Montana Department of Environmental Quality

Water Protection Bureau
P.O. Box 200901
Helena, MT 59620-0901

PERMIT FACT SHEET

MONTANA GROUND WATER POLLUTION CONTROL SYSTEM (MGWPCS)

Permittee:	Wildflower Subdivision Homeowner's Association
Permit Number:	MTX000142
Permit Type:	Domestic wastewater
Application Type:	Renewal
Facility Name:	Wildflower Subdivision Wastewater Facility
Facility Location:	SW 1/4 of Section 6, T5N, R20W, Ravalli County Latitude: 46.217216 Longitude: -114.147137
Facility Address:	Wildflower Lane, Hamilton, MT
Facility Contact:	Steven Winkler, HOA President, Territorial Landworks (Operator)
Treatment Type:	Level 2, Advantex Pods
Receiving Water:	Class I Ground Water
Number of Outfalls:	1
Outfall / Type:	001, Subsurface drainfield
Effluent Type:	Domestic strength wastewater
Mixing Zone:	Department Modified 400 foot Standard
Effluent Limit Type:	WQBEL
Effluent Limits:	Total nitrogen: 60% removal, 7.7 lbs/day
Flow Rate:	Design maximum: 14,400 gpd Design average daily: 9,600 gpd
Effluent sampling:	Monthly, EFF-001
Influent sampling:	Monthly, INF-001
Ground water sampling:	Quarterly, MW-1, MW-2
Fact Sheet Date:	July, 2020
Prepared By:	Rich Morse

1.0 PERMIT INFORMATION

DEQ issues MGWPCS permits for a period of five years. The permit may be reissued at the end of the period, subject to reevaluation of the receiving water quality and permit limitations. This fact sheet provides the basis for DEQ's decision to renew a MGWPCS wastewater discharge permit Wildflower Subdivision Homeowner's Association for the Wildflower Subdivision wastewater treatment system.

1.1 APPLICATION

DEQ received an application for renewal of this permit on July 5th, 2016. Renewal fees accompanied the application. DEQ reviewed the submittal and issued a completeness letter on July 17, 2016.

1.2 PERMIT HISTORY

This facility was reviewed by DEQ Subdivision Program as file numbers EQ#03-2467 and 04-1464. The initial discharge permit was issued in 2004. The permit was renewed in 2011 with interim nitrogen limits. The interim limit of 46.7 milligrams per liter (mg/L) was in effect until November 1, 2014 when the final definition based effluent limit (DBEL) of 24 mg/L came into effect.

1.3 CHANGES TO THIS PERMIT

Some of the reporting requirements and parameters for the facility have changed. The Wildflower Subdivision facility is a Level 2 treatment system. The State of Montana's definition of a Level 2 treatment system is "removal of at least 60% of total nitrogen as measured from the raw sewage load to the system or: discharges a total nitrogen concentration of 24 mg/L or less" (ARM 17.30.702). The renewed permit expresses the definition-based effluent limit as 60% removal of total nitrogen content. In addition, the renewed permit includes a water-quality based effluent limit to ensure this discharge does not cause significant changes to water quality.

To calculate percent removal of TN, DEQ has added an influent sampling requirement to this permit. Downgradient monitoring and influent reporting are new requirements in this permit (**Table 10**). All required parameters must be reported. Sampling requirements and compliance timetables are listed in the special conditions section of this fact sheet (**Section 5.3** and **Table 11)**.

DEQ calculated a further limit defining the maximum allowable nitrogen load that can be discharged from the facility while maintaining nondegradation of water quality criteria at the end of the 400 foot mixing zone. This water quality based effluent limit (WQBEL) is calculated using site-specific water quality data. The WQBEL is 7.7 lbs per day TN. This WQBEL is included in the final effluent limits shown in **Table 8, Section 5.3** of this fact sheet and is in addition to the required percent removal limit.

2.0 FACILITY INFORMATION

2.1 LOCATION

The wastewater treatment system is located approximately one mile south of Hamilton in the Bitterroot Valley. **Figure 1** is a vicinity map for the facility.

Figure 1. Location of the Wildflower Subdivision

The Wildflower Subdivision's wastewater facility serves 48 residences. The subdivision is under the management of the homeowners association. Effluent treated at the facility is residential in strength. The treatment and discharge locations are in a central common park area. **Figure 2** and **Figure 3** respectively, are the site map and the site plan for the Wildflower Subdivision.

Figure 2. Site Plan for Wildflower Subdivision

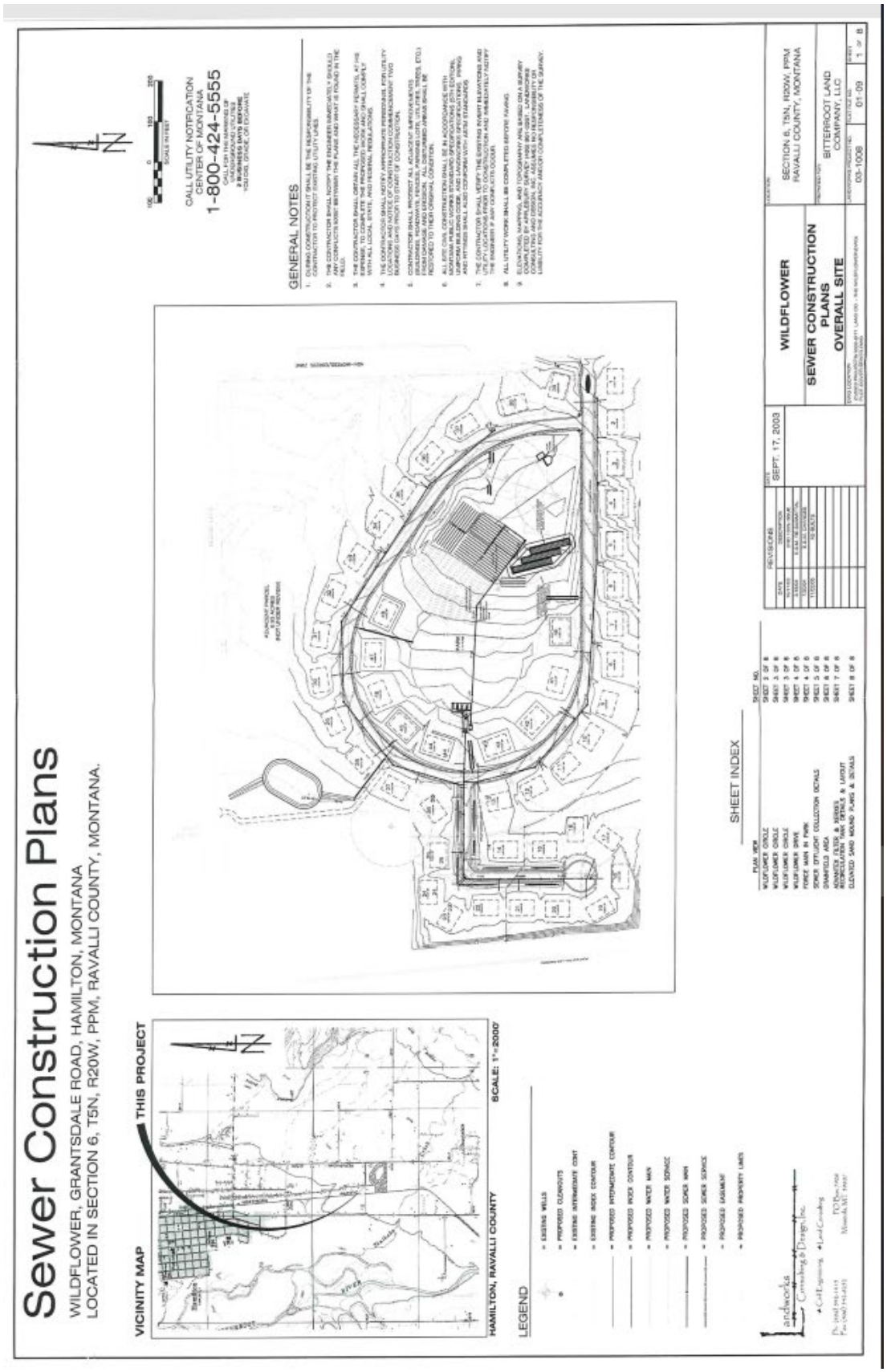

Figure 3. Wildflower Subdivision Wastewater plan.

2.2 OPERATIONS

System operations are summarized in **Table 1**.

Table 1. Collection, Treatment, and Disposal Summary

Collection	
Contributing sources:	48 residences
Standard industrial code(s) of sources:	SIC #4952 (Sewerage Systems)
Collection method:	Individual septic tanks to gravity-driven sewer lines. STEP tank to treatment.
Flow volume:	Average daily design flow: 9,600 gallons per day Maximum daily design flow: 14,400 gallons per day
Treatment	
Treatment level:	Level 2, Advantex AX-100 Pods.
Treatment technology:	Individual residential septic tanks, 15,000 gallon recirculating tank with four trickling filters (Advantex). Pressure-dosed to a multi-zoned subsurface drainfield and a raised sand mound.
Treatment location:	Latitude: 46.217159°, Longitude: 114.148221°
Disposal	
Method of disposal:	Infiltration to ground water
Disposal structure:	Subsurface drainfield (Outfall 001)
Outfall location:	Latitude: 46.216988°, Longitude: 114.146709°

The Wildflower wastewater treatment system has individual septic tanks at each of the 48 home sites. The effluent flows via gravity to a central treatment location with a 15,000 gallon recirculating tank attached to Level 2 treatment using Advantex pods consisting of trickling membrane treatment technology. After recirculating, the effluent is pressure dosed to several alternating drainfields and one raised sand mound. All of the discharge structures use a single DEQ modified 400 foot long standard mixing zone.

Effluent monitoring (EFF-001) and flow metering (FM-001) are located in the dose tank prior to discharge to the drainfields. A new requirement of this permit is influent sampling. The applicant will need to identify or construct an influent monitoring location (INF-001) in a DEQ approved location prior to the recirculation tank shown in **Figure 4** of this fact sheet.

Monitoring and sampling requirements are further discussed in **Section 6**. Relative locations of the dose tank and the recirculation tank are shown in the line diagram of the system **(Figure 4).**

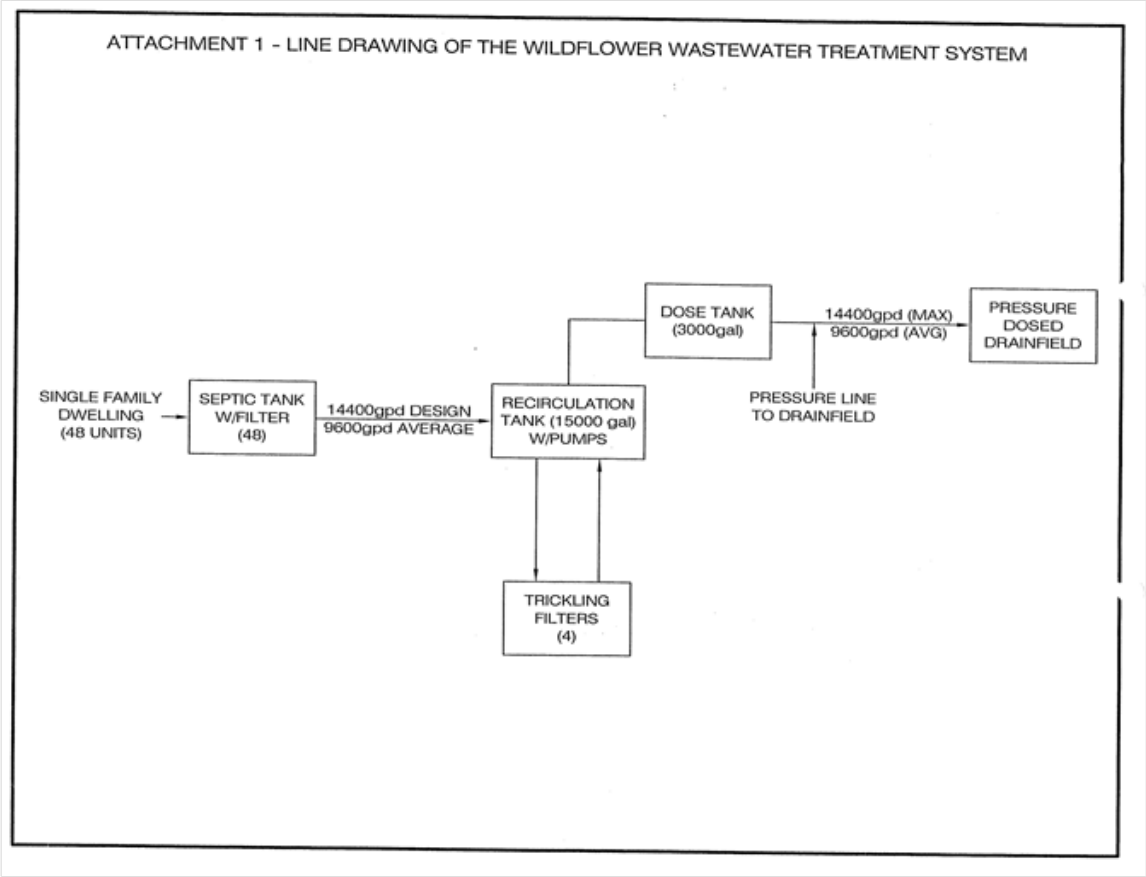

Figure 4. Wastewater Treatment System Line Diagram.

2.3 EFFLUENT CHARACTERISTICS

During the previous permit cycle, the facility sampled and reported effluent quality criteria to DEQ in the form of discharge monitoring reports (DMRs). This data is summarized below in **Table 2**. The majority of the concentrations are reported in units of milligrams per liter (mg/L), which is equivalent to one part per million.

Table 2. Effluent Quality Data from Outfall 001, Wildflower Subdivision

Parameter	Units	Reported DMR values			2011 Limit	# of Samples
		Minimum	Maximum	Average		
Flow rate	Gallons/day (Daily Max)	1192	5493	3691	14,400	18
	Gallons/day (30 day average)	1192	5493	3691	14,400	18
Chloride (as Cl)	mg/L	90	136	108	–	18
BOD	mg/L	4	270	86.3		18
Conductivity	uS/cm	5	948	835		18
Nitrogen, nitrate+nitrite	mg/L	2.39	29.6	15.5	–	18
Nitrogen, total Kjeldahl	mg/L	0	83.2	23.4	–	18
Nitrogen, total*	mg/L	21.6	87.5	41.5	24	18
Phosphorus, total	pounds/day	0.01	.74	0.3	-	18
Total dissolved solids	mg/L	447	582	511	–	18

CFU = colony forming unit
*Total Nitrogen = Nitrate + Nitrite + Total Kjeldahl Nitrogen (as N)
Period of record: September 2015 – December 2019

There was one influent sample done during the last permit cycle. The results of the March 2014 influent analysis are in **Figure 5** below.

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LABORATORY ANALYTICAL REPORT
Prepared by Billings, MT Branch

Client: Territorial Landworks Inc
Project: Wildflowers Influent
Lab ID: B14032152-001
Client Sample ID: Wildflower Influent

Report Date: 04/11/14
Collection Date: 03/27/14 14:00
DateReceived: 03/28/14
Matrix: Waste Water

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL PROPERTIES							
Conductivity @ 25 C	1070	umhos/cm		5		A2510 B	03/28/14 11:01 / cnm
Solids, Total Dissolved TDS @ 180 C	591	mg/L		10		A2540 C	03/28/14 10:02 / pjw
INORGANICS							
Chloride	146	mg/L		1		E300.0	04/01/14 04:07 / klc
AGGREGATE ORGANICS							
Oxygen Demand, Biochemical (BOD)	93	mg/L		30		A5210 B	03/28/14 12:35 / ldv
NUTRIENTS							
Nitrogen, Nitrate+Nitrite as N	8.38	mg/L	D	0.06		E353.2	04/03/14 15:49 / djr
Nitrogen, Kjeldahl, Total as N	52	mg/L	D	3		E351.2	04/04/14 10:55 / pdg
Nitrogen, Total	60	mg/L		3		Calculation	04/04/14 13:55 / sln
Phosphorus, Total as P	7.36	mg/L	D	0.05		E365.1	04/03/14 10:26 / pdg

Figure 5. Wildflower Subdivision Influent Sampling Results from March 2014. The location of sampling for this sample is unknow.

2.4 GEOLOGY

According to the United States Geological Survey (USGS), most of the wells in the Bitterroot Valley are completed in the unconfined to semiconfined aquifers contained in Quaternary and Tertiary basin fill deposits. On the basis of data from 9,424 wells in the Bitterroot Valley, the shallow static water levels and the largest values for yield and specific capacity typically are associated with wells completed in Quaternary deposits. Quaternary and Tertiary deposits can be described as a sequence of complexly stratified lenses of cobbles, gravels, and sand with varying amount of intercalcated silt and clay (USGS 2000).

2.5 HYDROGEOLOGY

The average estimated hydraulic conductivity (K) of the aquifer is 269.31 ft./day. This estimate was derived from aquifer tests conducted on 5 nearby wells (GWIC ID # 52514, 145703, 52560, 189223 and 202014). These average values were calculated by the Department with information supplied in supplemental permit application materials. These wells were installed between 1983 and 2003. All wells were finished in the shallow aquifer. Total depths of these wells ranges from 28-58 feet below ground surface. The Department will use a conductivity value of 269.31 ft/day for permit limit calculations.

The principal water-bearing zone varies across the site. Static water level of the well data submitted by Land Works Consulting & Design, Inc. and used to triangulate ground water flow direction indicate static water levels between 13.9 and 16.4 feet below ground surface (bgs). The estimated hydraulic gradient and groundwater flow direction is 0.0107 ft./ft. and N 60° W respectively. The three wells used to make these determinations are all within approximately 1,000 feet of the site. These wells are the Johnson (GWIC ID # 145703), Sconyers (GWIC well ID # 52514) and the Hawkes wells describe the aquifer that hosts the receiving water.

Important hydrogeologic characteristics are summarized below in **Table 3**. The data supplied for **Table 3** was supplied by the applicant and was accepted in the previous permit renewals.

Table 3. Hydrogeologic Summary

Average depth to ground water	6 feet
General ground water flow direction	N60°W
Hydraulic conductivity	269.31 feet per day
Hydraulic gradient	0.0107 feet/feet
Nearest downgradient surface water	Manmade pond (2,858 feet)

2.6 GROUND WATER MONITORING WELLS

There are two ground water monitoring wells associated with this permit: MW-1 and MW-2. These monitoring wells are both located at the end of the 400- foot mixing zone. These wells are plotted on **Figure 2**. Monitoring well construction details are provided below in **Table 4**. Well logs for MW-1 and MW-2 are in **Appendix A.** The location and character of the ambient well used for background nitrate levels in this permit renewal is also shown in **Table 4**.

Table 4. Monitoring Well Summary

Monitoring Well MW-1	
MBMG GWIC ID:	Not recorded
Location- latitude/longitude:	Not recorded (See site map for location)
Location- narrative:	In mixing zone, 200 feet downgradient from outfall between lot 27 and 28
Rationale:	200 feet downgradient in the 400-foot mixing zone
Depth; screened interval:	Total Depth= 25 feet, Screened from 10-25 feet, Static Water Level 16 feet. Bgs.
Monitoring Well MW-2	
MBMG GWIC ID:	Not recorded
Location- latitude/longitude:	Not recorded (see site map for location)
Location- narrative:	In mixing zone, 200 feet down gradient from outfall between lot 27 and 28
Rationale:	200 feet downgradient in the 400-foot mixing zone
Depth; screened interval:	Total Depth = 40 feet, Screened from 25-40 feet, Static Water Level 16 feet bgs.
Ambient monitoring Well PWS-2	
MBMG GWIC ID:	ID# 203563
Latitude- Longitude:	Latitude: 46.216498, Longitude: -114.146154
Location - Narrative:	Southeast end of Park area.
Well description:	Open bottom well, total depth is 64 feet. Static water level is 10 feet.
Well notes:	The coordinates for PWS-2 given on the GWIC well log do not match what is on site. The above coordinates accurately reflect the location as supplied by the operator.

If a DEQ-approved monitoring well is abandoned, destroyed or decommissioned, or is no longer able to be sampled due to fluctuations in the ground water table, the permittee must install or designate a new well to replace the abandoned, destroyed, decommissioned, or non-viable well.

2.7 GROUND WATER QUALITY CHARACTERISTICS

Water sample analysis from the subdivision PWS-2 well are provided below in **Table 5**. Based on the 348 microsiemens per centimeter (µS/cm) specific conductance, the receiving water is Class I ground water. Data reported in the table is taken from three quarters of applicant supplied analysis.

Table 5. Ambient Water Quality Reported From Monitoring Well PWS-2

PWS-2 represents *shallow ground water 200 fee*t upgradient of Outfall 001						
	Units	**Reported Values**			**Reporting**	**# of**
		Minimum	**Maximum**	**Average**	**Limit**	**Samples**
Sulfate, total	mg/L					NR
Chloride (as Cl)	mg/L	2.0	3.0	2.3	1	3
Total dissolved solids	mg/L					NR
Escherichia coli bacteria	CFU/100mL	NR	<2	<1	1	3
Nitrogen, nitrate+nitrite (as N)	mg/L	0.45	0.8	0.6	0.01	3
Nitrogen, total Kjeldahl (as N)	mg/L					NR
Organic carbon	mg/L					NR
pH	Standard units					NR
Specific conductivity (@25°C)	µS/cm	316	385	348	5	3
Static water level	Feet below ground surface			64		1

NR= parameter not recorded.

3.0 WATER QUALITY STANDARDS AND NONDEGRADATION

Part of DEQ's mission is to protect, sustain, and improve the quality of state waters. Water quality standards provide the basis for effluent limits that DEQ applies to discharge permits (**Section 5**). These standards include three components: designated uses, water quality criteria, and nondegradation policy. DEQ protects all designated uses of state water by basing effluent limits on the most restrictive water quality limitations, intended to protect the most sensitive uses.

3.1 DESIGNATED USES

With a specific conductivity of 348 µS/cm (**Table 5** above), the receiving water is Class I ground water and therefore a high-quality water of the State. Class I ground waters must be maintained suitable for the following uses with little or no treatment:

- Public and private drinking water supplies
- Culinary and food processing purposes
- Irrigation
- Drinking water for livestock and wildlife
- Commercial and industrial purposes

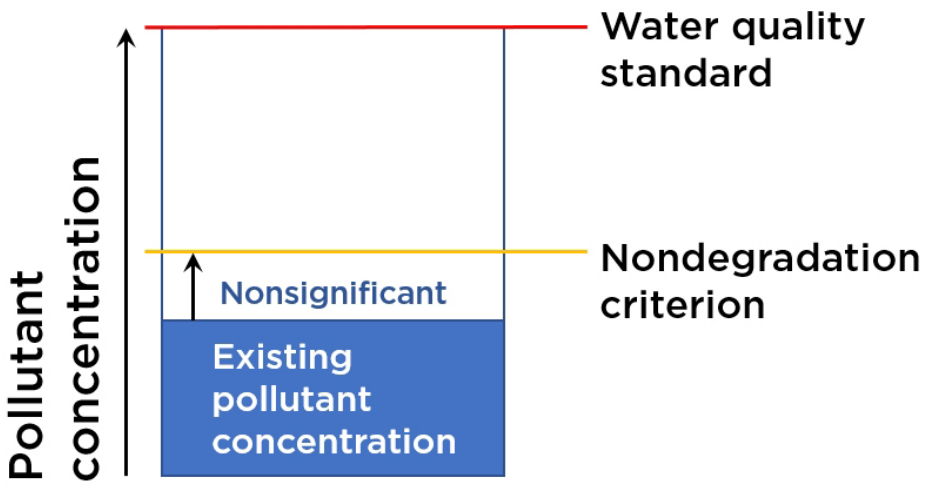
DEQ protects all the assigned beneficial uses by protecting the most sensitive. Drinking water is the most sensitive use of this receiving water.

3.2 Water Quality Criteria

Montana has water quality standards for both surface water and ground water. The numeric criteria for each are different because they must support different uses. DEQ writes permits to protect the most sensitive, thereby protecting all uses. DEQ's ground water standard for nitrate is 10.0 mg/L, as is the standard for nitrate + nitrite (as nitrogen). Class I ground water must be maintained suitable for use as a drinking water supply with little or no treatment, and therefore must meet the corresponding human health standard of 10.0 mg/L total nitrogen. These water quality standards may not be exceeded outside a designated mixing zone (**Section 4**).

3.3 Nondegradation

Montana's nondegradation policy is intended to preserve the existing condition of high-quality state waters. Any water whose existing condition is better than the water quality standards must be maintained in that high quality. Nondegradation policy allows discharges to cause only nonsignificant changes in water quality. Changes in water quality that are deemed significant require an authorization to degrade. An authorization to degrade is not an authorization to pollute; the water quality standard must not be exceeded.



DEQ must determine whether the proposed discharge will result in significant changes in water quality.

3.4 Nonsignificance

The proposed activity is a new source resulting in a change of existing water quality. DEQ must determine whether these water quality changes are significant. Some nonsignificant activities are specified in the Administrative Rules of Montana; other activities are evaluated for significance according to a process provided in the Rules. DEQ evaluated the significance of this discharge using the criteria and methods described below.

3.4.1 Ground Water Nonsignificance Criteria

For this discharge to ground water, the following nonsignificance criteria are relevant:

Nitrogen

Under Montana statute, ground water total nitrogen at or below 7.5 mg/L at the downgradient end of the mixing zone (see **Section 4**) is a nonsignificant change in water quality, so long as the discharge does not cause degradation of surface water. Evaluation of the effects to surface water are discussed in **Section 3.4.2**. Using the nonsignificance criterion of 7.5 mg/L, DEQ established effluent limits that cause the discharge to comply with ground water nonsignificance/nondegradation criteria at the end of the mixing zone. This is discussed in detail in **Section 5.1**.

Phosphorus

A total phosphorus surface water breakthrough time of greater than 50 years is a nonsignificant change in water quality. The phosphorus criterion requires an analysis to determine a breakthrough time. Breakthrough occurs when the subsurface soils lose their capability to adsorb any more phosphorus, and it reaches surface water.

Using these conservative estimates, DEQ's phosphorus breakthrough analysis estimates that phosphorus discharged to ground water from Outfall 001 may reach surface water in 68 years (See **Appendix D** of this Fact Sheet). A phosphorus breakthrough of greater than 50 years is considered nonsignificant. A non-significant phosphorus source does not require a phosphorus limit.

Ground water discharges meeting these criteria are nonsignificant, so long as they do not cause degradation of surface waters (see **Section 3.4.2**).

3.4.2 Surface Water Nondegradation

This permit authorizes a discharge to ground water that may result in nonsignificant changes to ground water quality. In order to be nonsignificant, changes in ground water quality must not cause degradation of surface water. Therefore DEQ investigates whether the discharge has reasonable potential to degrade the nearest downgradient surface water. The phosphorus breakthrough analysis is based upon distance and time to nearest surface water, inherently addressing the potential for degradation of surface water. Therefore, the analysis of reasonable potential for surface water degradation in this section is limited to nitrogen. Ground water concentrations are calculated using the mixing zone equation (**Section 4**).

By using recent ground water nitrogen concentrations to identify the available assimilative capacity in the receiving aquifer, DEQ accounts for cumulative impacts of multiple nitrogen sources. These projections may be reanalyzed during every permit renewal cycle to incorporate updated site-specific information, which may include new upgradient or downgradient sources of nitrate.

The downgradient surface waters, as described by the applicant are:

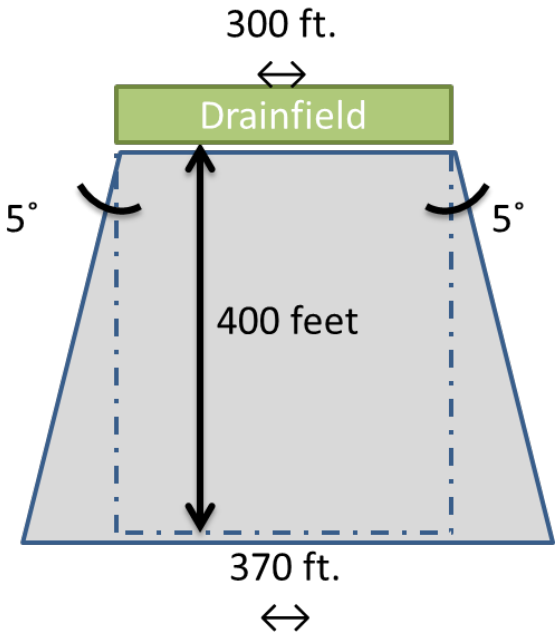
Bitterroot River - 4,100 feet downgradient.
Skalkaho Creek – 3,671 feet downgradient.
Groundwater pond – 2,858 feet downgradient.

The calculations underlying these projections are discussed and provided in full in **Appendix D** of this fact sheet. These projections demonstrate that nitrate in ground water will not result in degradation of the nearest surface water. DEQ also calculated potential downgradient changes for the Bitterroot River **(Appendix C).** Discharges in compliance with this permit will not result in a measurable change of total nitrogen in downgradient surface water. Therefore, water quality changes that result from discharges in compliance with this permit are nonsignificant.

4.0 Mixing Zone

DEQ authorizes a standard mixing zone for total nitrogen discharged from Outfall 001. A mixing zone is a specifically defined area of the receiving water where water quality standards may be exceeded. DEQ evaluates the suitability according to criteria established in the Administrative Rules of Montana. The mixing zone is then defined in the permit. The applicant requested a department modified standard mixing zone for this discharge, consistent with previous permit cycles.

A standard mixing zone extends 500 feet downgradient from the source. This facility has requested a 400 foot department modified standard mixing zone. The upgradient boundary is equal to the width of the source (measured perpendicular to the of ground water flow direction). The mixing zone widens in the downgradient direction by 5° on either side. The width of the downgradient boundary is calculated by adding the increased width for each side (the tangent of 5° (0.0875) times the mixing zone length) to the width of the upgradient boundary. Standard mixing zones extend 15 feet below the ground water table. The mixing zone for Wildflower Subdivision is entirely contained within the subdivision boundary.



The volume of ground water (Q_{GW}) available to mix with the effluent is calculated using Darcy's Equation:
$Q_{GW} = KIA$

Where:
Q_{GW} = ground water flow volume (feet^3/day)
K = hydraulic conductivity (feet/day)
I = hydraulic gradient (feet/feet)
A = cross-sectional area (feet^2) at the downgradient boundary of the mixing zone.

Table 6 summarizes the variables used in Darcy's equation and the resulting volume of ground water available to mix at Outfall 001. These values are drawn from the previous fact sheet and updated ambient well data.

Table 6. 400-foot Standard Mixing Zone for Total Nitrogen Discharged from Outfall 001

Parameter	Units	Value
Receiving water nitrogen concentration	0.6	mg/L
Ground water flow direction	N60°W	Bearing
Length of mixing zone	400	Feet
Thickness/depth of mixing zone	15	Feet
Upgradient width of mixing zone	300	Feet
Downgradient width of mixing zone	370	Feet
Cross-sectional area of mixing zone (A)	5,500	Square feet
Hydraulic conductivity (K)	269	Feet per day
Hydraulic gradient (I)	0.0107	Feet per feet
Volume of ground water available for mixing (Q_{GW})	15,831	Cubic feet per day

In order to determine whether a mixing zone is allowable, DEQ calculates a predicted concentration at the downgradient end of the mixing zone. This mixing calculation follows the following procedure:

- Volume of ground water times the concentration of the parameter = existing load;
- Volume of discharge times the concentration of the parameter = waste load; and
- (Existing load + waste load) / total volume = predicted concentration.

Because the predicted concentration must satisfy the most stringent nonsignificance criterion (**Section 3**), DEQ can calculate water quality based effluent limits (WQBELs) by rearranging the equation and solving for the effluent concentration (**Section 5**).

5.0 PERMIT CONDITIONS

Discharge permits include conditions that ensure compliance with the Montana Water Quality Act and the regulations used to implement it. These conditions include effluent limits as well as any special conditions that DEQ deems necessary to protect the quality of the receiving water.

Montana's numeric water quality standards are published in Circular DEQ-7. Water quality criteria applicable to this permit are summarized below in **Table 7**. The permit establishes effluent limits that will meet water quality standards and nondegradation criteria, thereby protecting beneficial uses and existing high quality waters. The most restrictive criteria in **Table 7** provide the basis for the effluent limits.

Table 7. Applicable Ground Water Quality Criteria

Parameter	Human Health Standard	Beneficial Use Support	Nondegradation Criteria
Nitrate plus nitrite (as Nitrogen[N])	10 mg/L	-	-
Total Nitrogen	-	10 mg/L	**7.5 mg/L**
Total Phosphorus	-	-	**>50 year breakthrough**

DEQ calculated the effluent limits using the same method as for the previous permit. DEQ uses updated ambient ground water quality data to re-evaluate the receiving water quality and the assimilative capacity for dilution.

5.1 TOTAL NITROGEN EFFLUENT LIMIT

The Wildflower Subdivision's wastewater facility is a Level 2 treatment system. The DEQ definition of a Level 2 treatment system is treatment that removes at least 60% of the total nitrogen content of the raw sewage entering the system (ARM 17.30.702). The effluent limit for this facility requires 60% reduction of TN from the raw sewage.

In order to further protect water quality, DEQ also calculated a water quality based effluent limit that ensures that water quality criteria are not exceeded at the end of the 400 foot mixing zone (see description above). This effluent limit is applied to this facility in addition to the TN percent reduction limit. The nonsignificance criterion of 7.5 mg/L is the most restrictive of the water quality criteria applicable to this permit; therefore it is the water quality target for this effluent limit. DEQ established the final WQBEL for this discharge by back-calculating the effluent concentration that results in 7.5 mg/L at the end of the mixing zone, given the available dilution. Available dilution is determined by recent ground water quality sampling of the receiving water. Ambient total nitrogen averaged 0.6 mg/L (**Section 2**). DEQ calculates an effluent limit that protects receiving water quality and beneficial uses according to the following equation:

$$\underline{\text{Equation 1:}}\ C_{lmt} = C_{std} + D(C_{std} - C_{gw})$$

Where:

C_{lmt} = effluent limitation concentration
C_{std} = limiting water quality criterion
C_{gw} = ambient receiving ground water concentration
D = dilution ratio (Q_{gw} / Q_{eff})
Q_{gw} =ground water flux at the end of the mixing zone
Q_{eff} = average maximum daily discharge

Using the values provided above in **Table 6**, the result for C_{lmt} is 64.2 mg/L. This is the final WQBEL expressed as a concentration. Load limits are more appropriate for discharges to ground water since the long-term loading is the greater concern in absence of aquatic life considerations. Additionally, load limits inherently control both the strength and volume of the discharge. A discharge of 14,400 gallons per day containing 64.2 mg/L total nitrogen (TN) is equivalent to 7.7 pounds per day. The limit calculations are provided in detail in **Appendix B**.

Based on the information and analyses presented above, DEQ proposes the following numerical effluent limitations for total nitrogen in **Table 8** below.

TABLE 8. Final Nitrogen Limits

Wildflower Subdivision Proposed Final Effluent Limits - Outfall 001			
Parameter	Units	Effluent Limitations	
		Daily Minimum(1)	Daily Maximum(1)
Nitrogen, Total (as N)	Pounds per day		7.7
	% removal	60	
Footnotes: Beneficial Uses: ARM 17.30.1006 (1) See definition in Part V of permit.			

5.3 SPECIAL CONDITIONS

In accordance with ARM 17.30.1031 this section contains the basis for special permit conditions that are necessary to assure compliance with the ground water quality standards and the Montana Water Quality Act.

The following special conditions will be included in the permit:

1. Within 180 days of the effective date of this permit the applicant will begin influent monitoring. The applicant will submit for DEQ approval an Influent Sampling , Analysis and Reporting Plan for influent sampling. Applicant will locate and if necessary construct a suitable DEQ approved influent monitoring location. Within 180 days of the effective date of this permit, influent monitoring will be required in Discharge Monitoring Reports (DMRs) for the facility.
The 2020 effluent limit is based on the definitions of a Level II treatment system. The limit for a Level 2 waste water treatment system is the removal of at least 60% total nitrogen or a concentration of less than 24 mg/L. Percent removal calculations require influent monitoring data.

2. Within 60 days of the effective date of this permit quarterly monitoring of downgradient wells MW1 and MW2 will begin. All parameters listed in **Table 10** must be reported to DEQ in the DMR system.

3. Within 12 months of the effective date of this permit the applicant will provide DEQ with a plan and schedule for the implementation of performance improvement changes to the Wildflower Subdivision wastewater treatment system.

4. Within 24 months of the effective date of this permit the applicant will submit to DEQ a report demonstrating progress toward improved nitrogen reduction. Plans are subject to DEQ approval. If necessary this report will include further plans and schedules for system improvements.

These additional requirements are being added to this permit for the following reasons:

- Permit violations during the previous permit cycle.
- This area is experiencing rapid growth with high density development.
- Proximity of the water table to the surface (8-20 ft. below the surface).
- The shallow aquifer is a coarse grained alluvial aquifer with a relatively high hydraulic conductivity (269 ft./day).

- The need to identify the effects to ground water from the discharging of wastewater from the treatment system.

See **Table 11** of fact sheet and **Part 1-F** of the permit for a compliance schedule.

6.0 MONITORING AND REPORTING REQUIREMENTS

DEQ requires effluent and ground water monitoring to assure compliance with the effluent limitations and therefore water quality standards. Effluent monitoring and ground water monitoring is required as a condition of this permit. All monitoring and sampling required by this permit must be representative; therefore the permit identifies specific monitoring locations. Monitoring requirements and rationale are summarized below.

6.1 EFFLUENT MONITORING

This permit includes numeric effluent limitations with specific magnitudes and durations to ensure the discharge will not cause or contribute to an exceedance of an applicable water quality standard (see **Section 3**). Accordingly, the permittee is required to monitor and report at a specified frequency in order to demonstrate compliance with these limitations.

Effluent samples and discharge flow measurements must be representative of the nature and volume of the effluent. The effluent sample location (EFF-001) is located at dose tank prior to discharge to drainfields as shown in **Figure 4**. The permittee is required to install, if not already in place, maintain and report flow measurements using a flow-measuring device capable of measurements that are within 10 percent of the actual flow. The flow measuring device (FM-001) for Outfall-001 is located at the dose tank prior to discharge (**Figure 4).** The flow measuring device must be installed and in operating condition prior to discharge.

Effluent monitoring and reporting requirements are summarized in **Table 9**. All analytical methods must be in accordance with the Code of Federal Regulations, 40 CFR Part 136 for each monitored parameter.

6.2 Influent Monitoring

This permit includes numeric effluent limitations based on percent removal of total nitrogen. Influent sampling must be done to calculate percent removal. Influent samples must be representative of the nature of the influent. The influent sample location (INF-001) is in a locale approved by DEQ in a submitted Influent Sampling, Analysis and Reporting Plan (see special conditions **Section 5.3**) . Influent monitoring and reporting requirements are summarized in **Table 9**.

Table 9 – Effluent and Influent Monitoring Requirements

Influent and Effluent Monitoring and Reporting Requirements – Outfall 001 Wildflower Subdivision

Analyte/Measurement Method	Monitor Location	Units	Sample Type (1)	Minimum Sample Frequency	Reporting Requirements (1)(2)(3)	Report Freq
Count of Daily Samples Collected During Reporting Period	EFF-001	-	-	-	Count	Quarterly
Flow Rate, Effluent (4)	FM-001	gpd	Contin-uous	Contin-uous	Daily Maximum Quarterly Average	Quarterly
Nitrogen, Nitrite+Nitrate (as N)	EFF-001	mg/L	Grab	1/Quarter	Daily Maximum Quarterly Average	Quarterly
Nitrogen, Total Kjeldahl (TKN)(as N)	EFF-001	mg/L	Grab	1/Quarter	Daily Maximum Quarterly Average	Quarterly
Effluent Total Nitrogen (as N) (5)	EFF-001	mg/L	Calculate	1/Quarter	Daily Maximum Quarterly Average	Quarterly
		lbs/day (8)	Calculate	1/Quarter	Daily Maximum Quarterly Average	Quarterly
Influent Total Nitrogen (as N) (5)	INF-001	mg/L:	Grab	1/Quarter	Daily Maximum Quarterly Average	Quarterly
Percent Nitrogen Removal (6)(7)(8)		%	Calculate	1/Quarter	Daily Minimum (3) Quarterly Average	Quarterly
Phosphorus, Total (as P)	EFF-001	mg/L	Grab	1/Quarter	Daily Maximum Quarterly Average	Quarterly
		lbs/day (9)	Calculate	1/Quarter	Daily Maximum (10) Quarterly Average (11)	Quarterly
		lbs/year (12)	Calculate	1/Year	Annual Load Average (12), Annual Maximum (13)	Annually (14)

Footnotes:

EFF-001, INF-001 and FM-001 locations are descibed in Section 2.2 of the Fact Sheet.

If no discharge occurs through out the reporting period, "no discharge" shall be recorded on the effluent Discharge Monitoring Report (DMR) report forms.

Grab sample will represent concentration for a 24 hour period.

Parameter analytical methods shall be in accordance with the Code of Federal Regulations, 40 CFR Part 136, unless specified above.

(1) See definitions in Part V of the permit.

(2) Daily Maximum: Report highest measured daily value for the reporting period on Discharge Monitoring Report (DMR) form.

(3) Daily Minimum: Report lowest measured daily value for the reporting period on Discharge Monitoring Report (DMR).

(4) Requires recording device or totalizing meter, must be capable of recording daily effluent volume.

(5) Total Nitrogen is the sum of Nitrate + Nitrite and Total Kjeldahl Nitrogen.

(6) Percent Removal will be based on daily minimum.

(7) At least 60% removal of total nitrogen from the raw influent.

(8) Calculated as {[(Influent TN - Effluent TN)/Influent TN]*100} using the corresponding quarterly average values as reported on the Discharge Monitoring Report (DMR) form for the reporting period.

(9) Load calculation: lbs/day = (mg/L) x flow (gpd) x [8.34 x 10^{-6}].

(10) Daily Maximum Load calculation: lbs/day = the maximum of all calculated individual daily average loads (lbs/day) recorded during the reporting period.

(11) Quarterly Average Load calculation: lbs/day = the average of all calculated individual daily average loads (lbs/day) recorded during the reporting period.

(12) Annual Load calculation: lbs/year = (mg/L) x flow (gpd) x [8.34 x 10-6] x 365 (days/year).

(13) Annual Load calculation: lbs/year = the total average of all calculated individual daily average loads (lbs/day) recorded during the calendar year, multiplied by 365 (days/year).

(14) Annual maximum load shall be reported (DMR) on an annual basis (due January 28 each year of the permit cycle).

6.3 GROUND WATER MONITORING

As a special condition, this permit requires downgradient ground water monitoring to provide long term characterization of the aquifer. Ground water monitoring includes both water quality sampling and water level monitoring. Ground water monitoring will be required at monitoring wells MW-1 and MW-2. Data collected via ground water monitoring will be used for mixing zone evaluation, and aquifer characterization in future permit renewals and in compliance assessment. Ground water monitoring and reporting requirements are summarized in **Table 10.** Sampling and reporting requirements shall commence 60 days from the effective date of the permit.

Ground water monitoring and reporting requirements are summarized in **Table 10**. All analytical methods must be in accordance with the Code of Federal Regulations, 40 CFR Part 136 for each monitored parameter.

See special conditions in **Section 5.3** and **Table 11** for compliance requirements regarding the location and characterization of existing monitoring wells. All parameters listed must be reported.

Table 10 – Ground Water Monitoring Requirements

Ground Water Monitoring and Reporting Requirements, Wildflower Subdivision

Analyte/Measurement	Monitor Location[1]	Units	Sample Type[2]	Minimum Sampling Frequency	Reporting[2][3][4] Requirements	Reporting Frequency
Chloride (as Cl)	MW-1, MW-2	mg/L	Grab	1/Quarter	Quarterly Average	Quarterly
Count of Daily Samples Collected During Reporting Period	MW-1, MW-2	-	-	-	Count	Quarterly
Escherichia coli Bacteria	MW-1, MW-2	CFU/100ml	Grab	1/Quarter	Daily Maximum Quarterly Average[5]	Quarterly
Nitrogen, Nitrate + Nitrite (as N)	MW-1, MW-2	mg/L	Grab	1/Quarter	Daily Maximum Quarterly Average	Quarterly
Nitrogen, Total Ammonia (as N)	MW-1, MW-2	mg/L	Grab	1/Quarter	Daily Maximum Quarterly Average	Quarterly
Nitrogen, Total Kjeldahl (TKN)(as N)	MW-1, MW-2	mg/L	Grab	1/Quarter	Daily Maximum Quarterly Average	Quarterly
pH	MW-1, MW-2	s.u.	Grab or Instantaneous	1/Quarter	Quarterly Average	Quarterly
Specific Conductivity @ 25°C	MW-1, MW-2	µS/cm	Grab or Instantaneous	1/Quarter	Minimum Quarterly Average Maximum	Quarterly
Static Water Level (SWL)[6]	MW-1, MW-2	ft-bmp	Grab or Instantaneous	1/Quarter	Minimum Quarterly Average Maximum	Quarterly
Sample Depth	MW-1, MW-2	ft-bmp	Instantaneous	1/Quarter	Minimum Quarterly Average Maximum	Quarterly

Footnotes:

CFU = Colony Forming Units

ft-bmp = feet below measuring point

s.u. = standard units

At no time shall the permittee mark or state "no discharge" on any monitoring well DMR form.

Each monitor well to be individually sampled and analyzed for each respective parameter listed above.

If any monitoring well(s) are abandoned, destroyed or decommissioned, or are no longer able to be sampled due to fluctuations in the ground water table; the permittee shall install a new well to replace the abandoned, destroyed, decommissioned, or non-viable well(s).

Parameter analytical methods shall be in accordance with the Code of Federal Regulations, 40 CFR Part 136, unless specified above.

Submittal of discharge monitoring report forms (DMRs) will be required, regardless of the operational status of the facility or of each individual monitoring well.

(1) Refer to Section 2 of the permit and Section 6 and Figure 2 of the Fact Sheet for the location of the monitoring wells.

(2) See definitions in Part V of the permit.

(3) Submittal of DMRs will be required, regardless of the installation status of each individual monitoring well. If the monitoring well(s) is not installed for an individual monitoring period, the following shall be stated upon each applicable DMR: "monitoring well has not been installed".

(4) Daily Maximum: Report highest measured daily value for the reporting period on Discharge Monitoring Report (DMR).

(5) The geometric mean must be reported if more than one sample is taken during a reporting period.

(6) Measuring point (point of reference) for SWL measurements shall be from top of casing and measured to within 1/100th of one foot.

6.4 COMPLIANCE SCHEDULE

The actions listed in **Table 11** below must be completed on or before the respective scheduled completion date. A report documenting each respective action must be received by DEQ on or before the scheduled reporting date. Completion of all actions or deliverables must be reported to DEQ in accordance with Part II.D and Part IV.G of the permit.

Table 11 – Compliance Schedule

Compliance Schedule, Wildflower Subdivision			
Action	**Frequency**	**Scheduled Completion Date of Action.**(1)	**Scheduled Report Due Date.**(2)
Develop and implement a site-specific Influent Sampling, Analysis, and Reporting Plan.	Single event	*Within 180 days of the effective date of the permit.*	*Due on or before the 28th day of the month following the completion date.*
Develop and implement a site-specific Ground Water Sampling, Analysis, and Reporting Plan for the quarterly monitoring of MW1 and MW2. (3)	Single event	*Within 60 days of the effective date of the permit.*	*Due on or before the 28th day of the month following the completion date.*
Complete and submit to DEQ for approval, a report documenting actions planned to improve nitrogen reduction at the facility. This report must detail any changes in operation and maintenance and any plant optimization or any other steps to be taken taken by the facility to improve its performance.	Single event	*Within one year of the effective date of the permit.*	*Due on or before the 28th day of the month following the completion date.*
Complete a Compliance Status and Construction Update Report for the facility.	Single event	*Within 24 months of the effective date of the permit.*	*Due on or before the 28th day of the month following the completion date.*

Footnotes:

(1) The actions must be completed on or before the scheduled completion dates.

(2) Reports must be received by DEQ on or before the scheduled report due dates. The reports must include all information as required for each applicable action as listed in Section 6 of the fact sheet or Part II of the permit.

(3) Sampling parameters required for each respective monitoring well as listed within **Table 9** of the fact sheet and **Part II** of the permit.

PUBLIC NOTICE

Legal notice information for water quality discharge permits are listed at the following website: http://deq.mt.gov/Public/notices/wqnotices. Public comments on this proposal are invited any time prior to close of business on **December 16, 2020.** Comments may be directed to:

DEQWPBPublicComments@mt.gov

or to:

Montana Department of Environmental Quality
Water Protection Bureau
PO Box 200901
Helena, MT 59620

All comments received or postmarked prior to the close of the public comment period will be considered in the formulation of the final permit. DEQ will respond to all substantive comments pertinent to this permitting action and may issue a final decision within thirty days of the close of the public comment period.

All persons, including the applicant, who believe any condition of the draft permit is inappropriate, or that DEQ's tentative decision to deny an application, terminate a permit, or prepare a draft permit is inappropriate, shall raise all reasonably ascertainable issues and submit all reasonably available arguments supporting their position by the close of the public comment period (including any public hearing). All public comments received for this draft permit will be included in the administrative record and will be available for public viewing during normal business hours.

Copies of the public notice are mailed to the applicant, state and federal agencies, and interested persons who have expressed interest in being notified of permit actions. A copy of the distribution list is available in the administrative record for this draft permit. Electronic copies of the public notice, draft permit, fact sheet, and draft environmental assessment are available at the following website: http://deq.mt.gov/Public/notices/wqnotices.

Any person interested in being placed on the mailing list for information regarding this permit may contact the DEQ Water Protection Bureau at (406) 444-5546 or email DEQWPBPublicComments@mt.gov. All inquiries will need to reference the permit number (MTX000142), and include the following information: name, address, and phone number.

During the public comment period provided by the notice, DEQ will accept requests for a public hearing. A request for a public hearing must be in writing and must state the nature of the issue proposed to be raised in the hearing.

APPENDIX A – MONITORING WELL LOGS (NOTE: COORDINATES ON WELL LOGS ARE NOT CORRECT)

Downgradient Monitoring Well MW-1

Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: 11107.001 WELL NO: MW-1

PROJECT: Wildflower STATE: MT COUNTY: Ravalli LOGGED BY: Perine

LEGAL LOCATION: T R S TRACT
N. Lat: 46.2175 W. Long: -114.1474

DESCRIPTIVE LOCATION: Between Lot 27 and 28 of the Wildflower subdivision located at the southwest corner of Grantsdale Rd. and Blood Ln. near the town of Grantsdale MT

DATE STARTED: 11/7/2005 DATE COMPLETED: 11/7/2005 DRILLING CO/ DRILLER: Aqwa Drilling

DRILLING METHOD: Air Rotary BOREHOLE DIAM (IN): 6" DRILL FLUIDS USED: air

TOTAL DEPTH DRILLED: 25' TOTAL DEPTH CASED: 25' INTERVAL PERFORATED FROM OR SCREENED (FT:) 10'-25' DIAMETER: 2" CASING TYPE: sch. 40 PVC

METHOD OF PERFORATION:
- Open Hole
- Open Bottom
- Saw Slotted
- X — Factory 0.02 " (size)
- Other: Roller Perf tool 1/2" x 1"; 4 rows

DURING WELL CONSTRUCTION WAS/WERE:

	YES	NO
Well Developed	x	
Well Pumped		x
Water Samples Collected		x
Material Samples Collected		x

ANNULAR COMPLETION CHARACTERISTICS
WELL PROTECTOR: LENGTH: 1.5' above GS DIAM: 4.5' below GS
LOCK NO:

SURFACE SEAL TYPE:	bentonite powder	FROM: 0	TO: 7
BACKFILL MATERIAL:		FROM:	TO:
HOLE PLUG:	bentonite chips	FROM: 7	TO:9
FILTER PACK TYPE:	10-20 Silica Sand	FROM: 9	TO: 25

STATIC WATER LEVEL: 16' below GS DATE: 11/7/2005 MEASURING POINT DESCRIPTION/ ELEVATION: top of north side of of PVC MEASURING POINT RELATIVE TO GROUND SURFACE (+/-)

REMARKS:

INTERVAL(FT) below ground surface	LITHOLOGIC DESCRIPTION	REMARKS
0-1	Topsoil	
1-20	GP; Poorly Graded Gravel with Sand; fine to coarse gravel with medium to coarse grained sand.	
20-25	SW ; Well Graded Sand with Gravel and Silt; fine to medium grained sand; fine to medium angular gravel; light brown silt; trace clay.	

Downgradient Monitoring Well MW-2

Geomatrix

WELL LITHOLOGIC AND COMPLETION LOG

JOB NO: 11107.001 WELL NO: MW-2

PROJECT: Wildflower STATE: MT COUNTY: Ravalli LOGGED BY: Perine

LEGAL LOCATION: T R S TRACT
N. Lat: 48.2175 W. Long: -114.1474

DESCRIPTIVE LOCATION: Between Lot 27 and 28 of the Wildflower subdivision located at the southwest corner of Grantsdale Rd. and Blood Ln. near the town of Grantsdale MT

DATE STARTED: 11/7/2005

DATE COMPLETED: 11/7/2005

DRILLING CO/ DRILLER: Aqwa Drilling

DRILLING METHOD: Air Rotary

BOREHOLE DIAM (IN): 6"

DRILL FLUIDS USED: air

TOTAL DEPTH DRILLED: 40'

TOTAL DEPTH CASED: 40'

INTERVAL PERFORATED FROM OR SCREENED (FT:) 25-40

DIAMETER: 2"

CASING TYPE: sch. 40 PVC

METHOD OF PERFORATION:

		DURING WELL CONSTRUCTION WAS/WERE:	YES	NO
	Open Hole	Well Developed	x	
	Open Bottom	Well Pumped		x
	Saw Slotted	Water Samples Collected		x
X	Factory 0.02" (size)	Material Samples Collected		x
	Other: Roller Perf tool 1/2" x 1"; 4 rows			

ANNULAR COMPLETION CHARACTERISTICS

WELL PROTECTOR:	LENGTH: 1.5' above GS	SURFACE SEAL TYPE:	bentonite powder	FROM: 0	TO: 18
	DIAM: 4.5' below GS	BACKFILL MATERIAL:		FROM:	TO:
LOCK NO:		HOLE PLUG:	bentonite chips	FROM: 18	TO:20
		FILTER PACK TYPE:	10-20 Silica Sand	FROM: 20	TO: 40

STATIC WATER LEVEL: 16' below GS / 19.55 below casing DATE: 11/7/2005

MEASURING POINT DESCRIPTION/ ELEVATION: top of north side of of PVC

MEASURING POINT RELATIVE TO GROUND SURFACE (+/-)

REMARKS:

INTERVAL(FT) below ground surface	LITHOLOGIC DESCRIPTION	REMARKS
0-1	Topsoil	
1-20	GP; Poorit Graded Gravel with Sand; fine to coarse gravel with medium to coarse grained sand.	
20-40	SW ; Well Graded Sand with Gravel and Silt; fine to medium grained sand; fine to medium angular gravel; light brown silt; trace clay.	

Upgradient Ambient Well PWS-2

MONTANA WELL LOG REPORT

This well log reports the activities of a licensed Montana well driller, serves as the official record of work done within the borehole and casing, and describes the amount of water encountered. This report is complied electronically from the contents of the Ground-Water Information Center (GWIC) database for this site. Acquiring water rights is the well owner's responsibility and is NOT accomplished by the filing of this report.

Other Options

Plot this site on a topographic map
View scanned well log (7/15/2008 12:51:25 PM)

Site Name: PIGMAN BUILDERS *WELL 2
GWIC Id: 203536

Section 1: Well Owner

Owner Name
PIGMAN BUILDERS
Mailing Address
935 NORTH 1ST STREET

City	State	Zip Code
HAMILTON	MT	59840

Section 2: Location

Township	Range	Section	Quarter Sections
05N	20W	6	NE¼ SW¼

County: RAVALLI
Geocode:

Latitude	Longitude	Geomethod	Datum
46.216818	114.147382	TRS-SEC	NAD83

Altitude: **Method**: **Datum**: **Date**:

Addition: **Block**: **Lot**:

Section 3: Proposed Use of Water
PUBLIC WATER SUPPLY (1)

Section 4: Type of Work
Drilling Method: ROTARY

Section 5: Well Completion Date
Date well completed: Monday, June 02, 2003

Section 6: Well Construction Details

Borehole dimensions

From	To	Diameter
0	20	12
20	64	8

Casing

From	To	Diameter	Wall Thickness	Pressure Rating	Joint	Type
-1.5	64	8	0.250			STEEL

Completion (Perf/Screen)

From	To	Diameter	# of Openings	Size of Openings	Description
64	64	8			OPEN BOTTOM

Annular Space (Seal/Grout/Packer)

From	To	Description	Cont. Fed?
0	20	BENTONITE	

Section 7: Well Test Data

Total Depth: 64
Static Water Level: 10
Water Temperature:

Air Test *

100 gpm with drill stem set at 55 feet for 5 hours.
Time of recovery _ hours.
Recovery water level _ feet.
Pumping water level _ feet.

** During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

Section 8: Remarks

Section 9: Well Log
Geologic Source
Unassigned

From	To	Description
0	2	TOP SOIL
2	7	FINE GRAVEL
7	10	SAND
10	16	SAND GRAVEL
16	30	SAND GRAVEL SILT
30	41	LARGE GRAVEL
41	64	GRAVEL SAND
64	64	CLAY

Driller Certification
All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name:
Company: ADVANCED WELL DRILLING INC
License No: WWC-619
Date Completed: 6/2/2003

APPENDIX B – EFFLUENT LIMIT CALCULATIONS

The system consists of a trickling membrane, Advantex AX-100 pods system which is a Level 2 method for nitrogen treatment.

To protect beneficial uses [ARM 17.30.1006(1)(b)(ii)], there shall be no increase of a parameter to a level that renders the waters harmful, detrimental, or injurious to the beneficial uses. Therefore, no wastes may be discharged such that the waste either alone or in combination with other wastes will violate or can reasonably be expected to violate any standard. DEQ establishes the effluent limitations for nitrogen based on the projection that the entire nitrogen load in the wastewater stream may ultimately be converted to nitrate (USEPA, 2002a).

The allowable discharge concentrations are derived from a mass-balance equation (ARM 17.30.517) which is a simple steady-state model, used to determine concentration after accounting for other sources of pollution in the receiving water and any dilution as provided by a mixing zone. The mass-balance equation (Equation 1) derived for ground water is as follows:

Equation 1:

$$Q_{gw}C_{gw} + Q_{eff}C_{eff} = Q_{comb}C_{proj}$$

Where:

Q_{gw}	=	ground water available for mixing
C_{gw}	=	ambient receiving ground water concentration
Q_{eff}	=	maximum design capacity of wastewater system
C_{eff}	=	effluent pollutant concentration
Q_{comb}	=	combined ground water and effluent ($Q_{comb} = Q_{gw} + Q_{eff}$)
C_{proj}	=	projected pollutant concentration (after available mixing)

The mass-balance equation has been arranged to calculate effluent limits so that the discharge does not cause or contribute to an exceedance of the most restrictive water quality standard. This equation can be applied to any effluent and receiving water where the applicable dilution ratio is known. This equation will only be used for nitrogen which has been authorized for mixing (**Section 4**).

Equation 2:

$$C_{lmt} = C_{std} + D(C_{std} - C_{gw})$$

Where:
C_{lmt} = effluent limitation concentration
C_{std} = water quality standard concentration = 7.5 mg/L
C_{gw} = ambient receiving ground water concentration = 0.6mg/L D = dilution ratio (Q_{gw} / Q_{eff}) = 15,831/1,925 =8.223

$$C_{lmt} = 7.5 + (15{,}831/1{,}9251)(7.5 - 0.6) = \mathbf{64.24\ mg/L}$$

A mass-balance approach is used to calculate the effluent quality of the discharge that meets the most restrictive water quality standard at the end of the mixing zone. Numeric effluent limitations are expressed as loads since this type of limitation inherently regulates both volume and strength of the effluent as prescribed by 75-5-402(3), MCA. Load limits ensure compliance with the ground water standards at the end of the mixing zone. Based on the proposed design capacity, the respective load effluent limitation is:

7.7 lbs/day
[(8.34*10-6)* 64.24 mg/L*14,400]
as based on the following equation:

Equation 3:

$$L_{lmt} = CON * C_{eff} * DC_{eff}$$

Where:
L_{lmt} = effluent limitation-load
C_{eff} = allowable effluent concentration
DC_{eff} = design capacity of wastewater treatment system (gpd)
CON = conversion factor [$8.34*10^{-6}$]

The final effluent limit for this facility is 60% removal of total nitrogen based on the definition of Level 2 treatment. The water quality based effluent limit calculated above is applied in addition to the percent removal limit. The Final Effluent Limits are summarized in Table 8.

Appendix C: Low flow calculations for Bitterroot (7Q10 analysis).

The 7Q10 analysis calculates the lowest seven day flow expected with a ten year frequency. This represents a conservative worst case scenario for dilution potential in the Bitterroot River. This low flow analysis was done by DEQ in September of 2020 using data from 1998 to 2017. A low flow analysis was also done by the City of Hamilton in 2011 for the permitting of their municipal wastewater facility (see DEQ Permit #MT0020028). This permit renewal uses a 7Q10 of 164.4cfs for Bitterroot River dilutions capacity.

DEQ Wildflower Subdivision Low Flow Stats Calculations.

DEQ used the USGS StreamStats methodology to determine the annual 7Q10 value ("low flow stat") for this analysis. Determination of a 7Q10 for a given location depends on the availability of representative gages, their proximity to the outfall point, and their drainage area compared to the outfall.

USGS StreamStats methodology states that if a facility lies between two relevant long term USGS gages with similar periods of record, similar hydrologic regimes, the gage stations drainage area is greater than 5% different than the drainage area of the facility, and the 7Q10 is increasing in the downstream direction (Table 1, Table 2a, Table 2b) then equation 11 from Chapter G of Montana StreamStats should be used to determine low flow stats (**Equation 1**) (USGS, 2015).

A straight line from the end of the Wildflower Subdivision mixing zone intersects the Bitterroot River approximately 2 river miles upstream from the town of Hamilton, MT. This point is bracketed by two long term gage stations: USGS gage 1234400 Bitterroot River near Darby, MT, and USGS gage 12350250 Bitterroot River at Bell Crossing near Victor, MT.

Equation 1. Linear Interpretation of Low Flow Stat Between Two Gaged Sites

$$logQ_u = logQ_{g1} + \left(\frac{logQ_{g2} - logQ_{g1}}{logA_{g2} - logA_{g1}}\right)(logA_u - logA_{g1}) \quad (11)$$

where

Q_u is the streamflow characteristic for the ungaged site,

Q_g is the streamflow characteristic for the gaging station (table 1–1),

A_u is the contributing drainage area for the ungaged site,

A_g is the contributing drainage area for the gaging station (table 1–2), and

g_1 and g_2 are for gaging stations 1 and 2, respectively.

USGS gage 12344000 actively records data only from March to November on an annual basis, consequently DEQ could not calculate a 7Q10 for this site (Table 2b). StreamStats suggests when there is a long-term gaging station on the stream with a drainage area greater than 5% different that the drainage area of the facility, and the facility is not bracketed by two gages, then the

drainage area ratio method should be used to calculate low flow stats (**Equation 2**) (USGS, 2015).

Equation 2. Drainage area ratio method for 7Q10.

$$Q_u = Q_g \left(\frac{A_u}{A_g}\right)^{exp_{Q,R}}$$

where

Q_u is the streamflow characteristic for the ungaged site,

Q_g is the streamflow characteristic for the gaging station (table 1–1),

A_u is the contributing drainage area for the ungaged site,

A_g is the contributing drainage area for the gaging station (table 1–2), and

exp is the coefficient for drainage area adjustment for the streamflow characteristic (Q) and region (R) of the gaging station (table 1–3).

Table 1. Data Summary for USGS Gage Locations and Facility

Location	Drainage Area (square miles)	% Within Drainage Area	Period of Record	Most Recent Calendar Year
USGS 12344000	1050	27.5	1991-2020	2020
USGS 12350250	1944	34	1988-2020	2020
Wildflower Subdivision Mixing Zone	1450	N/A	N/A	N/A

DEQ delineated the watershed upslope of Wildflower Subdivision using a 64-meter digital elevation model for Montana, downloaded from the Defense Mapping Agency's 3-arc second 1x1 degree 1: 250,000 scale Digital Elevation Models database (Defense Mapping Agency 1970). A mask was created with the U.S. Department of Agriculture's complete digital hydrologic unit boundary layer of sub watersheds for Montana (U.S. Department of Agriculture, Natural Resources Conservation Service 2014). The watershed outlet was chosen at 46.224434, -114.166276; coordinates were obtained through personal communication with Rich Morse on 9/18/2020. Additionally, the USGS National Hydrography Dataset (U.S. Department of Agriculture, Natural Resources Conservation Service 2014) was used to burn in the stream network to increase accuracy. Watershed areas for USGS gage stations 12344000 and 12350250 were obtained from their respective websites (USGS, 2000).

Table 2a. Low Flow Stats Calculations at USGS 12344000 Bitterroot River Near Darby, MT.

Statistic	Climatic Years Used	Period of Record (Years/Seasons)	Value (cfs)
7Q10	1950-2019	70	128.07
14Q5	1955-2018	70	207.67

Table 2b. Low Flow Stats Calculations at USGS 12350250 Bitterroot River at Bell Crossing Near Victor, MT.

Statistic	Climatic Years Used	Period of Record (Years/Seasons)	Value (cfs)
7Q10	N/A	N/A	N/A
14Q5	1988-2017	11	181.24

Based on the above-mentioned methodology DEQ reached the following low flow values:

Statistic	Value (cfs)
7Q10	164.47
14Q5	193.37

References

Defense Mapping Agency. 1970. “Montana 3-Arc Second 1x1 Degree 1: 250,000 Scale Digital Elevation Model.” http://ftp.geoinfo.msl.mt.gov/Data/Spatial/NonMSDI/Elevation/DEM_64m_1992.zip

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Appendix D: Surface water impact analyses.

Analysis 1. Phosphorus breakthrough analysis to three downgradient surface water bodies:

(a) Breakthrough analysis for Bitterroot River.

MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY (DEQ)

PHOSPHOROUS BREAKTHROUGH ANALYSIS TO BITTERROOT RIVER

SITE NAME:	Wildflower Subdivision
COUNTY:	Ravalli
Permit #:	MTX000142
NOTES:	Variables used are based on conservative measurements
	Design Capacity = 14,400 gpd = ft³/day 1,925: Phosphoorus Breakthrough = 89 years
	Phosphorus Breakthrough of grater than 50 years is defined as nonsignificant.
	The Bitterroot River is 4,100 feet Downgradient.

VARIABLES	DESCRIPTION	VALUE	UNITS
Lg	Length of Primary Drainfield as Measured Perpendicular to Ground Water Flow	280	ft
L	Length of Primary Drainfield's Long Axis	340	ft
W	Width of Primary Drainfield's Short Axis	140	ft
B	Depth to Limiting Layer from Bottom of Drainfield Laterals*	16	ft
D	Distance from Drainfield to Surface Water	4100	ft
T	Phosphorous Mixing Depth in Ground Water (0.5 ft for coarse soils, 1.0 ft for fine soils)**	0.5	ft
Ne			
Sw	Soil Weight (usually constant)	100	lb/ft3
Pa	Phosphorous Adsorption Capacity of Soil (usually constant)	200	ppm
#I	Number of proposed wastewater treatment systems	1	
CONSTANTS			
PI	Phosphorous Load per proposed wastewater treatment system	464	lbs/yr
X	Conversion Factor for ppm to percentage (constant)	1.0E+06	
EQUATIONS			
Pt	Total Phosphorous Load = (PI)(#I)	464	lbs/yr
W1	Soil Weight under Drainfield = (L)(W)(B)(Sw)	76160000	lbs
W2	Soil Weight from Drainfield to Surface Water = [(Lg)(D) + (0.0875)(D)(D)] (T)(Sw)	130943750	lbs
P1	Total Phosphorous Adsorption by Soils = (W1 + W2)[(Pa)/(X)]	41421	lbs
SOLUTION			
BT	**Breakthrough Time to Surface Water = P / Pt**	89	years

BY: R. Morse
DATE: 9/15/2020

NOTES: ** Depth to limiting layer is typically based on depth to water in a test pit or bottom of a dry test pit minus two feet to account for burial depth of standard drainfield laterals.*

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(b) Breakthrough analysis for Skalkaho Creek

MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY (DEQ)

PHOSPHOROUS BREAKTHROUGH ANALYSIS TO SKALKAHO CREEK

SITE NAME:	Wildflower Subdivision
COUNTY:	Ravalli
Permit #:	MTX000142
NOTES:	Variables used are based on conservative measurements
	Design Capacity = 14,400 gpd = ft³/day 1,925: Phosphorus breakthorough= 80 years.
	Phosphorus Breakthrough of greater than 50 years is defined as nonsignificant.
	Skalkaho Creek is 3,627 feet down gradient.

VARIABLES	DESCRIPTION	VALUE	UNITS
Lg	Length of Primary Drainfield as Measured Perpendicular to Ground Water Flow	280	ft
L	Length of Primary Drainfield's Long Axis	340	ft
W	Width of Primary Drainfield's Short Axis	140	ft
B	Depth to Limiting Layer from Bottom of Drainfield Laterals*	16	ft
D	Distance from Drainfield to Surface Water	3627	ft
T	Phosphorous Mixing Depth in Ground Water (0.5 ft for coarse soils,	0.5	ft
Ne	1.0 ft for fine soils)**		
Sw	Soil Weight (usually constant)	100	lb/ft3
Pa	Phosphorous Adsorption Capacity of Soil (usually constant)	200	ppm
#I	Number of proposed wastewater treatment systems	1	
CONSTANTS			
PI	Phosphorous Load per proposed wastewater treatment system	464	lbs/yr
X	Conversion Factor for ppm to percentage (constant)	1.0E+06	
EQUATIONS			
Pt	Total Phosphorous Load = (PI)(#I)	464	lbs/yr
W1	Soil Weight under Drainfield = (L)(W)(B)(Sw)	76160000	lbs
W2	Soil Weight from Drainfield to Surface Water = [(Lg)(D) + (0.0875)(D)(D)] (T)(Sw)	108331689	lbs
P1	Total Phosphorous Adsorption by Soils = (W1 + W2)[(Pa)/(X)]	36898	lbs
SOLUTION			
BT	**Breakthrough Time to Surface Water = P / Pt**	80	years

BY: R. Morse
DATE: 9/15/2020

NOTES: ** Depth to limiting layer is typically based on depth to water in a test pit or bottom of a dry test pit minus two feet to account for burial depth of standard drainfield laterals.*

REV. 04/2000

(c) Breakthrough analysis for nearest surface water (groundwater pond).

MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY (DEQ)

PHOSPHOROUS BREAKTHROUGH ANALYSIS TO MAN MADE POND (Nearest Surface Water)

SITE NAME:	Wildflower Subdivision
COUNTY:	Ravalli
Permit #:	MTX000142
NOTES:	Variables used are based on conservative measurements
	Design Capacity = 14,400 gpd = ft³/day 1,925: Phosphohorus Breathrough = 65 years
	Phosphorus Breakthrough of grater than 50 years is defined as nonsignificant
	Nearest surface water is a reported man made pond 2,858 feet down gradient.

VARIABLES	DESCRIPTION	VALUE	UNITS
Lg	Length of Primary Drainfield as Measured Perpendicular to Ground Water Flow	280	ft
L	Length of Primary Drainfield's Long Axis	340	ft
W	Width of Primary Drainfield's Short Axis	140	ft
B	Depth to Limiting Layer from Bottom of Drainfield Laterals*	16	ft
D	Distance from Drainfield to Surface Water	2858	ft
T	Phosphorous Mixing Depth in Ground Water (0.5 ft for coarse soils,	0.5	ft
Ne	1.0 ft for fine soils)**		
Sw	Soil Weight (usually constant)	100	lb/ft3
Pa	Phosphorous Adsorption Capacity of Soil (usually constant)	200	ppm
#I	Number of proposed wastewater treatment systems	1	
CONSTANTS			
PI	Phosphorous Load per proposed wastewater treatment system	464	lbs/yr
X	Conversion Factor for ppm to percentage (constant)	1.0E+06	
EQUATIONS			
Pt	Total Phosphorous Load = (PI)(#I)	464	lbs/yr
W1	Soil Weight under Drainfield = (L)(W)(B)(Sw)	76160000	lbs
W2	Soil Weight from Drainfield to Surface Water = [(Lg)(D) + (0.0875)(D)(D)] (T)(Sw)	75747718	lbs
P1	Total Phosphorous Adsorption by Soils = (W1 + W2)[(Pa)/(X)]	30382	lbs
SOLUTION			
BT	**Breakthrough Time to Surface Water = P / Pt**	65	years

BY: R. Morse
DATE: 9/15/2020

NOTES: ** Depth to limiting layer is typically based on depth to water in a test pit or bottom of a dry test pit minus two feet to account for burial depth of standard drainfield laterals.*

REV. 04/2000

Analysis 2.

These are the calculated ground water nitrogen concentrations using three scenarios: (a) TN at end of a 400 foot mixing zone, (b) TN at 4,100 foot from the drainfield, (c) Distance of mixing needed to meet TN nondegradation criteria.

MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY (DEQ)

Montana Ground Water Pollution Control System

Ground Water Dilution Projection (GWDP) - Nondegradation Significance Analysis

These projections estimate the parameter concentrations in the aquifer downgradient of the subsurface discharge. After dilution with ground water, the projected concentration is compared to the respective significance criteria in determining nonsignificant changes in water quality (ARM 17.30.715).

Site Name:	MTX000142, Wildflower Subdivision
Location:	Hamilton
Permit #:	MTX000142, Outfall 001
Notes:	Design Capacity = design flow 14,400gpd; design flow 1925ft³/d
	These calculations are for the following parameter of interest: Nitrate
	These calculations use the most restrictive ground water standard.
	These calculations do not credit potential losses due to chemical transformation.
	These calculations do not credit potential losses due to attenuation.

Projected Concentration Calculation

$$Cr = \frac{(Qd)(Cd) + (Qs)(Cs)}{Qd + Qs}$$

The Activity is Not Significant if Cr < Significance Criteria

GWDP(a) - Ground Water Nitrate Projection at the End of the Mixing Zone.

Qd =	1925	ft³/d	Design capacity - effluent flow rate
Cd =	24.0	mg/L	Concentration - effluent (treated wastewater)
	400	ft	Length of ground water dilution zone
	15	ft	Thickness of dilution zone
	300	ft	Outfall width, perpendicular to ground water flow direction
	370	ft	Projected width of downgradient dilution zone
	5550	ft²	Cross sectional area of dilution zone (A)
	269	ft/d	Hydraulic conductivity (K)
	0.011	ft/ft	Hydraulic gradient (I)
Qs(Qgw) =	15975	ft³/d	Ground water volume (Qgw)
Cs =	0.60	mg/L	Ambient nitrate concentration in ground water
Cr =	3.12	mg/L	Projected concentration - end of the mixing zone
Sign. Criteria =	5.0	mg/L	Nonsignificance Criteria, ARM 17.30.715
Sign. Activity?	<5.0	mg/L	**The activity is not significant**

GWDP(b) - Ground Water Nitrate Projection just prior to the Downgradient Surface Water.

Qd =	1925	ft³/d	Design capacity - effluent flow rate
Cd =	24.0	mg/L	Concentration - effluent (treated wastewater)
	4100	ft	Length of ground water dilution zone
	15	ft	Thickness of dilution zone
	300	ft	Outfall width, perpendicular to ground water flow direction
	1018	ft	Projected width of downgradient dilution zone
	15263	ft²	Cross sectional area of dilution zone (A)
	269	ft/d	Hydraulic conductivity (K)
	0.011	ft/ft	Hydraulic gradient (I)
Qs(Qgw) =	45162	ft³/d	Ground water volume (Qgw)
Cs =	0.60	mg/L	Ambient nitrate concentration in ground water
Cr =	1.56	mg/L	Projected concentration - just prior to surface water
Sign. Criteria =	5.0	mg/L	Nonsignificance Criteria, ARM 17.30.715
Sign. Activity?	<5.0	mg/L	**The activity is not significant**

GWDP(c) - Distance in Ground Water from the discharge source where the Significance Criteria for Nitrate is met.

Qd =	1925	ft³/d	Design capacity - effluent flow rate
Cd =	24.0	mg/L	Concentration - effluent (treated wastewater)
	1	ft	Length of ground water dilution zone
	15	ft	Thickness of dilution zone
	300	ft	Outfall width, perpendicular to ground water flow direction
	300	ft	Projected width of downgradient dilution zone
	4503	ft²	Cross sectional area of dilution zone (A)
	269	ft/d	Hydraulic conductivity (K)
	0.011	ft/ft	Hydraulic gradient (I)
Qs(Qgw) =	13323	ft³/d	Ground water volume (Qgw)
Cs =	0.600	mg/L	Ambient nitrate concentration in ground water
Cr =	3.554	mg/L	Projected concentration
Sign. Criteria =	5.0	mg/L	Nonsignificance Criteria, ARM 17.30.715
Distance =	0	ft	**Distance needed to meet the significance criteria**

Projections performed by R. Morse on September 15, 2020.

Analysis 3:

DEQ evaluated whether there is reasonable potential for change in surface water concentrations of total nitrogen in the Bitterroot River due to the Wildflower Subdivision discharge to groundwater. This analysis considers three scenarios:

(a) Simple comparison of the Wildflower Subdivision effluent concentration and volume with the surface water concentration and volume in the Bitterroot River. This scenario ignores all groundwater mixing and attenuation in the intervening 4,100 feet of subsurface.

(b) Comparison of the predicted groundwater concentration and volume at the end of the permitted 400 foot subsurface mixing zone with surface water concentration and volume in the Bitterroot River. This scenario ignores all groundwater mixing and attenuation in the 3,700 feet between the mixing zone and the Bitterroot River.

(c) Comparison of the predicted concentration and volume of groundwater 4,100 foot from the drainfield to the concentration and volume in the Bitterroot River.

This analysis shows no reasonable potential for measurable or significant nutrient impacts for any of the three scenarios.

MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY (DEQ)

Montana Ground Water Pollution Control System

Surface Water Dilution Projection (SWDP) - Reasonable Potential (RP)

Conservative estimation of parameter concentrations after instantaneous dilution with the nearest downgradient surface water. After dilution, there is no reasonable potential if the projected concentration is below the applicable aquatic criteria (DEQ-Circular 12-A). If the projected change in concentration is less than the required reporting value (RRV) (DEQ-Circular 12-A) then the result of the action is not measurable.

Site Name:	Wildflower Subdivision
Location:	Hamilton, Bitterroot Valley
Permit #:	MTX000142, Outfall 001
Notes:	Design Capacity = 14,400 gpd; 1,925 ft³/d
	These calculations are for the following parameter of interest: Total Nitrogen
	Certain calculations may not credit potential ground water dilution.
	These calculations do not credit potential ground water dispersion.
	These calculations do not credit potential losses due to attenuation.
	These calculations do not credit potential losses due to chemical transformation.
	These calculations do not credit potential dilution or losses within the hyporheic zone.

Projected Concentration Calculation

$$Cr = \frac{(Qd)(Cd) + (Qs)(Cs)}{Qd + Qs}$$

After dilution, the activity may not have a Reasonable Potential if Cr < Aquatic Std.
-and- After dilution, the activity may not be measurable if Cr-Cs < Required Reporting Value (RRV)

SWDP(a) - Reasonable potential scenario 1: no dilution prior to surface water

Qd =	**1925.00**	ft³/d	Wastewater Treatment System design capacity - effluent flow rate
Cd =	**24.00**	mg/L	Concentration - effluent (treated wastewater)
Qs =	**164.47**	ft³/s	Flow rate of surface water (7Q10)
Cs =	**0.12**	mg/L	Concentration in surface water
Cr =	**0.12**	mg/L	Projected concentration after instantaneous dilution
Standard =	**0.3000**	mg/L	Surface Water Aquatic Standard, DEQ Circular - 12-A
RP?	**<0.30**	mg/L	**There is not a reasonable potential**

SWDP(b) - Reasonable potential scenario 2: dilution within a 400 foot mixing zone prior to surface water

Qd =	**15263.00**	ft³/d	Ground Water Volume (Qgw)
Cd =	**3.10**	mg/L	Actual Concentration of Ground water (edge of ground water mixing zone)
Qs =	**164.47**	ft³/s	Flow rate of surface water (7Q10)
Cs =	**0.12**	mg/L	Concentration in surface water
Cr =	**0.12**	mg/L	Projected concentration after instantaneous dilution
Standard =	**0.3000**	mg/L	Surface Water Aquatic Standard, DEQ Circular - 12A
RP?	**<0.30**	mg/L	**There is not a reasonable potential**

SWDP(c) - Reasonable potential scenario 3: dilution between outfall and surface water (4,100 feet)

Qd =	**45162.00**	ft³/d	Ground Water Volume (Qgw)
Cd =	**1.56**	mg/L	Actual Concentration of Ground water (just prior to surface water body)
Qs =	**164.47**	ft³/s	Flow rate of surface water (7Q10)
Cs =	**0.12**	mg/L	Concentration in surface water
Cr =	**0.12**	mg/L	Projected concentration after instantaneous dilution
Standard =	**0.3000**	mg/L	Surface Water Aquatic Standard, DEQ Circular - 12-A
RP?	**<0.30**	mg/L	**There is not a reasonable potential**

Projections performed by R. Morse on September 2020.