MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY

Water Quality Division

MONTANA POLLUTANT DISCHARGE ELIMINATION SYSTEM (MPDES)

Permit Fact Sheet – 2019 Major Modification

Permittee: ExxonMobil Corporation

Permit No.: MT0000477

Receiving Waters: Yellowstone River

Facility Information:

Name: ExxonMobil Billings Refinery
Contact: James Forsyth, Environmental Coordinator

Location: 700 ExxonMobil Road
Billings, MT 59101

County: Yellowstone

Fee Information:

Major/Minor: Major

Type: Privately-owned treatment works

Number of Outfalls: Two (for fee determination only)
Outfall 001 /003 /004 – Process wastewater
Outfall 002 – Noncontact cooling water

1 BACKGROUND

This fact sheet provides the principal facts considered in preparing a major modification of the Montana Pollutant Discharge Elimination System (MPDES) for ExxonMobil Corporation Billings Refinery. Only those conditions subject to modification are reopened as part of this permitting action.

1.1 Permit and Application Information

ExxonMobil Corporation (ExxonMobil) is the owner and operator of the Billings Refinery. Wastewater discharged from this refinery is regulated under MPDES Permit MT0000477, which became effective on August 1, 2015 and expires on July 31, 2020 (2015-issued permit).

On September 7, 2018, the Department of Environmental Quality (DEQ) received an application for a major modification from ExxonMobil for a new outfall configuration (Outfall 004), including CORMIX modeling, mixing zone demonstrations as required by ARM 17.30.506, and the $5,000 application fee. DEQ sent an email on September 28, 2018 requesting clarification on several items. This was discussed with ExxonMobil on October 2, 2018. ExxonMobil refined their review and DEQ received additional information via email on November 2, 2018 and a resubmittal on November 5, 2018. On December 11, 2018, ExxonMobil revised their mixing zone request to be for a source-specific mixing zone.

1.1.1 Scope of Major Modification

This Fact Sheet provides the details of DEQ's review, which included:

- installation of a single-port diffuser (Outfall 004);
- granting of a source-specific mixing zone for the diffuser for ammonia, hydrogen sulfide, and selenium; and
- evaluation of Reasonable Potential for these three parameters based on the allowable dilution provided by the diffuser, and development of any necessary effluent limits.

1.2 Description of Facility and Discharge Points

1.2.1 Description and Location of Facility

The ExxonMobil Billings Refinery is a petroleum refinery located south of the Yellowstone River in Billings, Montana. The refinery processes, treats, and transforms crude oil and other raw materials into refined hydrocarbon products, byproducts, and intermediates. ExxonMobil is not requesting any change to the processes or process wastewater streams.

1.2.2 Wastewater Treatment or Controls

ExxonMobil is not requesting any change in the wastewater treatment or controls.

1.2.3 Discharge Description

ExxonMobil is proposing to add a new outfall (Outfall 004) to discharge treated process wastewater into the Yellowstone River through a single-port diffuser. With this major modification, the Billings Refinery will be authorized to discharge treated process wastewater from any one of the three following outfalls at any given time:

- Outfall 001 - historically the primary outfall and unchanged from the 2015-issued permit;
- Outfall 003 - diffuser approved in 2007 but not installed and unchanged from the 2015-issued permit; and
- Outfall 004 - single-port diffuser discharging 20 feet from the bank.

In addition to the process wastewater discharge that may occur at Outfall 001, 003, or 004 (but not at more than one outfall at any time), ExxonMobil is permitted to discharge noncontact cooling from Outfall 002. This outfall is not addressed in this major modification.

The proposed Outfall 004 discharge will be to the Yellowstone River at nearly the same location as Outfall 001 was permitted in the 2015-issued permit, except the discharge will be modified from a bank-side discharge to be from a single port diffuser located 20 feet from the righthand bank (see **Table 1**).

Table 1: Discharge Location for Outfall 004

Outfall	Latitude/Longitude	Approximate Distance from Bank	Distance from Stream Bottom	Port Diameter
004	45.82081, -108.42916	>20 feet	2.5 feet	8”

1.2.4 Effluent Characteristics

This major modification addresses three parameters: ammonia, hydrogen sulfide, and total recoverable selenium.

Outfall 003 has not been constructed and therefore has no effluent data.

Outfall 001 ammonia, hydrogen sulfide, and total recoverable selenium effluent characteristics for discharges between August 2015 and December 2018 are given in Part 2.2.7. ExxonMobil suspended discharge from Outfall 001 when they initiated discharge to the City of Billings by January 1, 2019.

1.2.5 Planned Changes

ExxonMobil is requesting permit coverage for Outfall 004, a new single-port diffuser that extends at least 20 feet from the bank (see Part 1.2.3).

1.3 Compliance Summary

Discharge Monitoring Reports (DMRs) submitted by ExxonMobil from August 2015 through December 2018 show two exceedances of the daily maximum total sulfide limit of 5.8 lb/day (March 2017 and November 2017). ExxonMobil submitted a letter to DEQ received on November 28, 2017 that reported a November 2017 plant upset that resulted in elevated sulfide results.

There have been two compliance evaluation inspections since the 2015-issued permit:

- June 15, 2016 - no findings.
- November 29, 2017 - DEQ found that ExxonMobil did not properly report the 30-day average ammonia concentration in September 2017. ExxonMobil submitted a response letter to DEQ received on January 22, 2018 that explained their ammonia calculation was correct due to an extra ammonia sample taken that month. The elevated total sulfide concentrations in November 29th were also noted during the inspection.

2 RATIONALE FOR EFLUENT LIMITS

There are two principal bases for effluent limits: technology-based effluent limits (TBELs) that specify the minimum level of treatment or control and water quality-based effluent limits (WQBELs) that attain and maintain applicable numeric and narrative water quality standards.

2.1 Technology-based Effluent Limits

TBELs are not affected by this major modification (Outfall 004 will have the same TBELs as Outfalls 001 and 003).

2.2 Water Quality-based Effluent Limits

2.2.1 Scope and Authority

Permits are required to include WQBELs if TBELs are not adequate to protect state water quality standards. The purpose of this section is to provide a basis and rationale for the proposed WQBELs to protect designated uses of the receiving waters, based on Montana water quality standards found in ARM 17.30.601-670, which also includes, by reference, Circular DEQ-7 *Montana Numeric Water Quality Standards*. Montana's regulations on Mixing Zones are contained in ARM 17.30.501-518.

2.2.2 Applicable Water Quality Standards

Outfall 004 will discharge directly into the Yellowstone River located within the Middle Yellowstone watershed, United States Geological Survey (USGS) Hydrological Unit Code (HUC) 10070007 and Montana assessment unit MT43F001_010. The designated water-use classification for the drainage is B-3.

Acute and chronic ammonia standards are contained in Circular DEQ-7. These standards are based on the following:

- whether salmonid fish may be present (yes - Rainbow Trout, Brown Trout, and Mountain Whitefish);
- whether fish in early life stages may be present (irrelevant for the Billings Refinery as the ambient temperature is above 15 deg C and therefore early life stages does not affect the ammonia standard); and
- the 75th percentile pH and temperature, as summarized in **Table 2**, below.

Table 2: Basis for Ammonia Numeric Water Quality Standards -Yellowstone River

Dependent Parameter	Measured Parameter	Receiving Water Statistic	Yellowstone River	Info Source
Ammonia – Acute	pH	75th percentile	8.4 su	ExxonMobil 2015-issued Fact Sheet (based on Billings Water Treatment Plant 2007-2011)
Ammonia – Chronic	pH	75th percentile		
	Temperature	75th percentile	16 deg C	Phillips66 - 2012 Mixing Zone Study

Table 3 summarizes relevant water quality standards for parameters analyzed in this major modification.

Table 3: Numeric Water Quality Standards for the Yellowstone River Relevant for this Major Modification (1)

Parameter	Units	Acute (S_a)	Chronic (S_c)	Human Health (S_{hh})	Category
Ammonia, total as N (2)	mg/L	2.59	1.17	--	Toxic
Hydrogen Sulfide	µg/L	--	2 (3)	--	Toxic
Selenium, total recoverable	µg/L	20	5	50	Toxic

Footnote:
(1) Table 3 summarizes the standards used in the Reasonable Potential Analysis conducted as part of this Major Modification.
(2) Ammonia standards based on 75th percentile ambient pH of 8.4 su and temperature of 16 deg C. Since the temperature is greater than 15 deg C, the chronic condition is not affected by early life stages present.
(3) The Required Reporting Value (RRV) for hydrogen sulfide of 20 µg/L is greater than the chronic standard.

2.2.3 Impaired Waters

The Yellowstone River at assessment unit MT43F001_010 is listed as impaired on Montana's 2018 Clean Water Act 303(d) list. However, the three parameters evaluated in this major modification (ammonia, hydrogen sulfide, and selenium) are not listed as probable causes of impairment.

2.2.4 Nondegradation Analysis

Sources that are in compliance with permit conditions and do not exceed the established limits determined from a permit issued by DEQ prior to April 29, 1993 are not considered new or increased sources.

ExxonMobil Billings Refinery is not a new or increased source. They did not request any increase in process rate. In order to ensure that the parameter loads that are discharged do not constitute an increase or have a practicable effect, DEQ has maintained the mixing zone at a minimal size and minimal amount of dilution.

2.2.5 Mixing Zones

A mixing zone is defined as a limited area of a water body where initial dilution of a discharge takes place, where water quality changes may occur, and where certain numeric water quality standards may be exceeded. DEQ must determine the appropriateness of a requested mixing zone and may grant it only if it has the smallest practicable size, minimum practicable effect on

water uses, and definable boundaries. A source-specific mixing zone may not be used unless approved by DEQ.

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. The discharge must also comply with general prohibitions which require that state waters, including mixing zones, be free from substances which will:

(a) settle to form objectionable sludge deposits or emulsions beneath the surface of the water or upon adjoining shorelines;

(b) create floating debris, scum, a visible oil film (or be present in concentrations at or in excess of 10 milligrams per liter) or globules of grease or other floating materials;

(c) produce odors, colors or other conditions as to which create a nuisance or render undesirable tastes to fish flesh or make fish inedible;

(d) create concentrations or combinations of materials which are toxic or harmful to human, animal, plant or aquatic life; and

(e) create conditions which produce undesirable aquatic life.

DEQ may grant a source-specific mixing zone based on the applicants' demonstration that the mixing zone meets the restrictions and general considerations specified. Based on the demonstration, DEQ may grant a portion of the critical flow of the receiving water for dilution; DEQ bases dilution on the available portion of the seven-day, 10-year low flow (7Q10) at the mixing zone boundary.

The resulting length of the chronic/human health mixing zone is the distance from the point of discharge to the end of the mixing zone after which all applicable water quality standards must be met. Furthermore, acute water quality standards for aquatic life may not be exceeded in any portion of the mixing zone unless the DEQ finds that allowing minimal initial dilution will not threaten or impair existing uses. To prevent acute lethality in the mixing zone, the length of the acute mixing zone will be no more than 10% of the chronic mixing zone length.

2.2.5.1 **Outfall 004 Mixing Zone Determination**

ExxonMobil proposes to install a single-port diffuser (Outfall 004) as an option to discharge the facility's treated process wastewater. The permit will prohibit discharge from more than one process wastewater outfall at a time. Outfall 004 will be at a new location with different mixing characteristics than Outfall 001 and Outfall 003. Although this new outfall is proposed to be in the same general location as Outfall 001, the diffuser will discharge 20 feet from the bank (see **Table 1**).

The discharges from the proposed Outfall 004 are to the Yellowstone River. Therefore, the 7Q10 for this major modification is based on the available portion of the entire flow for this stretch of the Yellowstone River. As reported by the USGS in 2015 (river flow data from 1940 - 2008) the 7Q10 is 1,130 cubic feet per second (cfs). However, DEQ determined that the current 7Q10 for this stretch of the Yellowstone River is 1,149 cfs (or 742.6 million gallons per day (mgd)) based on flow data between 1930 - 2017.

ExxonMobil 2018 Mixing Zone Study

ExxonMobil submitted a new mixing zone study for Outfall 004 with the major modification application received September 7, 2018. Based on DEQ comments, the mixing zone study was revised and re-submitted on November 5, 2018 (*Billings Refinery Effluent Dilution Analysis*, *Revision 1*, by Tischler/ Kocurek of Round Rock Texas, October 2018). DEQ based the mixing zone determinations for this major modification on the revised study.

The mixing zone study's request was for an instantaneous standard mixing zone. However, upon review of the modeling results DEQ found the discharge could not be shown to have 'not more than a ten percent difference in bank-to-bank concentrations at a downstream distance less than two stream/river widths.' Therefore, ExxonMobil requested a source-specific mixing zone based on the findings from the November 5th mixing zone study submittal.

The study included CORMIX modeling for five scenarios to predict a chronic dilution factor at the end of the chronic mixing zone (two stream widths @ 267 feet or 81.4 meters) and an acute dilution factor at the end of the acute mixing zone (10% of the chronic mixing zone @ 26.7 feet or 8.1 meters) for each scenario. DEQ determined that the "Summer Avg" scenario was the worst-case (lowest dilution factor). The main CORMIX variables used for this scenario were:

(1) Discharge parameters - also see Section 1.2.3 of this Fact Sheet:

- D0 = Port diameter = 8 inches (0.2 m)
- A0 = Port area = 48 in^2 = 0.031 m^2
- H0 = Port height above bottom = 2.5 feet (0.76 m)
- U0 = Discharge port velocity = 3.915 m/sec
- Q0 = Discharge rate = 2.81 MGD or 0.123 m^3/s
- DISTB = Distance of port from bank = 20 feet (6.1 m)
- THETA = Vertical discharge angle = 0º (parallel to bottom)
- SIGMA = Horizontal discharge angle = 90º (perpendicular to river flow direction)
- RHO0 = Density @ effluent temperature of 27.2º C = 996.4584
- DRHO0 = Density difference @ port (ambient - discharge) = 2.502

(2) Yellowstone River parameters

- BS = Mixing zone width = 133.5 feet (40.7 m) average river width
- HA = Total water depth at port = 8.5 feet (2.6 m)
- QA = Low flow (7Q10) = 1131 ft^3/sec (32.02 m^3/sec)
- RHOAM = Density at ambient water temperature of 15.9º C = 998.9606

ExxonMobil set the concentration ("C") to 100% at the discharge. CORMIX results for each model provided the decreasing % effluent calculated as the plume travels downstream and mixes with the river water. The model output provided the % effluent at the chronic and acute mixing zone boundaries. The % effluent is used to develop the chronic dilution factor based on "100% / % effluent." For instance, using the Summer Avg results at the chronic mixing zone boundary of 81.4 meters downstream from the discharge, the effluent is 0.96% of the original concentration resulting in a dilution factor of 104:1. The Summer Avg modeling results at the

acute mixing zone boundary of 8.14 meters is 5.3% of the original concentration (which results in a dilution factor of 100%/5.3%, or 19:1).

Appendix C in the *Billings Refinery Effluent Dilution Analysis* mixing zone study provides a summary of the results for the five model runs. The results for the worst-case run (Summer Avg) are the basis for the dilution granted for Outfall 004 as shown in **Table 4**:

Table 4: Yellowstone River - Maximum Dilution Available for Outfall 004

Criterion Condition	Mixing Zone Downstream Boundary [(1)]	Plume Width @ End of Mixing Zone	Conc. (% initial) @ Boundary	Dilution Factor @ end of Mixing Zone	**Dilution Granted mgd**	Dilution Granted cfs	**Maximum % of River @ Low Flow**
Chronic/HHS	267 ft (81.4 m)	53.8 ft	0.96%	104	292	452	39.3 %[(2)]
Acute	26.7 ft (8.1 m)	11.2 ft	5.3%	10.4[(3)]	53	82	7.1 % [(3)]

Footnote: mgd = million gallons/day; cfs = cubic feet/second; HHS = Human Health Standard; DF = Dilution Factor

(1) The length of the chronic/HHS mixing zone was determined by 2 x the calculated 'average channel width' of 133.5 feet (=267 feet). The acute mixing zone length is 10% of the chronic length.

(2) For chronic and human health standards, the maximum amount of dilution available (percent of river at low flow) is calculated by multiplying the maximum average monthly discharge for Outfall 004 (2.81 mgd) x DF at the end of the mixing zone to get the amount of dilution granted (mgd). After converting the chronic dilution mixing zone flow from mgd to cfs, this value is divided by the 7Q10 of 1,149 cfs to provide the percent of the low flow granted as dilution.

(3) ExxonMobil requested an acute mixing zone dilution that is 10% of the chronic dilution. Estimated percent of river at low flow available for acute dilution is calculated by multiplying the maximum acute discharge (5.12 mgd) x DF at the end of the mixing zone to get the amount of dilution granted (mgd). After converting the acute dilution mixing zone flow from mgd to cfs, this value is divided by the 7Q10 of 1,149 cfs to provide the percent of the low flow granted as dilution.

ExxonMobil Water Quality Assessment

The mixing zone study documents that the source-specific mixing zone will comply with the following requirements contained in ARM 17.30.518(2) and (4):

ARM 17.30.506(1): ExxonMobil asserted that the 267-foot mixing zone will not threaten or impair existing beneficial uses, including the following factors under ARM 17.30.506(2):

(a) *Biologically important areas* - the plume will not be shore-hugging. ExxonMobil stated that the conditions in the river bed are not conducive to fish spawning or nurseries within the mixing zone boundaries. They stated that the river bottom within the mixing zone area is a sand substrate that is mobile at high stream flows, and the channel has relatively high velocities (approximately 1 foot per second).

DEQ noted that Montana Fish, Wildlife and Parks (FWP) stated the following as part of their comment on the 2015-issued permit: While this is a transitional zone between cold water species and cool-warm-water species, this area still supports robust populations of salmonids, including a popular brown trout fishery. The brown and rainbow trout are not believed to

spawn in this section, however the whitefish do. According to MT FWP Fisheries Biologist Mike Ruggles (DEQ communication March 8, 2019), brown trout could construct redds and non-salmonids could broadcast along the gravel beds in the Yellowstone River. However, Mr. Ruggles stated that the species expected in this area generally do not frequent the Yellowstone River from Billings through 10 miles downstream.

(b) *Drinking water or recreational activities* – DEQ confirmed no public water supply intakes within or near the downgradient mixing zone boundary, there will be no drinking water impact, and there are no beach or swimming area within the mixing zone.

(c) *Attraction of aquatic life to the effluent plume* - the rapid mixing of the discharge and velocity in the river should preclude any measurable attraction to the plume.

(d) *Toxicity/Persistence of the substance discharged* - sulfide and ammonia are not persistent pollutants. Selenium is a toxic and persistent pollutant; however, the calculated selenium concentration at the end of the acute mixing zone is 21% of the acute standard and at the end of the chronic mixing zone is 27% of the chronic standard, which is protective of aquatic life.

(e) *Passage of aquatic organisms* -

- Chronic - the plume will have a maximum width of 54 feet at the end of the chronic mixing zone; the remaining zone of passage will be at least 46 feet wide.
- Acute - ExxonMobil calculates that a passive organism would have a 27 second residence time within the 26.7-foot acute mixing zone; well under the 15 minutes discussed in the Technical Support Document for Water Quality-based Toxics Control (TSD).

  In fact, DEQ noted that the port's discharge meets the second TSD alternative for demonstrating that the acute standards are met: the port has a discharge velocity greater than 3 m/sec (3.9 m/sec) and the mixing zone length is less than 50 x the length scale (i.e. 8.14 meters acute mixing zone length is less the square root of the cross-sectional area of the outfall [50 x (sq root 0.031 m^2)] = 8.8).

(f) *Cumulative effects of multiple mixing zones* - ExxonMobil did not identify any mixing zones that overlap with the proposed Outfall 004 mixing zone. DEQ notes that Outfall 002, which is located approximately 2,000 feet upstream from Outfall 004, spatially overlaps but does not contribute elevated concentrations of ammonia, hydrogen sulfide, or selenium. Furthermore, the permit will include a condition that ExxonMobil can only discharge from one of the process wastewater outfalls (001, 003, or 004) at any one time.

ARM 17.30.507(1) - DEQ finds from the information provided that the proposed discharge conforms with ARM 17.30.507(1)(a) standards will not be exceeded beyond the boundaries of the mixing zone and (b) acute standards will not threaten or impair existing beneficial uses.

75-5-303, MCA - DEQ has reviewed this request to ensure that the quality of high-quality waters will be maintained in accordance with 75-5-303, MCA.

ARM 17.30.518(4) - the mixing zone study satisfied DEQ that the source-specific mixing zone requirements under ARM 17.30.518(4) were met.

(a) *quantity, toxicity, and persistence of the pollutant(s)* -

- Ammonia biodegrades into nitrates (DEQ agrees that a first-order rate of decay is expected, but does not account for decay in the reasonable potential analysis).
- Hydrogen Sulfide - ExxonMobil asserts that H_2S oxidizes rapidly (to sulfite and sulfate) in aerobic conditions. DEQ agrees that hydrogen sulfide should oxidize in the Yellowstone River, but questions how rapidly (DEQ does not account for decay in the reasonable potential analysis).
- Selenium - this parameter is toxic and persistent. However, based on the mixing zone study, after mixing the maximum selenium concentration discharged (C_d) is calculated to be equivalent to approximately 21 - 27% of the acute and chronic standards.

(b) *rate of flow* - wastewater discharged at 3.9 m/sec (12.8 feet per second, fps), into the Yellowstone River which flows at 1 fps.

(c) *volume of flow* - wastewater discharged at a maximum average monthly rate of 2.81 mgd and a maximum daily rate of 5.12 mgd into the Yellowstone River with a 7Q10 of 742.6 mgd.

(d) *concentration of pollutants within the mixing zone* - calculated by 'CORMIX output of % initial effluent concentration @ X distance downstream' x C_d (see **Section 2.2.7.4**):

Ammonia:	@ discharge = 100% x C_d of 13 mg/L	= 13 mg/L
	@ acute boundary = 5.3% x 13 mg/L	= 0.7 mg/L
	@ chronic boundary = 0.96% x 13 mg/L	= 0.1 mg/L
Hydrogen Sulfide:	@ discharge = 100% x C_d of 141 mg/L	= 141 mg/L
	@ acute boundary = 5.3% x 141 mg/L	= 7.5 mg/L
	@ chronic boundary = 0.96% x 141 mg/L	= 1.4 mg/L
Selenium:	@ discharge = 100% x C_d of 38 mg/L	= 38 mg/L
	@ acute boundary = 5.3% x 38 mg/L	= 2.0 mg/L
	@ chronic boundary = 0.96% x 38 mg/L	= 0.4 mg/L

(e) *length of time pollutants will be present* - approximately 27 seconds in the acute mixing zone and 270 seconds in the chronic mixing zone.

(f) *proposed boundaries of the mixing zone* - chronic 267 feet length and 53.8 width; acute 26.7 feet length and 11.2 feet width.

(g) *potential impacts to water uses* - none.

(h) *potential compliance monitoring* - monitoring will be required at the final retention pond overflow (Pond 6) at 45.82052, -108.42911, prior to discharge into the Yellowstone River.

(i) *contingency plan* - none necessary.

(j) *specific explanation as to why the proposed mixing zone is the smallest practicable size and why it will have a minimum practicable effect on water users* -

- ExxonMobil proposed two times the stream width as the chronic mixing zone length and 10% of that for acute mixing zone length. DEQ has determined that the mixing zone sizes are appropriate.

- ExxonMobil proposed dilution factors of 104:1 for chronic and 10.4:1 for acute based on the mixing zone study, which equates to a maximum allowable dilution of 39.3% of the 7Q10 for chronic and 7.1% of the 7Q10 for acute. However, the mass-balance calculation of pollutant concentrations at the mixing zone boundaries (see **Appendix A**), shows that this is more dilution than is necessary:
  - Ammonia - the mass-balance equation predicts no Reasonable Potential to cause or contribute to an exceedence of the standard even if DEQ grants only 5% chronic and 3% acute dilution; and
  - Selenium - the mass-balance equation predicts no Reasonable Potential to cause or contribute to an exceedence of the standard even if DEQ grants only 4% chronic and 1% acute dilution; and
  - Hydrogen Sulfide - due to the laboratory detection limit constraints, it is difficult to predict the exact concentration that would contribute to an exceedence of the standard; therefore the 39.3% dilution for chronic conditions is appropriate.

DEQ Conclusion

As stated in **Section 2.2.5,** DEQ may grant a mixing zone only if it has the smallest practicable size, minimum practicable effect on water uses, and definable boundaries (75-5-301(4), MCA). DEQ agrees to the proposed mixing zone sizes, but will grant only the dilution needed for this major modification:

- Ammonia - 5% chronic and 3% acute;
- Selenium - 4% chronic and 1% acute; and
- Hydrogen Sulfide - 39.3% chronic

The amount of dilution granted for these and other parameters may be re-evaluated in future permitting actions.

2.2.6 Pollutants and Parameters of Concern

The parameters of concern evaluated under this major modification are limited to ammonia, hydrogen sulfide, and selenium, as requested by ExxonMobil.

2.2.7 Reasonable Potential Analysis

MPDES permits include limits on all pollutants which will cause, or have a reasonable potential (RP) to cause an excursion of any water quality standard. No wastes may be discharged that can reasonably be expected to violate any state water quality standards outside of an approved mixing zone. The procedures DEQ uses to evaluate RP and develop WQBELS follow federal guidance in the *Technical Support Document for Water Quality-based Toxics Control (TSD)*, EPA/505/2-90-001.

The basis for this method is a mass-balance equation, which is a simple, steady-state model. The mass-balance equation is used to determine the concentration of a pollutant of concern after accounting for other sources of pollution in the receiving water and any dilution provided by a mixing zone (see *Equation 1*:)

$$Q_sC_s + Q_dC_d = Q_rC_r \qquad \textit{Equation 1}$$

Where:

Q_s = critical upstream flow (available dilution in 7Q10)
C_s = critical upstream receiving water pollutant concentration (75th percentile)
Q_d = critical effluent flow
C_d = critical effluent pollutant concentration
Q_r = resultant in-stream flow after discharge ($Q_r = Q_s + Q_d$)
C_r = resultant in-stream pollutant concentration (after available dilution)

The variables can be rearranged to solve for the critical resultant in-stream pollutant concentration using *Equation 2*.

$$C_r = \frac{Q_d C_d + Q_s C_s}{Q_d + Q_s} \qquad (\textit{Equation 2})$$

Where the projected receiving water concentration (C_r) exceeds the lowest applicable numeric water quality standard for the pollutant of concern there is RP, and WQBELs must be calculated.

The values used to establish the maximum allowable change in surface water quality are based on critical conditions as discussed below.

2.2.7.1 Critical Stream Flow (Qs)

Critical stream flow is based on the available part of the 7Q10 considering dilution. DEQ determined that the 7Q10 for this stretch of the Yellowstone River is 1,149 cfs (742.6 mgd). (See **Section 2.2.5** Mixing Zones.) Based on an evaluation of the CORMIX model results (see **Section 2.2.5.1**), the following is the amount of dilution granted for each mixing zone type:

$Q_{s\text{-}a}$ - Acute dilution

$Q_{s\text{-}c}$ - Chronic/Human Health Standard (HHS) dilution

Specifically:

- Ammonia - 5% chronic ($Q_{s\text{-}c}$) and 3% acute ($Q_{s\text{-}a}$);
- Selenium - 4% chronic ($Q_{s\text{-}c}$) and 1% acute ($Q_{s\text{-}a}$); and
- Hydrogen Sulfide - 39.3% chronic ($Q_{s\text{-}c}$)

2.2.7.2 Critical Background Receiving Water Pollutant Concentration (C_s)

For purposes of the RP analysis and determining assimilative capacity, the critical background concentration (C_s) for each pollutant is defined to be the 75th percentile or upper bound estimate of the ambient data. **Table 5** summarizes the most recent ambient Yellowstone River data for the three parameters of concern. The sources of data were:

- USGS Station 06214500 located at 45.80012, -108.46803, which is 2.5 miles upstream of ExxonMobil (immediately upstream from the Billings Wastewater Treatment Plant and 2,000 feet downstream from the exit of the Yegen Drain) for ammonia (1986 to 1992) and selenium (1974 - 1982); and
- ExxonMobil (2015-issued permit) for hydrogen sulfide (2013).

Table 5: Yellowstone River Receiving Water Pollutant Concentration					
Parameter	Units	Required Reporting Value (RRV)	Upper Quartile (C_{75})	Number of Samples	Comment or Not Applicable (NA)
Ammonia	mg/L	0.07	0.05	20	USGS 06214500 (1986 - 1992)
Hydrogen Sulfide	µg/L	20	< 2 (1)	1	ExxonMobil 2013
Selenium, Total	µg/L	1	1.0	23	USGS 06214500 (1974 - 1982)
Footnote: (1) ExxonMobil collected duplicate samples from five Yellowstone River locations in June 2013. All samples were nondetect at 20 µg/L total sulfide and based on pH, conductivity, and temperature <10% of the sulfide would be hydrogen sulfide.					

2.2.7.3 Critical Effluent Flow (Q_d)

For industrial sources, the critical effluent flow rate is based on a 'reasonable measure of actual production' [ARM 17.30.1345(2)(b)]. The critical effluent flow used for this major modification was based on the actual flow between August 2015 and December 2018:

- Acute aquatic life – 5.12 mgd (the highest maximum daily flow observed during the period of record).
- Chronic aquatic life/HH – 2.81 mgd (the maximum monthly average flow for the period of record).

2.2.7.4 Critical Effluent Pollutant Concentration (C_d)

The critical effluent concentration is based on the 95th percentile of the expected effluent concentration observed or predicted in the discharge. Due to the low frequency (percentage) of samples and the non-normal distribution of most effluents, DEQ follows the estimation procedures described in EPA's TSD Chapter 3 to estimate the critical effluent concentration (C_d). **Table 6** presents C_d for the three parameters included in this major modification:

Table 6: Outfall 001 Effluent Characteristics (August 2015 through December 2018)

Parameter	Units	Maximum Daily	Number of Samples (n)	Coefficient of Variation (CV)	Multiplying Factor 95% Confidence Level (1)	Critical Effluent Concentration (C_d)
Ammonia (as N)	mg/L	12.3	41 (2)	0.4	1.07	13
Hydrogen Sulfide	µg/L	148 (3)	191	1.0	0.65	97
Selenium, Total Recoverable	µg/L	38	54	0.3	1.01	38

Footnote:
(1) Multiplying Factor from the TSD Table 3-2.
(2) Number of samples is equivalent to the number of reporting months for ammonia. Actual number of samples based on weekly sampling.
(3) ExxonMobil provided a spreadsheet of H_2S results between August 2015 - December 2018. The maximum result of 257 µg /L occurred during a plant upset and bypass in November 2017 and was discounted. The next highest H_2S result was 148 µg/L.

A summary of the analysis to determine if the discharge from Outfall 004 has the RP to cause or contribute to an exceedence of a water quality standard (WQS) is provided in **Table 7**, below.

Table 7: Reasonable Potential Analysis –Outfall 004

Parameters	**Units**	**C_{r-A}**	**S_A**	**C_{r-C}**	**S_C**	**RP? (Y/N/U)**	**Rationale/ Comments**
Ammonia as N	mg/L	2.5	2.6	1.0	1.2	N	C_r < WQS
Hydrogen Sulfide	µg/L	--	--	< 2.9	2	U	Nondetect reporting limit equal to or greater than standard
Selenium	µg/L	16	20	4.2	5.0	N	C_r < WQS

2.2.8 Water Quality-based Effluent Limitations

DEQ develops WQBELs for any pollutant for which there is RP to cause or contribute to exceedances of water quality standards, after application of any approved mixing zones. The following summarizes the RP analysis in **Part 2.2.7** and evaluates the need to develop WQBELs for discharge through the proposed single-port diffuser at Outfall 004:

- ***Ammonia*** - there is no RP to exceed the ammonia water quality standards outside the approved acute and chronic mixing zones. No ammonia WQBEL is needed for Outfall 004.
- ***Selenium -*** there is no RP to exceed the selenium water quality standards outside the approved acute and chronic mixing zones. No selenium WQBEL is needed for Outfall 004.
- ***Hydrogen Sulfide (H_2S)*** DEQ determined that the H_2S RP analysis is "unknown."

  H_2S has a chronic aquatic life standard of 2 µg/L and a Required Reporting Value (RRV) of 20 µg/L in Circular DEQ-7. H_2S is a portion of dissolved sulfide, with the percentage dependent on pH (4500-S^{2-} H. Calculation of Un-Ionized Hydrogen Sulfide*, Standard Methods for the Examination of Water and Wastewater*).

  During the POR from August 2015 to December 2018, ExxonMobil reported daily H_2S effluent concentrations up to 148 µg/L (other than the November 2017 result of 257 µg/L due to a plant upset). Based on the TSD method, the H_2S critical discharge concentration (C_d) is calculated to be 97 µg/L.

  Considering 39.3% dilution granted as part of the source-specific chronic mixing zone, DEQ determined that the worst-case critical ambient condition (C_s) would need to be at or below 1.0 µg/L H_2S, or ExxonMobil would have RP. However, because of the limits on the analytical capabilities for H_2S, DEQ cannot determine if the ambient condition is below 2 µg/L and therefore cannot determine ExxonMobil has RP to exceed the H_2S chronic standard of 2 µg/L.

  DEQ considered the following information in an effort to determine the ambient concentration:

  - ExxonMobil - Billings Refinery: June 2013 ambient analysis showed sulfide as nondetect at 20 µg/L with < 10% hydrogen sulfide (or < 2.0 µg/L H_2S).
  - Sulfide, including hydrogen sulfide, is not a persistent compound, although the rate of decay is of debate.

  Additional ambient and effluent H_2S monitoring will be required.

2.2.9 Whole Effluent Toxicity Limits

No changes are requested or made to Whole Effluent Toxicity (WET) for this major modification.

3 EFFLUENT LIMITS

3.1 Anti-backsliding Analysis

Section 402(o) of the Clean Water Act and 40 CFR 122.44(l) require, with some exceptions, that effluent limits or conditions in reissued permits be at least as stringent as those in the existing permit. One of the exceptions is "material and substantial alterations or additions to the permitted facility." The installation of a single-port diffuser (Outfall 004) is a substantial alteration of ExxonMobil's discharge.

In addition, DEQ granted only the minimal initial dilution needed (see **Section 2.2.7.1**) to prevent ExxonMobil from increasing the loads discharged of these pollutants.

3.2 Stringency Analysis

The final WQBELs must be compared to TBELs calculated for the same parameter to determine the most protective limitations that meet the requirements of both technology standards and water quality standards. This permit major modification does not include any TBEL changes. Furthermore, the discharge from Outfall 004 rather than Outfall 001 or 003 has been demonstrated to meet the water quality standards.

3.3 Effluent Limits

The 2015-issued permit will be modified in Part I.B.4 to add "5. *Final Effluent Limitations for Outfall 004.*"

The effluent limits for Outfall 004 in this section will be identical to the existing final effluent limits for Outfall 003 (underline indicates additions, cross-out indicates removal). All limits in **Table 8** are TBELs retained from the 2015-issued permit other than the oil & grease concentration limit and the acute WET toxicity prohibition. Oil and grease and WET are WQBELs retained from the 2015-issued permit.

In addition, the following conditions will be added to Outfalls 001, 003, and 004:

A condition will be added below the limits table for Outfall 001:

> "Discharge may only occur from Outfall 001, Outfall 003, or Outfall 004 at any time. No discharge shall occur from Outfall 001 when there is a discharge from Outfall 003 or 004."

A condition will also be added below the limits table for Outfall 003:

> "Discharge may only occur from Outfall 001, Outfall 003, or Outfall 004 at any time. No discharge shall occur from Outfall 003 when there is a discharge from Outfall 001 or 004."

A condition will also be added below the limits table for Outfall 004:

> Discharge may only occur from Outfall 001, Outfall 003, or Outfall 004 at any time. No discharge shall occur from Outfall 004 when there is a discharge from Outfall 001 or 003."

5. Final Effluent Limitations for Outfall 004
(Effective immediately upon the issuance of the Final Permit)

Table 8: Numeric Discharge Limitations: Outfall ~~003~~ 004 (1)

Parameter/Code	Units	Average Monthly	Daily Maximum
Biochemical Oxygen Demand (00310)	lb/day	511	919
Net Total Suspended Solids (00530) (2)	lb/day	409	640
Chemical Oxygen Demand (81017)	lb/day	3,558	6,869
Oil and Grease (00552)	lb/day	148	279
Oil and Grease (00552)	mg/L	--	10
Phenolic Compounds (32730)	lb/day	1.97	6.9
Ammonia as N (00610)	lb/day	267	587
Sulfide, Total (00745)	lb/day	2.6	5.8
Total Chromium (01118)	lb/day	2.26	6.52
Hexavalent Chromium (01032)	lb/day	0.2	0.43
Acute Whole Effluent Toxicity (WET)	% Effluent	--	> 100%

Footnotes:
(1) See Definitions section at end of permit for explanation of terms.
(2) Use intake water TSS at river water pump house and effluent TSS recorded from Outfall 001, 003, or 004 to determine "Net" TSS.

The pH of the discharge shall remain between 6.0 and 9.0 standard units-unless such variation is due to natural biological processes. The pH in pond three shall be monitored daily to verify compliance with the pH effluent limit in the event naturally occurring biological processes are occurring. In the event a natural biological process occurs in pond three, the permittee must comply with Part III.H.2 requirements in this permit.

There shall be no discharge of floating solids or visible foam other than trace amounts.

There shall be no discharge that causes visible oil sheen in the receiving stream.

There shall be no discharge of wastewater which reacts or settles to form an objectionable sludge deposit or emulsion beneath the surface of the receiving stream or upon adjoining shorelines.

There shall be no acute toxicity in the effluent discharged by the facility.

4 RATIONALE FOR MONITORING AND REPORTING REQUIREMENTS

4.1 Discharge

Part I.C.1 of the 2015-issued permit will be modified to reflect the monitoring requirements are for Outfalls 001, 003, and 004 follows (underlines represent additions and strikeouts represent deletions).

The second paragraph of Part I.C.1 (page 9) will be modified to read as:

> Sample analyses for any "nondetect" results must meet Required Reporting Values (RRVs) in Circular DEQ-7 ~~(October 2012)~~ and Laboratory Method Limits (MLs) for volatile organics (EPA Methods 1624) and semi-volatile organics (1625 Revision B), unless another method is requested and approved by DEQ, in writing. Laboratory results for volatile organics and semi-volatile organics samples must be attached to the DMR for the month in which the sample was obtained.

The third paragraph of Part I.C.1 will be modified to read as follows:

> Wastewater samples must be obtained at the final retention pond overflow (Pond 6) at 45.82052, -108.42911.

Table 9 summarizes the proposed changes to be made to the monitoring table in the 2015-issued permit on page 8 (underlines represent additions and strikeouts represent deletions).

Table 9: Monitoring Requirements for Outfalls 001, 003, and 004 (1)

Parameter/Code	Units	Minimum Monitoring Frequency	Sample Type	RRV
Flow rate/00056	mgd	Continuous	Recorded	--
Biochemical Oxygen Demand (BOD_5)/00310	mg/L	1/Week	Composite	2
	lb/day	1/Week	Calculate	
Total Suspended Solids (Effluent)	mg/L	1/Week	Grab	10
Total Suspended Solids (Intake)	mg/L	1/Week	Grab	10
Net Total Suspended Solids/00530	mg/L	1/Week	Calculate	10
	lb/day	1/Week	Calculate	
Chemical Oxygen Demand (COD)/81017	mg/L	1/Week	Composite	1
	lb/day	1/Week	Calculate	
pH/00400	s.u.	1/Day	Instantaneous	0.1
Temperature/00011	°F	1/Week	Instantaneous	1
Ammonia, total (as N)/00610	mg/L	1/Week	Composite	~~0.1~~ 0.07
Nitrate + Nitrite as N/00630	mg/L	1/Week	Composite	0.02
Total Kjeldahl Nitrogen (TKN)/ 00625	mg/L	1/Week (2)	Composite	~~0.5~~ 0.225
Total Nitrogen/00600	mg/L	1/Week (2) ~~Month~~	Calculate	--
Total Phosphorus as P/00665	mg/L	1/Month (2)	Composite	0.003

Table 9: Monitoring Requirements for Outfalls 001, 003, and 004 (1)

Parameter/Code	Units	Minimum Monitoring Frequency	Sample Type	RRV
Arsenic, Total Recoverable/00978	µg/L	1/Month	Composite	1
Oil and Grease/00552	mg/L	1/Week	Grab	1
Dissolved Oxygen/00300	mg/L	1/Quarter	Grab	0.3
Sulfide, Total / 00745	mg/L	1/Week	~~Grab~~ Composite	20
	lb/day	1/Week	Calculate	--
Sulfide, Dissolved / 00746	µg/L	1/Week	Composite	20
~~Sulfide as~~ Hydrogen Sulfide (H_2S) / 71875	µg/L	1/Week	~~Grab~~ Composite	20 (3)
Phenolic Compounds/32730	µg/L	1/Week	Grab	10
	lb/day	1/Week	Calculate	
Chromium, Total/01118	µg/L	1/Week	Composite	10
	lb/day	1/Week	Calculate	
Chromium, Hexavalent/01032	µg/L	1/Week	Composite	10 2
	lb/day	1/Week	Calculate	
Selenium, Total Recoverable / 01147	µg/L	1/Month	Composite	1
Volatile Organics (4,6,7)	µg/L	1/Quarter	Grab	--
Semi-volatile Compounds (5,6,7)	µg/L	1/Quarter	Composite	--
Whole Effluent Toxicity, Acute (8)	% Effluent	1/Quarter	Composite	--

Footnotes:
(1) See definitions in Part V of permit. Required Reporting Value (RRV) in DEQ-7 or analytical method approved under 40 CFR 136.
(2) Monitoring for TKN, TN, and TP are required only during the summer months of July 1 - October 31st.
(3) Calculate H_2S based on dissolved sulfide concentrations and pH in accordance with Standard Methods Method 4500-S2-, unless another method is proposed and accepted by the DEQ.
(4) 40 CFR 122, Appendix J, Table 2, use EPA Method 1624 Revision B, or equivalent.
(5) 40 CFR 122, Appendix J, Table 2, use EPA Method 1625 Revision B, or equivalent.
(6) See approved method for RRV or minimum level (ML).
(7) Attach laboratory results for volatile organics and semi-volatile compounds to the monthly DMR form.
(8) See Whole Effluent Toxicity Testing-Acute Toxicity in Part I.C.1.a.

4.2 Upstream

DEQ is proposing the following additional upstream monitoring, as presented in **Table 10.** This upstream monitoring shall be conducted during any period that ExxonMobil discharges process wastewater to the Yellowstone River, beginning immediately upon the effective date of the permit modification. The results shall be submitted on DMRs for the representative monitoring

period and shall include the method and detection limit for each analysis and any calculations made for hydrogen sulfide concentrations.

Table 10: Yellowstone River Ambient Monitoring (1)

Parameter	Units	Monitoring Frequency	Type	RRV
pH	s.u.	Quarterly	Instantaneous	0.1
Temperature	deg C	Quarterly	Instantaneous	0.1
Ammonia (as N)	mg/L	Quarterly	Grab	0.07
Selenium, total recoverable	µg/L	Quarterly	Grab	1
Sulfide, Total	µg/L	Quarterly (2)	Grab	32
Sulfide, dissolved (3)	µg/L	Quarterly	Grab	32
Hydrogen Sulfide (4)	µg/L	Quarterly	Calculated	20
Conductivity	µmhos/cm	Quarterly (2)	Instantaneous	10

Footnotes:

(1) Monitoring location to be submitted to DEQ for approval prior to discharging directly to the Yellowstone River. The sample location must be upstream of the diffuser. Monitoring in accordance with the above frequency is required *during periods with discharge directly to the Yellowstone River*.

(2) Ambient total sulfide and conductivity monitoring required only needed if ExxonMobil uses the alternative method in Standard Methods 4500 S2- H to calculate ambient H_2S concentrations by using Table 2330:I to calculate ionic strength. Otherwise indicate NA.

(3) For dissolved sulfide, use the most appropriate method 4500 S2- *Standard Methods for the Examination of Water and Wastewater*.

(4) For hydrogen sulfide, use method 4500 S2- H. *Standard Methods for the Examination of Water and Wastewater*, unless another method is requested and approved in writing. The field pH must be recorded and noted with the sample.

5 RATIONALE FOR SPECIAL CONDITIONS AND COMPLIANCE SCHEDULE

There are no changes to the Special Conditions. There is no compliance schedule required for ammonia, hydrogen sulfide, or selenium. This major modification does not affect the other Compliance Schedule requirements contained in the 2015-issued permit Part I.E.

6 STANDARD CONDITIONS

There are no changes to the Standard Conditions.

7 PUBLIC PARTICIPATION

Public Notice

DEQ issued Public Notice No. **MT-19-15** dated **July 1, 2019**. The public notice states that a tentative decision has been made to issue an MPDES permit to the Permittee and that a draft permit, fact sheet and environmental assessment (EA) have been prepared. Public comments are invited any time prior to the close of the business on **August 1, 2019**. Comments may be directed to:

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

or

DEQWPBPublicComments@mt.gov

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 and issue a final decision within sixty days of the close of the public comment period or as soon as possible thereafter.

All persons, including the applicant, who believe any condition of a 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).

Notification of Interested Parties

Copies of the public notice were mailed to the discharger, state and federal agencies and interested persons who have expressed an interest in being notified of permit actions. A copy of the distribution list is available in the administrative record for this permit. In addition to mailing the public notice, a copy of the notice and applicable draft permit, fact sheet and EA were posted on DEQ’s website for 30 days.

Any person interested in being placed on the mailing list for information regarding this MPDES permit should contact DEQ, reference this facility, and provide a name, address, and email address.

Public Hearing

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.

Permit Appeal

After the close of the public comment period, DEQ will issue a final permit decision. A final permit decision means a final decision to issue, deny, modify, revoke and reissue, or, terminate a permit. A permit decision is effective 30 days after the date of issuance unless a later date is specified in the decision, a stay is granted, or the applicant files an appeal.

The Applicant may file an appeal within 30 days of DEQ's action to the following address:

Secretary, Board of Environmental Review
Department of Environmental Quality
1520 East Sixth Avenue
PO Box 200901
Helena, Montana 59620-0901

Additional Information

Requests for additional information or questions regarding this permit should be directed to the Water Protection Bureau at 406-444-5546.

Modification by: Christine Weaver

Date: June 2019