	274	274	243			
	Coeff of Variation (Cv)	0.930303424	5.21	0.912097297	0.667180156	0.571157439	0.042786713	0.042786713	0.194628011			
	Effluent Concentration, mg/L (Max. or 95 th Percentile)	411.2	972.5	64.85	125.78	12.86	6.99	7.94	970			
	Calculated 50 th percentile Effluent Conc. (when n>10)	120	30	17.69	52.85	5.6	7.1	7.1	720			
Receiving Water Data	90 th Percentile Conc., mg/L	309.8	343.5	56.05	110.37	11.11	6.99	7.7	920			
	Geo Mean, mg/L	119.59	45.71	11.601	53.45	5.79	7.22	7.22	724.22			
Water Quality Criteria	95 th Percentile Background Conc., mg/L	9.5	0.95	9.5	9.5	9.5	6.175	8.075	475			
	GWQ Criteria for Protection of Human Health, mg/L	10	1	10	10	10	6.5	8.5	500			
	Metal Criteria Translator, decimal	-	-	-	-	-	-	-	-			
	Carcinogen?	N	-	-	-	N	N	N	N			
Reasonable Potential												
Effluent percentile value		0.95	0.95	0.95	0.95	0.95	0.95	0.95	0.95			
$\sigma^2 = \ln(CV^2+1)$		0.790	1.827	0.778	0.607	0.531	0.043	0.043	0.193			
P _n	P _n = (1-confidence level) ^{1/n}	0.989	0.987	0.989	0.990	0.986	0.989	0.989	0.988			
Multiplier		1	1	1	1	1	1	1	1			
Max concentration (mg/L)		405.05	934.36	64.32	124.84	12.75	6.99	7.92	966.97			
Reasonable Potential? Limit Required?		YES	YES	YES	YES	YES	YES	NO	YES			
Limit Calculation												
# of Compliance Samples Expected per month		1	1	1	1	1	1	1	1			
LTA Coeff. Var. (CV), decimal		0.930303424	5.207439667	0.912097297	0.667180156	0.571157439	0.042786713	0.042786713	0.194628011			
Permit Limit Coeff. Var. (CV), decimal		0.930303424	5.207439667	0.912097297	0.667180156	0.571157439	0.042786713	0.042786713	0.194628011			
Waste Load Allocations, mg/L		--	--	6.495530837	2.98970367	9.396088261	6.122398716	8.099203045	446.2790536			
Long Term Averages, mg/L		--	--	2.444837911	1.32466342	4.515164598	5.711723381	7.555928574	331.080662			
Metal Translator or 1?		1	1	1	1	1	1	1	1			
Average Monthly Limit (AML), mg/L		9.88	21.16	6.496	2.99	9.396	6.122		446.28			
Maximum Daily Limit (MDL), mg/L		16.92	73.46	11.04	4.52	13.495	6.303		508.94			

Facility	Schenk Packing - COMBINED
Water Body Type	Freshwater
Rec. Water Hardness	** Enter Hardness on DFCalc Tab **

Dilution Attenuation Factors:

General	1.1
Human Health Carcinogenic	1.1
Human Health Non-Carcinogenic	1.0

Pollutant, CAS No. & NPDES Application Ref. No.	Biological Oxygen Demand	FECAL COLIFORM and E. COLI	NITRATE/NITRITE (N)	NITROGEN, TOTAL [includes; ammonia, nitrate (as N), nitrite (as N), & organic nitrogen]	OIL AND GREASE	pH	pH	SOLIDS, TOTAL DISSOLVED AND SALINITY			
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Human Health Reasonable Potential

σ	$\sigma^2 = \ln(CV^2+1)$	0.790	1.827	0.778	0.607	0.531	0.043	0.043	0.193
P_n	$P_n = (1-\text{confidence level})^{1/n}$	0.989	0.987	0.989	0.990	0.986	0.989	0.989	0.988
Multiplier		0.642	0.137	0.648	0.745	0.776	0.971	0.971	0.921
Dilution Factor		1.03	1.06	1.06	1.06	1.03	1.03	1.03	1.03
Max. Concentration, mg/L		119.99	30.96	17.31	52.89	5.606	7.104	7.104	720.14
Reasonable Potential? Limit Required?		YES	YES	YES	YES	NO	YES	NO	YES

Human Health Limit Calculation

# of Compliance Samples Expected per month	1	1	1	1		1		1
Average Monthly Effluent Limit, mg/L	0.327	0.066	0.655	0.655		0.213		16.37
Maximum Daily Effluent Limit, mg/L	0.449	0.047	0.898	0.884		0.219		18.58

Table D-20. Limit Calculations from EPA/505/2-90-001, *Technical Support Document for Water Quality-based Toxics Control*

COLUMN	Where:	Description		
A	Location \equiv	Location of the sampling point. LAGOON is the sample from the pump station after the treatment lagoon and before land application. MW-3 is the up gradient well, located outside the land application area at the west center of the area.		
B	Date \equiv	The collection date of the sample.		
C	Parameter \equiv	The parameter analyzed.		
D	Units \equiv	The units of the parameter value.		
E	K \equiv	Total number of results.		
F	ND \equiv	Formula to determine if a value is a non-detect. Equation is: =IF((E2 = "ND"), "Y", (IF((E2 = "B"), "Y", "")))		
		Where	E2 \equiv	The value in the column E (Qlf).
			"ND" \equiv	The designation for a non-detect in most samples.
			"B" \equiv	The designation for a non-detect in nitrate samples.
G	r \equiv	Total number of non-detects.		
H	k – r \equiv	Total number of detected samples.		
I	$\delta = r / k \equiv$	The ratio of non-detected results to the total number of results.		
J	$\mu_y \equiv$	The estimated mean (average) of all results. Equation is: $\Sigma[x_i] / k$, $1 \leq i \leq k$.		
		Where:	$x_i =$	The value in Colum E if parameter is normally distributed (e.g., pH).
			$x_i =$	The value in Column J (natural log) if the parameter is log-normally distributed (e.g., chloride).
			$x_i =$	The value in Column K (delta-lognormal [natural log without non-detects]) if the parameter results contain non-detects ($r > 0$) (e.g., BOD ₅); OR if the parameter is some other distribution (e.g., TSS is a cube-root normal distribution).
K	$\sigma_y^2 \equiv$	The estimated variance of all results. Equation is: $\Sigma[(x_i - \hat{\mu})^2] / (k - 1)$, $1 \leq i \leq k$. x_i is the same as the mean, above.		
L	$\sigma_y \equiv$	The standard deviation of all results. Equation is: $\sqrt{\hat{\sigma}^2}$.		
M	$1 - \delta \equiv$	Percent of parameters detected.		
N	E(x) \equiv	The Daily Average of a log-normal distribution. Equation is: $e^{\left(\mu_y + \sigma_y^2 / 2\right)}$		
O	V(x) \equiv	The Variance of a log-normal distribution. Equation is: $E(x) * \left(e^{\sigma_y^2} - 1\right)$		
P	cv(x) \equiv	The Coefficient of Variation of a log-normal distribution. Equation is: $\sqrt{\left(e^{\sigma_y^2} - 1\right)}$		
Q	$\hat{E}(X^*) \equiv$	The Daily Average of a delta-lognormal distribution (e.g., a log-normal distribution that contains both measured and non-detect values).		
		Equation is: $\delta D + (1 - \delta) e^{\left(\mu_y + \sigma_y^2 / 2\right)}$		
R	$V^{\wedge}(X^*) \equiv$	The Variance of a delta-lognormal distribution. Equation is: $(1 - \delta) e^{\left(\mu_y + \sigma_y^2 / 2\right)} * \left[e^{\sigma_y^2} - (1 - \delta)\right] + \delta(1 - \delta)D \left[D - 2e^{\left(\mu_y + \sigma_y^2 / 2\right)}\right]$		
S	cv(X*) \equiv	The Coefficient of Variation of a delta-lognormal distribution. Equation is: $\sqrt{V^{\wedge}(X^*)} / \hat{E}(X^*)$		
T	$Z^*_{(0.95)} \equiv$	Z-score determined from a standard table of percentiles. For a parameter WITH NO non-detects $z^*_{(0.95)} = 1.6449$. For a parameter WITH non-detects $z^*_{(0.95)} = \varphi^{-1} \left[(0.95 - \delta) / 1 - \delta \right]$; where φ^{-1} is the mathematical notation for z-score, δ is from Column P, and $1 - \delta$ is from Column T.		
U	$Z^*_{(0.99)} \equiv$	Z-score determined from a standard table of percentiles. For a parameter WITH NO non-detects $z^*_{(0.99)} = 2.3263$. For a parameter WITH non-detects $z^*_{(0.99)} = \varphi^{-1} \left[(0.99 - \delta) / 1 - \delta \right]$; where φ^{-1} is the mathematical notation for z-score, δ is from Column P, and $1 - \delta$ is from Column T.		

Table D-20. Limit Calculations from EPA/505/2-90-001, *Technical Support Document for Water Quality-based Toxics Control*

COLUMN	Where:	Description
V	Daily Max ($X_{.95}$) \equiv	The daily maximum value at the 95 percent confidence interval. Equation is $\hat{\mu} + 1.6449\hat{\sigma}$, for a normal distribution; or $\exp[\hat{\mu}_y + 1.6449\hat{\sigma}_y]$, for a log-normal distribution.
W	Daily Max ($X_{.99}$) \equiv	The daily maximum value at the 95 percent confidence interval. Equation is $\hat{\mu} + 2.3263\hat{\sigma}$, for a normal distribution; or $\exp[\hat{\mu}_y + 2.3263\hat{\sigma}_y]$, for a log-normal distribution.
X	Daily Max ($X_{.95}$) (w NDs) \equiv	The daily maximum value at the 95 percent confidence interval. Equation is $\hat{\mu} + z^*_{.95}\hat{\sigma}$, for a delta-normal distribution; or $\exp[\hat{\mu}_y + z^*_{.95}\hat{\sigma}_y]$, for a delta-lognormal distribution.
Y	Daily Max ($X_{.99}$) (w NDs) \equiv	The daily maximum value at the 95 percent confidence interval. Equation is $\hat{\mu} + z^*_{.99}\hat{\sigma}$, for a delta-normal distribution; or $\exp[\hat{\mu}_y + z^*_{.99}\hat{\sigma}_y]$, for a delta-lognormal distribution.
Z	Daily Max 0.95 Variability Factor \equiv	The ratio of the calculated Daily Maximum to the average value for that parameter. The larger the value the more likely the calculated value may be biased high. For a normal distribution the equation is: $\hat{X}_{0.95}/\hat{\mu}$, where $X_{0.95}$ is the calculated Daily Max ($X_{0.95}$). For log-normal distributions the equation is: $\hat{X}_{0.95}/E(X)$. For delta-lognormal distributions the equation is: $\hat{X}_{0.95}/\hat{E}(X^*)$.
AA	Daily Max 0.99 Variability Factor \equiv	The ratio of the calculated Daily Maximum to the average value for that parameter. The larger the value the more likely the calculated value may be biased high. For a normal distribution the equation is: $\hat{X}_{0.99}/\hat{\mu}$, where $X_{0.99}$ is the calculated Daily Max ($X_{0.99}$). For log-normal distributions the equation is: $\hat{X}_{0.99}/E(X)$. For delta-lognormal distributions the equation is: $\hat{X}_{0.99}/\hat{E}(X^*)$.
AB	n \equiv	The average of yearly sample size. This value of “n” is the one denoted in the variables and equations.
AC	σ^2_n \equiv	Variance of the distribution of the n-day monthly average. The equation is: σ^2/n , where σ^2 is the estimated variance (Column S), and n is the average of yearly sample size in cell AJ4.
AD	μ^{\wedge}_n \equiv	Mean of the distribution of the n-day monthly average. The equation is: μ^{\wedge} , the estimated mean from Column Q.
AE	σ^{\wedge}_n \equiv	Standard deviation of the distribution of the n-day monthly average. The equation is: $\sqrt{\hat{\sigma}^2_n}$, where $\sigma^{\wedge 2}_n$ is from Column AJ.
NOTE: Values for $\sigma^{\wedge 2}_n$, μ_n , and σ^{\wedge}_n are used for normal distribution ONLY.		
AF	$\hat{E}(X_n)$ \equiv	E(x). From Column U for a log-normal distribution, or Column X for a delta-lognormal distribution (log-normal WITH non-detects).
AG	$V^{\wedge}(X_n)$ \equiv	$\hat{V}(x)/n$, where $V^{\wedge}(x)$ is from Column V for a log-normal distribution, or Column Y for a delta-lognormal distribution; and n is from cell AK4.
AH	X_n \equiv	Average of the n-day monthly average values. N-day monthly average values are in Column AJ for log-normal distributions and other distribution types, and Column AK for delta-lognormal distributions.
AI	$cv^{\wedge}(X_n)$ \equiv	Coefficient of variation of the distribution of the n-day monthly average. The equation is: $\hat{\sigma}^2_n/\hat{\mu}_n$, where $\sigma^{\wedge 2}_n$ is from Column AJ and μ^{\wedge}_n is from Column AK for a normal distribution. Equation is $\sqrt{V(X_n)}/X_n$ for log-normal and delta-lognormal distributions.
AJ	Average Monthly 0.95 ($X_{0.95(n)}$) \equiv	The average monthly value at the 95 percent confidence interval. Equation is: $\hat{\mu}_n + 1.6449\hat{\sigma}_n$ for a normal distribution; or, $\hat{E}(X_n) + 1.6449\sqrt{\hat{V}(X_n)}$ for a log-normal distribution or other distribution type.
AK	Average Monthly 0.99 ($X_{0.99(n)}$) \equiv	The average monthly value at the 95 percent confidence interval. Equation is, $\hat{\mu}_n + 2.3263\hat{\sigma}_n$ for a normal distribution; or, $\hat{E}(X_n) + 2.3263\sqrt{\hat{V}(X_n)}$ for a log-normal distribution or other distribution type.
AL	Average Monthly 0.95 ($X_{0.95(n)}$) (w/ NDs) \equiv	The average monthly value at the 95 percent confidence interval. Equation is $\hat{\mu}_n + z^*_{.95}\hat{\sigma}_n$, for a delta-normal distribution; or, $\hat{E}(X_n) + z^*_{.95}\sqrt{\hat{V}(X_n)}$ for a delta-lognormal distribution.
AM	Average Monthly 0.99 ($X_{0.99(n)}$) (w/ NDs) \equiv	The average monthly value at the 95 percent confidence interval. Equation is $\hat{\mu}_n + z^*_{.99}\hat{\sigma}_n$, for a delta-normal distribution; or, $\hat{E}(X_n) + z^*_{.99}\sqrt{\hat{V}(X_n)}$ for a delta-lognormal distribution.
AN	Normality \equiv	List the normality of the distribution type (normal, log-normal, non-normal, etc.).
AO	Normality Used \equiv	The normality distribution used to calculate the limit values when the data are non-normal.
AP	Comments \equiv	Miscellaneous notations from the original DMR data set.

Table D-21. Outfall 001 Limit Calculation Results from TSD for WQ Limits Workbook

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
Location	Date Range	Parameter	Units	k	NDs	r	k - r	$\delta = r / k$	$\mu^{}_y$	$\sigma^2{}_y$	$\sigma^{}_y$	1 - δ	E(X)	V(X)	cv(X)	$\hat{E}(X^*)$	$V^*(X^*)$	cv(X*)
Outfall 001	01/15/1996 – 12/01/2019	Application Rate	in/day	275		0	275	0	0.0552	0.00016	0.012743							
Outfall 001	01/15/1996 – 12/01/2019	BOD ₅	mg/L	273		0	273	0	4.784	0.54053	0.7352		156.71	17,605.08	0.8467			
Outfall 001	01/15/1996 – 12/01/2019	Fecal Coliform	CFU/100 mL	236		15	221	0.0636	3.91	2.52	1.59	0.9364				166.41	3.38E+05	
Outfall 001	01/15/1996 – 12/01/2019	Flow	gpd	275		0	275	0	11.09	0.0855	0.2924		68,035.06	4.131E+08	0.29875			
Outfall 001	1/15/2000 – 12/01/2019	Hydraulic Loading	in/month	275		0	275	0	1.83	0.291	0.5394							
Outfall 001	01/15/1996 – 12/01/2019	Nitrate + Nitrite	mg/L	275		0	275	0	4.26	5.53	2.35							
Outfall 001	01/15/1996 – 12/01/2019	Total Nitrogen	lb./ac/month	349		0	349	0	3.83	1.89	1.3738							
Outfall 001	01/15/1996 – 12/01/2019	Total Nitrogen	lb./ac/yr.	351		0	351	0	205.103	6,601.29	81.25							
Outfall 001	01/15/1996 – 12/01/2019	Total Nitrogen	mg/L	284		0	284	0	3.97	0.3169	0.5629		62.17	1,440.97	0.61062			
Outfall 001	01/15/1996 – 12/01/2019	Oil & Grease	mg/L	210		26	184	0.1238	2.53	0.49284	0.702027	0.8762				3.05	-2.16	
Outfall 001	01/15/1996 – 12/01/2019	pH	SU	274		0	274	0	1.98	0.0017	0.04153		7.23	0.090152	0.04154			
Outfall 001	01/15/1996 – 12/01/2019	TDS	mg/L	243		0	243	0	6.59	0.0606	0.24624		746.52	34,836.15	0.25002			
Outfall 001	01/15/1996 – 12/01/2019	TKN	mg/L	275		0	275	0	3.21	0.82964	0.9108		37.52	1,819.59	1.14			

A	B	C	D	T	U	V	W	X	Y	Z	AA
Location	Date Range	Parameter	Units	Z* (0.95)	Z* (0.99)	Daily Max (X _{.95})	Daily Max (X _{.99})	Daily Max (X _{.95}) (w NDs)	Daily Max (X _{.99}) (w/ NDs)	Daily Max 0.95 Variability Factor	Daily Max 0.99 Variability Factor
Outfall 001	01/15/1996 – 12/01/2019	Application Rate	in/day			0.07618675	0.084869507			0.324194331	0.361141709
Outfall 001	01/15/1996 – 12/01/2019	BOD ₅	mg/L			400.79	661.44			2.56	4.22
Outfall 001	01/15/1996 – 12/01/2019	Fecal Coliform	CFU/100 mL	0.947	0.989			653.45	1,906.01	3.93	11.45
Outfall 001	01/15/1996 – 12/01/2019	Flow	gpd			105,448.83	128,696.702			1.55	1.89
Outfall 001	1/15/2000 – 12/01/2019	Hydraulic Loading	in/month			2.72	3.09			1.48	1.69
Outfall 001	01/15/1996 – 12/01/2019	Nitrate + Nitrite	mg/L			66.02	94.64			3.64	5.22
Outfall 001	01/15/1996 – 12/01/2019	Total Nitrogen	lb./ac/month			37.05	49.32			2.53	3.37
Outfall 001	01/15/1996 – 12/01/2019	Total Nitrogen	lb./ac/yr.			338.75	394.11			1.65	1.92
Outfall 001	01/15/1996 – 12/01/2019	Total Nitrogen	mg/L			133.93	196.55			2.15	3.16
Outfall 001	01/15/1996 – 12/01/2019	Oil & Grease	mg/L	0.943	0.989			13.21	17.09	0.820239233	1.06
Outfall 001	01/15/1996 – 12/01/2019	pH	SU			7.73	7.95			3.91	4.02
Outfall 001	01/15/1996 – 12/01/2019	pH ^A	SU			6.74	6.56				
Outfall 001	01/15/1996 – 12/01/2019	TDS	mg/L			1,085.87	1,284.25			1.45	1.72
Outfall 001	01/15/1996 – 12/01/2019	TKN	mg/L			110.87	206.23			2.95	5.496

Table D-21. Outfall 001 Limit Calculation Results from TSD for WQ Limits Workbook (continued)

A	B	C	D	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM
Location	Date Range	Parameter	Units	n	σ^2_n	μ_n	σ_n	$E(X_n)$	$V(X_n)$	X_n	$cv(X_n)$	Average Monthly 0.95 ($X_{.95(n)}$)	Average Monthly 0.99 ($X_{.99(n)}$)	Average Monthly 0.95 ($X_{.95(n)}$) (w/ NDs)	Average Monthly 0.99 ($X_{.99(n)}$) (w/ NDs)
Outfall 001	01/15/1996 – 12/01/2019	Application Rate	in/day	11.46	1.42E-05	0.05523	0.00376				0.06816	0.061418617	0.063983673		
Outfall 001	01/15/1996 – 12/01/2019	BOD ₅	mg/L	11.38				156.71	1,547.699	4.81	8.17	221.42	248.22		
Outfall 001	01/15/1996 – 12/01/2019	Fecal Coliform	CFU/ 100 mL	11.8				166.41	28,643.95	3.93	43.05			439.98	554.05
Outfall 001	01/15/1996 – 12/01/2019	Flow	gpd	11.46				68,035.06	3.61E+07	11.09	541.62	77,911.902	82,003.39		
Outfall 001	1/15/2000 – 12/01/2019	Hydraulic Loading	in/month	11.46	0.0254	1.83	0.1594				0.087	2.09	2.202		
Outfall 001	01/15/1996 – 12/01/2019	Nitrate + Nitrite	mg/L	11.46	0.4828	4.26	0.6949				0.1633	29.15	34.49		
Outfall 001	01/15/1996 – 12/01/2019	Total Nitrogen	lb./ac/month	15.86	0.11897	3.83	0.3449				0.0901	19.31	21.43		
Outfall 001	01/15/1996 – 12/01/2019	Total Nitrogen	lb./ac/yr.	12.9	511.73	205.103	22.62				0.1103	242.31	257.73		
Outfall 001	01/15/1996 – 12/01/2019	Total Nitrogen	mg/L	11.46				62.167	125.757	3.99	2.81	80.61	88.2541		
Outfall 001	01/15/1996 – 12/01/2019	Oil & Grease	mg/L	10.5	0.046937	2.53	0.21665				0.09			8.23	9.13
Outfall 001	01/15/1996 – 12/01/2019	pH	SU	11.71				7.23	0.0077	1.98	0.0443	7.37	7.43		
Outfall 001	01/15/1996 – 12/01/2019	pH ^A	SU												
Outfall 001	01/15/1996 – 12/01/2019	TDS	mg/L	11.59				746.52	3,005.47	6.58	8.33	836.69	874.05		
Outfall 001	01/15/1996 – 12/01/2019	TKN	mg/L	11.46				37.52	158.801	3.26	3.87	58.25	66.84		

A	B	C	D	AN	AP	AQ
Location	Date Range	Parameter	Units	Normality	Comments	
Outfall 001	01/15/1996 – 12/01/2019	Application Rate	in/day	Normal	Less eleven zero values.	
Outfall 001	01/15/1996 – 12/01/2019	BOD ₅	mg/L	Natural log		
Outfall 001	01/15/1996 – 12/01/2019	Fecal Coliform	CFU/100 mL	Natural log		
Outfall 001	01/15/1996 – 12/01/2019	Flow	gpd	Natural log		
Outfall 001	1/15/2000 – 12/01/2019	Hydraulic Loading	in/month	Normal		
Outfall 001	01/15/1996 – 12/01/2019	Nitrate + Nitrite	mg/L	Square root		
Outfall 001	01/15/1996 – 12/01/2019	Total Nitrogen	lb./ac/month	Square root		
Outfall 001	01/15/1996 – 12/01/2019	Total Nitrogen	lb./ac/yr.	Normal		
Outfall 001	01/15/1996 – 12/01/2019	Total Nitrogen	mg/L	Natural log		
Outfall 001	01/15/1996 – 12/01/2019	Oil & Grease	mg/L	Square root	Less twenty-five zero values.	
Outfall 001	01/15/1996 – 12/01/2019	pH	SU	Natural log		
Outfall 001	01/15/1996 – 12/01/2019	TDS	mg/L	Natural log		
Outfall 001	01/15/1996 – 12/01/2019	TKN	mg/L	Natural log		

Table D-22. Outfall 001 Limit Calculation Results from TSD for WQ Limits Workbook

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
Location	Date Range	Parameter	Units	k	NDs	r	k - r	$\delta = r / k$	μ^*_y	σ^{*2}_y	σ^*_y	1 - δ	E(X)	V(X)	cv(X)	$\hat{E}(X^*)$	$V^*(X^*)$	cv(X*)
Outfall 001	01/01/2015–12/01/2018	Total Nitrogen (FA)	lb./ac/month	57		0	57	0	0.98	0.93017	0.96445		4.24	27.59	1.24			
Outfall 001	01/01/2015–12/01/2019	Total Nitrogen (GH)	lb./ac/month	59		0	59	0	2.76	0.28176	0.53081		18.14	107.14	0.5705			
Outfall 001	01/01/2015–12/01/2019	Total Nitrogen (P)	lb./ac/month	59		0	59	0	2.48	0.14113	0.37567							
Outfall 001	01/01/2015–12/01/2019	Total Nitrogen (FA)	lb./ac/yr.	59		0	59	0	120.97	2,986.07	54.64							
Outfall 001	01/01/2015–12/01/2019	Total Nitrogen (GH)	lb./ac/yr.	59		0	59	0	4.97	0.25276	0.50275		162.97	7,637.583	0.5363			
Outfall 001	01/01/2015–12/01/2019	Total Nitrogen (P)	lb./ac/yr.	59		0	59	0	5.28	0.11783	0.34326		207.41	5,379.335	0.3536			
Outfall 001	04/15/2016 - 08/01/2019	Application Rate (FA)	in/day	185		0	185	0	-0.9342	0.234455	0.484205		0.441748	0.05156	0.514023			
Outfall 001	04/15/2016 - 08/01/2019	Application Rate (GH)	in/day	1,189		0	1,189	0	0.8584	0.09391	0.306445							
Outfall 001	04/15/2016 - 08/01/2019	Application Rate (P)	in/day	280		0	280	0	-0.5589	0.648087	0.805038		0.790748	0.570183	0.954924			
Outfall 001	04/15/2016 - 08/01/2019	Flow (FA)	gpd	185		0	185	0	9.996	0.400743	0.633042		26,806.09	3.542E+08	0.702092			
Outfall 001	04/15/2016 - 08/01/2019	Flow (GH)	gpd	1,189		0	1,189	0	10.61	0.654603	0.809076		56,431.94	2.944E+09	0.961447			
Outfall 001	04/15/2016 - 08/01/2019	Flow (P)	gpd	280		0	280	0	9.26	0.517508	0.71938		13,589.799	1.252E+08	0.823312			
Outfall 001	04/15/2016 - 08/01/2019	Hydraulic Loading (FA)	gal/ac	185		0	185	0	2.74	0.240626	0.490537		17.48	83.16	0.52158			
Outfall 001	04/15/2016 - 08/01/2019	Hydraulic Loading (GH)	gal/ac	1,189		0	1,189	0	1.64	0.867295	0.931287		7.97	87.78	1.17			
Outfall 001	04/15/2016 - 08/01/2019	Hydraulic Loading (P)	gal/ac	280		0	280	0	4.399	0.510118	0.714226		104.995	7,336.34	0.81577			

A	B	C	D	T	U	V	W	X	Y	Z	AA
Location	Date Range	Parameter	Units	Z* (0.95)	Z* (0.99)	Daily Max (X _{.95})	Daily Max (X _{.99})	Daily Max (X _{.95}) (w NDs)	Daily Max (X _{.99}) (w/ NDs)	Daily Max 0.95 Variability Factor	Daily Max 0.99 Variability Factor
Outfall 001	01/01/2015–12/01/2019	Total Nitrogen (FA)	lb./ac/mont h			13.01	25.102			3.07	5.92
Outfall 001	01/01/2015–12/01/2019	Total Nitrogen (GH)	lb./ac/mont h			37.74	54.18			2.08	2.99
Outfall 001	01/01/2015–12/01/2019	Total Nitrogen (P)	lb./ac/mont h			29.61	37.58			1.95	2.48
Outfall 001	01/01/2015–12/01/2019	Total Nitrogen (FA)	lb./ac/yr.			210.85	248.09			1.74	2.05
Outfall 001	01/01/2015–12/01/2019	Total Nitrogen (GH)	lb./ac/yr.			328.37	462.54			2.01	2.84
Outfall 001	01/01/2015–12/01/2019	Total Nitrogen (P)	lb./ac/yr.			343.92	434.54			1.66	2.095
Outfall 001	04/15/2016 - 08/01/2019	Application Rate (FA)	in/day			0.87	1.21			1.97	2.74
Outfall 001	04/15/2016 - 08/01/2019	Application Rate (GH)	in/day			2.53	3.88			2.73	4.19
Outfall 001	04/15/2016 - 08/01/2019	Application Rate (P)	in/day			0.54	0.93			0.68	1.18
Outfall 001	04/15/2016 - 08/01/2019	Flow (FA)	gpd			62,149.898	95,669.95			2.32	3.57
Outfall 001	04/15/2016 - 08/01/2019	Flow (GH)	gpd			153,942.98	267,170.41			2.73	4.73
Outfall 001	04/15/2016 - 08/01/2019	Flow (P)	gpd			8,564.103	13,981.92			0.63	1.03
Outfall 001	04/15/2016 - 08/01/2019	Hydraulic Loading (FA)	gal/ac			34.74	48.52			1.99	2.78
Outfall 001	04/15/2016 - 08/01/2019	Hydraulic Loading (GH)	gal/ac			23.91	45.11			2.9988	5.66
Outfall 001	04/15/2016 - 08/01/2019	Hydraulic Loading (P)	gal/ac			65.85	107.13			2.79	4.95

Table D-22. Outfall 001 Limit Calculation Results from TSD for WQ Limits Workbook (continued)

A	B	C	D	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM
Location	Date Range	Parameter	Units	n	σ^2_n	μ_n	σ_n	E(X _n)	V(X _n)	X _n	cv(X _n)	Average Monthly 0.95 (X _{.95(n)})	Average Monthly 0.99 (X _{.99(n)})	Average Monthly 0.95 (X _{.95(n)}) (w/ NDs)	Average Monthly 0.99 (X _{.99(n)}) (w/ NDs)
Outfall 001	01/01/2015–12/01/2019	Total Nitrogen (FA)	lb./ac/month	11.4				4.24	2.42	0.9789	1.59	6.798	7.86		
Outfall 001	01/01/2015–12/01/2019	Total Nitrogen (GH)	lb./ac/month	11.8				18.14	9.08	2.75	1.095	23.101	25.154		
Outfall 001	01/01/2015–12/01/2019	Total Nitrogen (P)	lb./ac/month	11.8	0.012	2.48	0.1094				0.0442	18.73	20.35		
Outfall 001	01/01/2015–12/01/2019	Total Nitrogen (FA)	lb./ac/yr.	11.8	253.06	120.97	15.91				0.13	147.13	157.97		
Outfall 001	01/01/2015–12/01/2019	Total Nitrogen (GH)	lb./ac/yr.	11.8				162.97	647.25	4.97	5.12	204.82	222.15		
Outfall 001	01/01/2015–12/01/2019	Total Nitrogen (P)	lb./ac/yr.	11.8				207.41	455.88	5.267	4.05	242.53	257.08		
Outfall 001	04/15/2016 - 08/01/2019	Application Rate (FA)	in/day	61.67				0.44175	0.00084	-0.8687	-0.03328	0.49	0.51		
Outfall 001	04/15/2016 - 08/01/2019	Application Rate (GH)	in/day	146.38	0.0064	0.8584	0.0253				0.0295	0.73	0.77		
Outfall 001	04/15/2016 - 08/01/2019	Application Rate (P)	in/day	93.33				0.790748	0.00611	-0.6126	-0.1276	0.23	0.24		
Outfall 001	04/15/2016 - 08/01/2019	Flow (FA)	gpd	61.67				26,806.09	5.744E06	10.19	235.301	30,748.32	32,381.39		
Outfall 001	04/15/2016 - 08/01/2019	Flow (GH)	gpd	148.63				56,431.94	1.922E07	10.62	419.18	63,752.49	66,785.03		
Outfall 001	04/15/2016 - 08/01/2019	Flow (P)	gpd	93.33				13,589.80	1.341E06	9.37	123.65	3,873.703	4,070.99		
Outfall 001	04/15/2016 - 08/01/2019	Hydraulic Loading (FA)	gal/ac	61.67				17.48	1.35	2.801	0.41462	19.39	20.18		
Outfall 001	04/15/2016 - 08/01/2019	Hydraulic Loading (GH)	gal/ac	148.63				7.97	0.59063	1.72	0.4471	9.24	9.76		
Outfall 001	04/15/2016 - 08/01/2019	Hydraulic Loading (P)	gal/ac	93.33				104.995	78.604	4.48	1.98	29.89	31.405		

A	B	C	D	AN	AP
Location	Date Range	Parameter	Units	Normality	Comments
Outfall 001	01/01/2015–12/01/2019	Total Nitrogen (FA)	lb./ac/month	Natural log	
Outfall 001	01/01/2015–12/01/2019	Total Nitrogen (GH)	lb./ac/month	Natural log	
Outfall 001	01/01/2015–12/01/2019	Total Nitrogen (P)	lb./ac/month	Cube-root	
Outfall 001	01/01/2015–12/01/2019	Total Nitrogen (FA)	lb./ac/yr.	Normal	Natural log yield a lower Daily Max variation, but normal yields values closer to the calculated 95 th percentile.
Outfall 001	01/01/2015–12/01/2019	Total Nitrogen (GH)	lb./ac/yr.	Natural log	
Outfall 001	01/01/2015–12/01/2019	Total Nitrogen (P)	lb./ac/yr.	Natural log	
Outfall 001	04/15/2016 - 08/01/2019	Application Rate (FA)	in/day	Natural log	
Outfall 001	04/15/2016 - 08/01/2019	Application Rate (GH)	in/day	Cube-root	Outlier values from fields 1 and 6 are removed due to biasing the results low.
Outfall 001	04/15/2016 - 08/01/2019	Application Rate (P)	in/day	Natural log	Daily Maximum and Average Daily values are reduced by 75% because of reduction in spray field area.
Outfall 001	04/15/2016 - 08/01/2019	Flow (FA)	gpd	Natural log	
Outfall 001	04/15/2016 - 08/01/2019	Flow (GH)	gpd	Natural log	Outlier values from fields 1 and 6 are removed due to biasing the results low.
Outfall 001	04/15/2016 - 08/01/2019	Flow (P)	gpd	Natural log	Daily Maximum and Average Daily values are reduced by 75% because of reduction in spray field area.
Outfall 001	04/15/2016 - 08/01/2019	Hydraulic Loading (FA)	gal/ac	Natural log	
Outfall 001	04/15/2016 - 08/01/2019	Hydraulic Loading (GH)	gal/ac	Natural log	Outlier values from fields 1 and 6 are removed due to biasing the results low.
Outfall 001	04/15/2016 - 08/01/2019	Hydraulic Loading (P)	gal/ac	Natural log	Daily Maximum and Average Daily values are reduced by 75% because of reduction in spray field area.

Appendix E--Response to Comments

Schenk Packing Co. Inc. was provided an opportunity to review the draft permit and fact sheet for factual accuracy. No discrepancies were noted. Comments made were addressed in this draft final document.

Ecology will complete this section after the public notice of draft period.