



Northwest Pipeline LLC
650 S. Main Street, Suite 300
Salt Lake City, UT 84101

May 9, 2025

(Submitted via email: info@nwcleanairwa.gov)

Dr. Christos Christoforou
Northwest Clean Air Agency
1600 South 2nd Street
Mt Vernon, WA 98273

**Subject: Modification Application to Order of Approval to Construct #1402a
Northwest Pipeline LLC
Sumas Compressor Station**

Dear Dr. Christoforou:

Northwest Pipeline LLC (NWP) is submitting the attached modification application to our existing Order of Approval. This project entails the replacement of the existing Unit 9 Solar Mars 90 turbine with a Solar Mars 100 turbine, as we discussed in our call on January 30, 2025.

During development of this project NWP also needed to make some adjustments to the emergency generators. NWP is needing to replace the previously permitted Waukesha generator with a similar sized Cummins generator due to some supply issues purchasing a replacement for the rental that is on site now. In addition, the larger Caterpillar 3512 generator for C-Plant that was part of our December 2022 application was part of an electrical project that has been delayed so the smaller Caterpillar generator that has been in place for some time will remain as reflected in the updated inventory in the application. NWP will modify the permit to replace the existing generator at such time that the future project is scheduled to proceed.

Online proof-of- payment of the \$1479 NSR application fee is attached. If you have any questions, please contact me at (303) 475-0989 or by email at Kirsten.Derr@Williams.com.

Sincerely,

Northwest Pipeline, LLC

A handwritten signature in blue ink that reads "Kirsten Derr". The signature is written in a cursive, flowing style.

Kirsten Derr
Environmental Specialist

This is a "printer friendly" page. Please use the "print" option in your browser to print this screen.



Northwest Clean Air Agency, WA

New Source Review Fee

Confirmation Number: 079882
Payment Date: Friday, May 9, 2025
Payment Time: 01:34PM PT

Payer Information

Name: Kirsten Derr
Street Address: 1337 S. Milwaukee St.
Denver, CO 80210
United States
Daytime Phone Number: (303) 475 - 0989
E-mail Address: kirsten.derr@williams.com
Name of Company: Northwest Pipeline LLC

Card Information

Card Type: MasterCard
Card Number: *****8970
Card Verification Number: ****

Payment Information

Payment Type: New Source Review Fee
Payment Amount: \$1,479.00
Convenience Fee: \$59.75
Total Payment: \$1,538.75

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ERM

Permit Modification Application

Sumas Compressor Station

PREPARED FOR
Northwest Pipelines LLC

DATE
8 May 2025

REFERENCE
0767481



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ACRONYMS AND ABBREVIATIONS

Acronym	Description
°F	degrees Fahrenheit
ASIL	acceptable source impact level
BACT	best available control technology
BPIP	Building Profile Input Program
CEMS	continuous emission monitoring system
CFR	Code of Federal Regulations
CO ₂	carbon dioxide
CO _{2e}	carbon dioxide equivalent
DLN	dry low-NO _x
Ecology	Washington State Department of Ecology
GCP	Good Combustion Practice
GHG	greenhouse gas
HAP	hazardous air pollutant
HCHO	formaldehyde
km	kilometer
lb/day	pounds per day
lb/MWh	pounds per megawatt-hour
lb/yr	pounds per year
MACT	maximum achievable control technology
MW	megawatt
N ₂	nitrogen
NAAQS	National Ambient Air Quality Standards
ng/J	nanograms per Joule

Acronym	Description
NESHAP	National Emission Standards for Hazardous Air Pollutants
NH ₃	anhydrous ammonia
NLCD	National Land Cover Dataset
NO	nitric oxide
NO ₂	nitrogen dioxide
NO _x	nitrogen oxide
NSPS	New Source Performance Standards
NSR	New Source Review
NWCAA	Northwest Clean Air Agency
O ₂	oxygen
PM	particulate matter
PM _{2.5}	particulate matter 2.5 micrometers or less
PM ₁₀	particulate matter 10 micrometers or less in diameter
ppm	parts per million
ppmvd	parts per million by volume (dry basis)
PSD	Prevention of Significant Deterioration
PTE	Potential to emit
RACT	reasonable available control technology
RBLC	RACT/BACT/LAER clearinghouse
SCR	Selective Catalytic Reduction
SER	Significant Emission Rate
SIL	Significant Impact Level
SNCR	Selective Non-Catalytic Reduction
SO ₂	sulfur dioxide
SO _x	sulfur oxide
SQER	small quantity emission rate
SUSD	startup/shutdown
TAP	toxic air pollutant
tBACT	toxics best available control technology
tpy	tons per year

Acronym	Description
USEPA	United States Environmental Protection Agency
VOC	Volatile organic compound
WAC	Washington Administrative Code

1. INTRODUCTION

Northwest Pipeline, LLC, operates the Sumas Compressor Station, a natural gas compressor station located approximately 3 kilometers (km) east of Sumas, Washington, in Whatcom County. It is also located immediately adjacent to the border between the United States and Canada. The Sumas station receives natural gas from Canada and is the first station on the United States side of the border to pressurize gas for transmission in the pipeline system leading into Washington and Oregon. Northwest Pipeline submits this Notice of Construction air permit application to seek authorization under Washington Administrative Code (WAC) 173-400-110 and Northwest Clean Air Agency (NWCAA) Section 300 for proposed modifications to the Sumas station. This project includes the removal of one existing turbine and the addition of one new turbine. All equipment at the site (existing and new) is fired on natural gas. The application is also making corrections and modifications to the generators. The Waukesha that was installed at D-Plant in 2024 as a replacement for one of the Caterpillars in the 2023 permit application needs to be replaced with a Cummins generator with emissions similar to the Waukesha. The new Caterpillar at C-Plant that was previously permitted as a replacement for the existing smaller Caterpillar has not yet been installed and the project involving the installation has been delayed for at least two years, therefore we are adding the existing Caterpillar back into the inventory and permit and will update the permit when the project involving the larger Caterpillar is approved for construction.

1.1 APPLICATION OVERVIEW

Six appendices are included with this submittal. Appendix A contains NWCAA forms. Appendix B contains emission calculations for the new turbine and facility wide emissions as well as Emission Master outputs used to calculate the tank emissions. Appendix C includes the State Environmental Policy Act checklist. Appendix D contains Best Available Control Technology (BACT) Cost effectiveness calculations. Appendix E includes equipment manufacturer specifications. Appendix F contains air dispersion modelling files. Appendix G contains Gas Composition data.

2. PERMIT MODIFICATION DESCRIPTION

The Sumas Compressor Station is located at 4738 Jones Road in Sumas, Whatcom County, Washington. The area is currently designated as attainment or unclassifiable for the National Ambient Air Quality Standards (NAAQS) for all pollutants. This project includes the removal of one existing compressor turbine and the addition of one new natural-gas-fired turbine as a dry gas compressor with a seal gas recovery unit. All equipment at the site (existing and new) is fired on natural gas. The new turbine will replace Unit 9.

3. EMISSIONS CALCULATIONS

Northwest Pipeline has analyzed the potential emissions from the proposed project, as well as the overall change in emissions from this project. Criteria air pollutant emissions and toxic air pollutant (TAP) emissions were calculated for the new natural-gas-fired turbine based on product description data provided by the vendor and United States Environmental Protection Agency (USEPA) AP-42 emission factors. Emissions for the two natural gas emergency generators were

updated from the previous permit application to include equipment specific emissions. A detailed methodology showing how emissions calculations are performed is included in Appendix B, including details on operating hours, design capacities, throughputs, and emission factors. A summary of the net emissions change (including both the new source and the source proposed for removal) is shown below in Table 1. TAP emissions from the project are listed in Table 2, along with a comparison to applicable Small Quantity Emission Rates (SQER) and *de minimis* emission limits from WAC 173- 460-150. As shown in Table 2, per WAC 173-460-060, a Toxics Best Available Control Technology (tBACT) analysis is required for 1,3butadiene, acetaldehyde, acrolein, benzene, ethylbenzene, and formaldehyde (HCHO) because these emissions are above the *de minimis* levels. tBACT is discussed in Section 5.4. In addition, the change in TAP emissions from the new Solar Mars 100 turbine is above the applicable SQER for HCHO, therefore, modelling analysis is required to further evaluate the ambient TAP concentration increases. Modelling results are discussed in Section 6.

TABLE 1 CURRENT AND PROPOSED CRITERIA POLLUTANT EMISSIONS FACILITY WIDE

	NO_x	CO	VOC	SO_x	PM_{10/2.5}
Current PTE (tpy)	151.87	244.09	44.73	1.12	17.12
Proposed PTE (tpy)	129.57	213.42	45.41	1.23	16.86
Change in PTE (tpy)	-22.30	-30.67	+0.68	+0.11	-0.26

Notes: CO = carbon monoxide; NO_x = nitrogen oxide; PM₁₀ = particulate matter 10 micrometers or less in diameter; PM_{2.5} = particulate matter 2.5 micrometers or less in diameter; PTE = potential to emit; SO_x = sulfur oxide; tpy = tones per year; VOC = volatile organic compound

TABLE 2 CHANGE IN TAP EMISSIONS FOR NEW TURBINE

Chemical	Change in PTE (lb/yr)	Change in PTE (lb/day)	De Minimis Emission Value	tBACT Analysis Required?	SQER	Modelling Required?
1,3-Butadiene	0.54	<0.01	2.7E-01 lb/yr	Y	5.40 lb/yr	N
Acetaldehyde	50.42	0.14	3.0E+00 lb/yr	Y	60.00 lb/yr	N
Acrolein	8.07	0.02	1.3E-03 lb/day	Y	0.03 lb/day	N
Benzene	15.13	0.04	1.0E+00 lb/yr	Y	21.00 lb/yr	N
Ethylbenzene	40.34	0.11	3.2E+00 lb/yr	Y	65.00 lb/yr	N
Formaldehyde	264.72	0.73	1.4E+00 lb/yr	Y	27.00 lb/yr	Y
Methyl alcohol (methanol)	0.00	0.00	7.4E+01 lb/day	N	1500.00 lb/day	N
n-Hexane	0.00	0.00	2.6E+00 lb/day	N	52.00 lb/day	N
Toluene	163.88	0.45	1.9E+01 lb/day	N	370.00 lb/day	N

Chemical	Change in PTE (lb/yr)	Change in PTE (lb/day)	De Minimis Emission Value	tBACT Analysis Required?	SQER	Modelling Required?
Xylenes	80.68	0.22	8.2E-01 lb/day	N	16.00 lb/day	N

Notes: lb = pound; N = no; Y = yes; yr = year

4. REGULATORY ANALYSIS

The proposed project will be subject to federal and state air quality regulations. This section includes a regulatory review that describes and cites potentially applicable federal and state air quality requirements and standards for the emission sources being added with this project. Note existing emission sources that are not being modified as part of this project have been excluded from this regulatory analysis.

4.1 NEW SOURCE PERFORMANCE STANDARDS (NSPS)

4.1.1 40 CODE OF FEDERAL REGULATIONS (CFR) 60 SUBPART GG - STANDARDS OF PERFORMANCE FOR STATIONARY GAS TURBINES

In accordance with 40 CFR 60.4305(b), the proposed new Solar Mars 100 gas turbine is exempt from the requirements of this subpart and will be regulated under NSPS Subpart KKKK discussed below.

4.1.2 40 CFR 60 SUBPART JJJJ- STANDARDS OF PERFORMANCE FOR STATIONARY SPARK IGNITION INTERNAL COMBUSTION ENGINES

Subpart JJJJ applies to stationary spark-ignition internal combustion engines that were constructed, modified, or reconstructed after 1 June 2008 (for the category of lean burn engines with a maximum engine power greater than or equal to 500 horsepower and less than 1,350 horsepower). Because the Cummins emergency engine fits into this category and is constructed after this date, it is subject to this regulation. The applicable requirements from Subpart JJJJ are as follows:

- Engines must meet the appropriate emissions standards for new engines, based on the model year, size, and fuel.
- Emergency engines may be operated for the purposes of maintenance and testing for up to 100 hours per year. There is no limit on emergency use.
- The owner/operator must operate and maintain the engine and any installed control devices according to the manufacturer's written instructions.

The Cummins is certified to meet Subpart JJJJ emission rates. The facility will comply with all other listed requirements for operation and maintenance of these engines.

Note the engine is not a compression ignition unit. Therefore, it is not subject to the requirements of 40 CFR 60 Subpart IIII—Standards of Performance for Stationary Compression Ignition Internal Combustion Engines.

4.1.3 40 CFR 60 SUBPART KKKK – STANDARDS OF PERFORMANCE FOR STATIONARY COMBUSTION TURBINES

This NSPS establishes emission standards and compliance schedules for the control of primarily NO_x and SO₂ emissions from stationary combustion turbines that commenced construction, modification, or reconstruction after 18 February 2025; therefore, the proposed new Solar Mars 100 gas turbine is subject to this regulation. Turbines subject to 40 CFR 60 Subpart KKKK are exempt from the requirements of 40 CFR 60 Subpart GG.

For NO_x, this NSPS allows the owner or operator the choice of a concentration-based or output-based emission standard. The concentration-based limit is expressed in units of parts per million by volume (on a dry basis) (ppmvd) at 15 percent oxygen (O₂). The output-based limit is expressed in units of emission mass per unit of useful recovered energy, nanograms per Joule (ng/J), or pounds per megawatt-hour (lb/MWh). The proposed combustion turbine will combust only pipeline natural gas and will have a heat input rating between 50 and 850 million British thermal units per hour. Therefore, the applicable NO_x standard for the proposed combustion turbine is 25 ppmvd at 15 percent O₂ or 150 ng/J of useful output (1.2 lb/MWh). The proposed combustion turbine will be designed to achieve a NO_x concentration of 9 ppmvd at 15 percent O₂. Northwest Pipeline plans to demonstrate compliance with the NO_x emission standard by conducting performance tests as outlined in 40 CFR 60.4340.

For SO₂, this NSPS is the same for all combustion turbines regardless of size or fuel type. The standard for combustion turbines located in a continental area prohibits the discharge into the atmosphere of any gases that contain SO₂ in excess of 110 ng/J (0.90 lb/MWh) gross energy output. The owner or operator of a combustion turbine can choose to comply with the SO₂ limit itself or with a limit on the sulfur content of the fuel. For a combustion turbine located in a continental area, the fuel sulfur content limit is 26 ng/J (0.06 lb SO₂/MMBtu) heat input. The combustion turbine proposed will meet the NSPS for SO₂ based on Northwest Pipeline's Federal Energy Regulatory Commission natural gas tariff, which has a sulfur content corresponding to less than 0.06 lb SO₂/MMBtu.

4.1.4 40 CFR 60 SUBPART OOOOA—STANDARDS OF PERFORMANCE FOR CRUDE OIL AND NATURAL GAS FACILITIES FOR WHICH CONSTRUCTION, MODIFICATION, OR RECONSTRUCTION COMMENCED AFTER 18 SEPTEMBER 2015 AND ON OR BEFORE 6 DECEMBER 2022

Because this project is occurring after 6 December 2022, this NSPS is not applicable to the new turbine.

4.1.5 40 CFR 60 SUBPART OOOOB—STANDARDS OF PERFORMANCE FOR CRUDE OIL AND NATURAL GAS FACILITIES FOR WHICH CONSTRUCTION, MODIFICATION, OR RECONSTRUCTION COMMENCED AFTER 6 DECEMBER 2022

The NSPS OOOOb rule was finalized by USEPA on 7 March 2024 and became effective 6 May 2024. It is applicable to facilities that begin construction, reconstruction, or modification after 6 December 2022. The equipment associated with this permit application will be subject to the

applicable source-specific standards, monitoring, notification, reporting, recordkeeping, and testing requirements of the NSPS for Crude Oil and Natural Gas Facilities, and related requirements of the NSPS, 40 CFR 60 Subpart A, General Provisions. The facility will comply with requirements as applicable.

The proposed project will therefore be governed under Subpart OOOOb. Facilities that meet the definition of affected facilities under NSPS Subpart OOOOb include the following:

- Hydraulically fractured natural gas wells
- Centrifugal compressors with wet and dry seals, and reciprocating compressors
- Process controllers at natural gas processing plants and other locations within the crude oil and natural gas source category
- Reciprocating Compressors located at a centralized production facility
- Storage vessels with potential VOC emissions greater than 6 tpy or methane emissions greater than 20 tpy
- A group of equipment within a process unit for the extraction of natural gas liquids from field gas, fractionation of liquids into natural gas products, or other operations associated with the processing of natural gas products
- Pneumatic pumps at onshore natural gas processing plants or well sites
- Fugitive equipment components at onshore natural gas processing plants, well sites, and compressor stations
- Sweetening units at onshore natural gas processing plants

The proposed project will not include any affected facilities with requirements related to well sites, natural gas processing plants, reciprocating compressors, or storage vessels with VOC emissions greater than 6 tpy nor methane emissions greater than 20 tpy.

Subpart OOOOb includes requirements for new, modified, or reconstructed centrifugal compressors with wet or dry seals. The centrifugal compressor associated with the combustion turbine will be equipped with dry gas seals and will comply with the applicable requirements.

The proposed turbine modification at the existing Compressor Station will result in a "modification" of the Compressor Station, due to an increase in horsepower rating. Therefore, the collection of fugitive equipment components at the Sumas Compressor Station will make the compressor station an affected source under NSPS Subpart OOOOb. Northwest Pipeline will comply with the leak survey and repair requirements outlined in the regulation for the Compressor Station, as applicable.

Subpart OOOOb also requires zero bleed pneumatic devices if process controllers are being added or modified. The project will result in an overall reduction in process controllers, therefore the modification of process controllers has not occurred. Therefore, this section of the rule does not apply.

The proposed turbine modification does not include the modification of pneumatic pumps. As such, the requirements of 60.5393b will not apply to the Sumas Compressor Station.

Subpart OOOOb applies standards to super-emitter events, which have the potential to occur at the Sumas Compressor Station. In accordance with the standards in 60.5371b, the Sumas Compressor Station will comply with the follow-up actions should a super-emitter event occur or be suspected to occur.

4.2 NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS (NESHAP)

4.2.1 40 CFR 63 SUBPART YYYY—NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS FOR STATIONARY COMBUSTION TURBINES

NESHAP Subpart YYYY applies to newly constructed turbines located at major sources of hazardous air pollutants (HAPs). The term “construction” is defined in 40 CFR 63.2 as the onsite fabrication, erection, or installation of an affected source. Construction does not include the removal of all equipment comprising an affected source from an existing location and reinstallation of such equipment at a new location. The owner or operator of an existing affected source that is relocated may elect not to reinstall minor ancillary equipment including, but not limited to, piping, ductwork, and valves. However, removal and reinstallation of an affected source will be construed as reconstruction if it satisfies the criteria for reconstruction as defined in this section. The costs of replacing minor ancillary equipment must be considered in determining whether the existing affected source is reconstructed. The Sumas facility is considered an area source of HAP emissions. Since construction (meaning onsite installation, as per the NESHAP definition) of the new Mars 100 turbine will occur at an area source, the Turbine NESHAP will not apply to this unit.

4.3 CHEMICAL ACCIDENT PREVENTION PROVISIONS

The goal of 40 CFR 68 and the risk management program it requires is to prevent accidental releases of substances that can cause serious harm to the public and the environment from short-term exposures and to mitigate the severity of releases that do occur. If a tank, drum, container, pipe, or other process at a facility contains any of the substances listed in Table 1 to 40 CFR 68.130 in an amount above the “threshold quantity” specified for that substance, the facility operator is required to develop and implement a risk management program.

The facility does not have any of the substances in the threshold quantities listed in Table 1 to 40 CFR 68.130 and therefore it is not subject to the requirements of 40 CFR 68.

4.4 NEW SOURCE REVIEW (NSR)

NSR requires stationary sources of air pollution to acquire permits before construction begins. NSR is also referred to as construction permitting or preconstruction permitting.

Based on the equipment and emissions, one or more of the following types of NSR permits may be required:

- Prevention of Significant Deterioration (PSD) permits, which are required for new major sources or a major source making a major modification in an attainment area.
- Nonattainment NSR permits, which are required for new major sources or major sources making a major modification in a nonattainment area.
- Minor source permits, which are required for sources that emit pollutants below the major source threshold but above the minor source threshold. It is generally the case that a major new or modified source will also require minor NSR permitting that covers a different subset of pollutants.

Sumas Compressor Station is located in an area that is in attainment for all pollutants. Therefore, only PSD permits and minor source permits are potentially applicable for projects at the facility. The subsections below examine triggering thresholds for these permits.

4.4.1 PREVENTION OF SIGNIFICANT DETERIORATION

Federal construction permitting programs regulate new and modified sources of attainment pollutants under PSD. Natural Gas Transmission Compressor Stations are not listed as one of the 28 industries regulated to a lower major source threshold, therefore, PSD permitting only applies to major sources with PTE greater than 250 tpy. Previously, Sumas Compressor station was subject to PSD. In December 2022 Williams submitted an NOC for an Equipment Replacement Project which resulted in a significant reduction of criteria pollutants and GHGs below the PSD significance level. Construction or operation of equipment at the Sumas Compressor Station will not exceed emission thresholds established by this permitting program.

4.4.2 MINOR SOURCE PERMIT

New or modified sources of air pollution are required to obtain a Notice of Construction or document an exemption determination before beginning construction of a new source of air pollution or modifying an existing source in a manner that causes its emissions to increase and contain a wide range of local, state, and federal requirements to minimize air pollution impacts on the environment. The type of activity, the size of the operation, and the kinds of pollutants emitted determine permit conditions.

Applicability to a modification is limited to the emission unit being modified and the air contaminants that would increase because of the modification.

5. BEST AVAILABLE CONTROL TECHNOLOGY (BACT) ANALYSIS

WAC 173-400-113(2) requires that a proposed new or modified source in an area that is in attainment of ambient air quality standards or unclassifiable employ BACT for all pollutants the emissions of which would increase as a result of the proposed project. The BACT analysis for new sources associated with this project is included below.

5.1 BACT REVIEW PROCESS

BACT, as it applies to regulated pollutants not subject to major new source review, is defined in WAC 173-400-030 as:

"...an emission limitation based on the maximum degree of reduction for each air pollutant subject to regulation under chapter 70.94 RCW emitted from or which results from any new or modified stationary source, which the permitting authority, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable for such source or modification through application of production processes and available methods, systems, and techniques, including fuel cleaning, clean fuels, or treatment or innovative fuel combustion techniques for control of each such pollutant."

This definition is almost identical to the one applied to sources located in attainment areas and subject to major new source review, which appears in 40 CFR Part 52.21 (i.e., federal PSD regulations).

On the 1 December 1987 memorandum from the USEPA Assistant Administrator for Air and Radiation,¹ the agency provided guidance on the "top-down" methodology for determining BACT. The "top-down" process involves the identification of all applicable emission reduction alternatives and ranking them according to effectiveness. Evaluation begins with the "top," or most stringent, alternative. If the most stringent option is shown to be technically or economically infeasible, or if environmental impacts are severe enough to preclude its use, then it is eliminated from consideration and then the next most stringent alternative is similarly evaluated. This process continues until the BACT level under consideration cannot be eliminated by technical or economic considerations, energy impacts, or environmental impacts. The top alternative that is not eliminated in this process becomes the proposed BACT level.

This top-down BACT analysis process can be considered to contain five basic steps:

- Step 1: Identify all available emission reduction alternatives with practical potential for application to the specific emission unit for the regulated pollutant(s) under evaluation;
- Step 2: Eliminate all technically infeasible alternatives;
- Step 3: Rank remaining alternatives by effectiveness;
- Step 4: Evaluate the economic, energy, and environmental impacts starting with the most effective alternative identified in Step 3; and
- Step 5: Select BACT, which will be the most effective available alternative not rejected in the previous steps.

Formal use of these steps is not always necessary. However, the USEPA has consistently interpreted the statutory and regulatory BACT definitions as containing two core requirements, which USEPA believes must be met by any BACT determination, regardless of whether it is conducted in a "top-down" manner. First, the BACT analysis must include consideration of the most stringent available technologies: i.e., those that provide the "maximum degree of emissions reduction." Second, any decision to require a lesser degree of emissions reduction must be justified by an objective analysis of "energy, environmental, and economic impacts" contained in the record of the permit decisions.

¹ <https://www.epa.gov/sites/production/files/2015-07/documents/estabsh.pdf>

Additionally, the least stringent emission reduction alternative considered in a BACT analysis must result in an emission rate no less stringent than the applicable NSPS emission rate, if any NSPS standard for that pollutant is applicable to the source.

The BACT analysis was conducted in a manner consistent with the stepwise approach outlined above. Potential reduction alternatives for criteria pollutant emissions were identified for each emission unit. These alternatives were identified by drawing upon previous environmental permitting experience for similar units, reviewing available regulatory agency BACT guidelines, and surveying available literature. Available alternatives that are judged to be technically feasible are further evaluated based on an analysis of economic, environmental, and energy impacts.

Assessing the technical feasibility of emission reduction alternatives is discussed in USEPA's draft "New Source Review Workshop Manual."² Using terminology from this manual, if an emission reduction alternative has been "demonstrated" successfully for the type of emission unit under review, then it would normally be considered technically feasible. For an undemonstrated technology, "availability" and "applicability" determine technical feasibility. An available technology is one that is commercially available; meaning that it has advanced through the following steps:

- Concept stage
- Research and patenting
- Bench-scale or laboratory testing
- Pilot-scale testing
- Licensing and commercial demonstration
- Commercial sales

Suitability for consideration as a BACT measure involves not only commercial availability (as evidenced by past or expected near-term deployment on the same or similar type of emission unit) but also involves consideration of the physical and chemical characteristics of the exhaust gas stream to be treated. An emission reduction method applicable to one emission unit may not be applicable to a similar unit, depending on differences in the exhaust streams' physical and chemical characteristics.

5.2 TURBINE – NO_x BACT

NO_x is generated when combustion temperatures are great enough for the nitrogen (N₂) in the combustion air or bound in the fuel to combine with O₂ to form nitric oxide (NO). Depending upon conditions, some portion of the NO will react with additional O₂ to form nitrogen dioxide (NO₂).

5.2.1 IDENTIFY COMMERCIALY AVAILABLE EMISSION REDUCTION ALTERNATIVES

The following alternatives have been identified for the reduction of NO_x emissions:

- Good Combustion Practices (GCP)
- Dry Low-NO_x (DLN) combustion
- Selective Non-Catalytic Reduction (SNCR)

² <https://www.epa.gov/sites/production/files/2015-07/documents/1990wman.pdf>

- Selective Catalytic Reduction (SCR)
- Water or Steam Injection

Good Combustion Practices

Techniques that seek to influence the combustion process and, thereby, prevent the formation of a given pollutant, are referred to as “combustion controls.” GCPs include combustion system design elements and operational strategies intended to control the amount and distribution of excess air in the combustion zone for enough oxygen to be present for complete combustion, while not creating high temperatures that promote the creation of NO_x.

Dry Low-NO_x Combustion

Combustion control techniques that utilize design and/or operational features of a turbine’s combustors, which reduce NO_x emissions without injecting an inert diluent (water or steam), are DLN technologies such as Solar’s proprietary DLN combustion technology, SoLoNO_x®. The particular features of a DLN combustion design are vendor-specific, but generally, DLN combustion reduce thermal NO_x formation by controlling peak combustion temperature, combustion zone residence time, and combustion zone free oxygen. Alternatives include combustion distribution over several burner stages and pre-mixing air and fuel prior to injection into the combustion zone. These measures produce a lean, pre-mixed flame that burns at a lower flame temperature and excess oxygen levels than conventional combustors preventing localized high temperature regions.

In lean combustion systems, excess air dominates the combustion zone to produce a significantly leaner fuel/air mixture than is required for complete combustion. Excess air in a combustion zone decreases the overall flame temperature because a portion of the energy released from the fuel heats the excess air to the reaction temperature. Pre-mixing the fuel and air prior to introduction into the combustion zone provides a uniform fuel/air mixture.

Since NO_x formation rates are an exponential function of temperature, the lean pre-mix system achieves a considerable reduction in NO_x. Depending on the manufacturer and product, DLN technologies achieve different levels of control efficiencies.

Selective Non-Catalytic Reduction

In the SNCR process, ammonia is mixed with the exhaust from the combustion device, and the NO_x in the exhaust reacts with the introduced ammonia to form N₂ and water. The reagent, which can be anhydrous ammonia (NH₃), aqueous ammonia, or urea dissolved in water, is typically injected at the exit of the turbine to mix with the hot flue gases. The success of this process in reducing NO_x emissions is highly dependent on the ability to achieve uniform mixing of the reagent into the flue gas. This must occur within a zone of the exhaust stream where the flue gas temperature is within a range typically from 1,600 to 2,200 degrees Fahrenheit (°F). In order to achieve the necessary mixing and reaction, the residence time of the flue gas within this temperature window should be at least 0.5 to 1.0 second. Within the temperature range, the reagent will react with NO_x to form N₂ and water (and CO₂ if urea is used as the reagent). The consequence of operating outside the optimum temperature range is additional NO_x generation or

significant NH₃ emissions. At temperatures above that range, the reagent will be converted to NO_x. At temperatures less than that range, the reagent will not react with the NO_x and significant quantities of NH₃ will discharge from the stack (known as “ammonia slip”).

Selective Catalytic Reduction

The SCR process is similar to SNCR, in that a reagent (usually NH₃) reacts with NO_x to form N₂ and water, but a catalyst matrix is used to allow the reduction reaction to take place at lower temperatures (600 to 700°F for SCR, as opposed to 1,600 to 2,200°F for SNCR).

Water or Steam Injection

Water and steam injection involves the injection of water or steam into the high temperature region of the combustor flame. The injected fluid provides a heat sink that absorbs some of the heat of combustion, thereby reducing the peak flame temperature and reducing the formation of thermal NO_x. This design seeks to control peak combustion temperature, zone residence time, and free oxygen, thereby minimizing thermal NO_x formation. Conventional combustion turbines ranged from 100 to 350 or more ppm of NO_x emissions. Although water and steam injection was successfully used prior to the 1990s on conventional combustion turbines, this design greatly reduces the turbine’s efficiency.

The water injected into the turbine must be of high purity to avoid introducing dissolved solids into the turbine. Dissolved solids in the water may damage the turbine due to erosion and/or the formation of deposits in the hot section of the turbine. Although water/steam injection can reduce NO_x emissions by over 60 percent, the lower average temperature within the combustor may produce higher levels of CO, VOC, and volatile HAPs as a result of incomplete combustion.³

5.2.2 ELIMINATE TECHNICALLY INFEASIBLE ALTERNATIVES

In this subsection, the technical feasibility of each of the emission reduction alternatives identified in the previous section is considered.

Good Combustion Practices

GCPs are a technically feasible method of limiting NO_x emissions from the turbine and are considered a baseline control alternative. NO_x exhaust concentrations of 25 parts per million (ppm) (or less) may be achievable using this approach, depending on the turbine design and configuration.

Dry Low-NO_x Combustion

DLN combustion is technically a feasible control alternative for the turbine. DLN combustion is capable of achieving 9 ppm in the exhaust. Achieving concentrations lower than those achievable by DLN combustion (9 ppm) requires the use of add-on controls, such as SCR, which is discussed below.

³ AP-42, Chapter 1, Section 4, Natural Gas Combustion, July 1998, and AP-42, Chapter 3, Section 1, Stationary Gas Turbines, April 2000.

Selective Non-Catalytic Reduction

The use of SNCR can achieve control efficiencies of up to 65 percent, with actual emission reductions varying based on inlet NO_x, and exhaust parameters such as temperature and total volumetric flow.⁴ For this assessment, SNCR is technically infeasible due to low stack temperature. The stack temperature from the new turbine is below the range of 1,600 to 2,200°F required for SNCR use.

Selective Catalytic Reduction

SCR is commonly used in the utility-scale electric power sector for the control of NO_x emissions from gas-fired turbines and is considered technologically feasible for the proposed Mars 100 turbine. SCR can achieve NO_x emission controls of up to 90 percent, depending on the inlet NO_x levels being controlled.⁵ For this assessment, we assume SCR would be capable of achieving a 90 percent removal efficiency.

Water or Steam Injection

Water or steam injection is a NO_x reduction technology commonly used to control NO_x emissions when combusting liquid fuel; however, it cannot be used in conjunction with DLN because it leads to unstable combustion. Since the proposed turbine will exclusively fire on natural gas and use DLN, implementing water or steam injection to reduce NO_x emissions further is infeasible.

5.2.3 RANK REMAINING ALTERNATIVES BY EFFECTIVENESS

Effectiveness is defined by the ability of an emission reduction alternative to reduce the emission rate of a given pollutant or group of pollutants. The use of SCR as a NO_x control option is considered technologically feasible for this project. Since the use of DLN combustion employing good combustion practices has been selected as part of the design of the proposed turbine, the costs of these options are not evaluated. Therefore, the use of control technology (SCR) has been evaluated for its cost effectiveness. The results of this analysis are described below.

5.2.4 CONSIDERATION OF ECONOMIC, ENERGY, AND ENVIRONMENTAL FACTORS

This step of a BACT analysis involves consideration of economic, energy, and environmental factors starting with the emission reduction alternative identified in the previous step to be the most effective.

Based on the information presented above, the use of SCR is evaluated here. Economic factors were considered using cost effectiveness as the criterion, which is calculated as the annualized cost of the emission reduction alternative divided by the annual tons of pollutant reduced by the emission reduction alternative.

Direct and indirect capital and operating costs were estimated based on the control cost estimation methodology provided by the USEPA's Air Pollution Control Cost Manual. The calculated

⁴ USEPA Cost Control Manual, Seventh Edition, Section 7, Chapter 1, "NO_x Controls – Selective Non-Catalytic Reduction," pp.1-1 to 1-4

⁵ USEPA Cost Control Manual, Seventh Edition, Section 7, Chapter 2, "NO_x Controls – Selective Catalytic Reduction," pp.1-1 to 1-4

annual cost to use add-on control options, which includes the capital cost of the equipment and installation costs amortized over the life of the equipment, as well as annual operating costs, was estimated for SCR. These costs were then divided by the level of emission reduction below baseline levels achievable by SCR. These calculations and the resulting cost-per-ton cost effectiveness values are presented in Appendix D1.

As seen in these calculations, the cost of SCR is anticipated to be \$22,345 per ton of NO_x removed (in 2024 dollars). In its 2016 guidance entitled "BACT and tBACT Cost-Effectiveness Thresholds⁶," Ecology lists the BACT cost effectiveness threshold range for NO_x emission control options as \$10,000 to \$12,000 per ton. Since the cost of the add-on control option is above the high end of this threshold range, the use of SCR is deemed to be not cost effective for this project.

5.2.5 PROPOSED BACT

Based on the analyses outlined above, BACT for NO_x from the new turbine is proposed as 9 ppm in the exhaust, achievable with low-NO_x burners employing good combustion control practices. The new turbine will be a Solar Mars 100, equipped with Solar's proprietary DLN combustion technology, SoLoNO_x®, capable of achieving the NO_x emission rate determined to represent BACT.

5.3 TURBINE – CO BACT

CO emissions are formed in combustion systems as a result of incomplete combustion of carbon in the fuel. The BACT analysis for CO emissions from the new turbine is contained in the next section.

5.3.1 IDENTIFY COMMERCIALY AVAILABLE EMISSION REDUCTION ALTERNATIVES

The following alternatives have been identified for the reduction of CO emissions from the new Mars 100 turbine.

- GCPs
- Oxidation Catalyst

Good Combustion Practices

Techniques that seek to influence the combustion process and, thereby, prevent the formation of a given pollutant, are referred to as "combustion controls." GCPs include combustion system design elements and operational strategies intended to control the amount and distribution of excess air in the combustion zone for enough O₂ to be present for complete combustion, which minimizes CO emissions in the exhaust.

Oxidation Catalyst

An oxidation catalyst is a post-combustion technology that removes CO from the exhaust gas stream after it is formed in the combustion turbine. In the presence of a catalyst, CO will react with O₂ present in the turbine exhaust, converting it to CO₂. No supplementary reactant is used in conjunction with an oxidation catalyst.

⁶ Notice of Construction Application and Supporting Information Report

Oxidation catalyst systems seek to remove pollutants from the turbine exhaust gas rather than limiting pollutant formation at the source. Oxidation of CO to CO₂ utilizes the excess oxygen present in the turbine exhaust; the activation energy required for the oxidation reaction to proceed is lowered in the presence of the catalyst. Technical factors relating to this technology include the catalyst reactor design, optimum operating temperature, back pressure loss to the system, catalyst life, and potential collateral increases in emissions of PM₁₀ and sulfuric acid mist emissions.

CO catalytic oxidation reactors operate in a relatively narrow temperature range. At lower temperatures, CO conversion efficiency falls off rapidly. At higher temperatures, catalyst sintering may occur, thus causing permanent damage to the catalyst. For this reason, the CO catalyst is strategically placed within the proper turbine exhaust point and proper operating temperature considering the temperature variations that are expected to occur across the unit's operating load range. Operation at part load or during start-up/shutdown will result in less than optimum temperatures and reduced control efficiency.

Catalyst systems are subject to loss of activity over time. Since the catalyst itself is the costliest part of the installation, the cost of catalyst replacement should be considered on an annualized basis. Catalyst life may vary from the manufacturer's typical 3-year guarantee to a 5- to 6-year predicted life. Periodic testing of catalyst material is necessary to predict annual catalyst life for a given installation.

5.3.2 ELIMINATE TECHNICALLY INFEASIBLE ALTERNATIVES

In this subsection, the technical feasibility of each of the emission reduction alternatives identified in the previous section is considered.

Good Combustion Practices

GCPs are a technically feasible method of limiting CO emissions from the turbine and are considered a baseline control alternative. CO exhaust concentrations of 25 ppm (or less) may be achievable using this approach, depending on the turbine design and configuration.

Oxidation Catalyst

Oxidation catalysts are commonly used for utility-scale and industrial-scale turbines (>25 megawatts [MW]). The proposed turbine is smaller (approximately 13 MW), and oxidation catalysts are less commonly used for turbines of this size due to their cost and negative impacts on system performance. In spite of this, the use of an oxidation catalyst is considered to be technologically feasible for the proposed new turbine. Oxidation catalysts can achieve CO concentrations as low as 2 ppm in the exhaust.

5.3.3 RANK REMAINING ALTERNATIVES BY EFFECTIVENESS

Effectiveness is defined by the ability of an emission reduction alternative to reduce the emission rate of a given pollutant or group of pollutants. The use of an oxidation catalyst is the most effective control option and has been further evaluated below for additional impacts compared to the use of good combustion practices.

5.3.4 CONSIDERATION OF ECONOMIC, ENERGY, AND ENVIRONMENTAL FACTORS

This step of a BACT analysis involves consideration of economic, energy, and environmental factors starting with the emission reduction alternative identified in the previous step to be the most effective.

Based on the information presented above, the use of an oxidation catalyst is evaluated here. Economic factors were considered using cost effectiveness as the criterion, which is calculated as the annualized cost of the emission reduction alternative divided by the annual tons of pollutant reduced by the emission reduction alternative.

Direct and indirect capital and operating costs were estimated based on the control cost estimation methodology provided by the USEPA's Air Pollution Control Cost Manual. The calculated annual cost to use add-on control options, which includes the capital cost of the equipment and installation costs amortized over the life of the equipment, as well as annual operating costs, was estimated for each option. These costs were then divided by the level of emission reduction below baseline levels achievable by each option. These calculations and the resulting cost-per-ton cost effectiveness values are presented in Appendix D2.

As seen in these calculations, the costs of an oxidation catalyst are anticipated to be \$18,504 per ton to remove CO. In its 2016 guidance entitled "BACT and tBACT Cost-Effectiveness Thresholds,"⁷ Ecology lists the BACT cost effectiveness threshold for CO emission control options as \$5,000 per ton. Since the cost of an oxidation catalyst is above this threshold, the use of this option is deemed to be not cost effective for this project.

5.3.5 PROPOSED BACT

Based on the analysis outlined above, BACT for CO emissions from the new turbine is proposed to be the use of good combustion practices to achieve a design CO exhaust concentration of 25 ppm in the exhaust.

5.4 TURBINE – VOC BACT AND TAP TBACT

As with CO, VOC and volatile TAP emissions are formed in fuel combustion systems as a result of incomplete combustion of carbon in the fuel. Trace amounts of VOC species in the natural gas fuel (e.g., HCHO) may also contribute to VOC emissions if they are not completely combusted. The BACT analysis for VOC emissions and the tBACT analysis for volatile TAPs, including 1,3 butadiene, acetaldehyde, acrolein, benzene, ethylbenzene, and HCHO from the new turbine are contained in the next subsection.

5.4.1 IDENTIFY COMMERCIALY AVAILABLE EMISSION REDUCTION ALTERNATIVES

The following alternatives have been identified for the reduction of VOC emissions, including volatile TAPs, from the new Mars 100 turbine.

- GCPs
- Oxidation Catalyst

⁷ Notice of Construction Application and Supporting Information Report

Good Combustion Practices

Techniques that seek to influence the combustion process and, thereby, prevent the formation of a given pollutant, are referred to as “combustion controls.” GCPs include combustion system design elements and operational strategies intended to control the amount and distribution of excess air in the combustion zone for enough oxygen to be present for complete combustion, which minimizes VOC and volatile TAP emissions in the exhaust.

Oxidation Catalyst

An oxidation catalyst is a post-combustion technology that removes VOC and volatile TAPs from the exhaust gas stream after it is formed in the combustion turbine. This is the same technology discussed above for the control of CO emissions. In the presence of a catalyst, VOC and volatile TAPs will react with O₂ present in the turbine exhaust, converting it to CO₂ and water. No supplementary reactant is used in conjunction with an oxidation catalyst.

Oxidation catalyst systems seek to remove pollutants from the turbine exhaust gas rather than limiting pollutant formation at the source. Oxidation of VOC and volatile TAPs to CO₂ utilizes the excess O₂ present in the turbine exhaust; the activation energy required for the oxidation reaction to proceed is lowered in the presence of the catalyst. Technical factors relating to this technology include the catalyst reactor design, optimum operating temperature, back pressure loss to the system, catalyst life, and potential collateral increases in emissions of PM₁₀ and sulfuric acid mist emissions.

5.4.2 ELIMINATE TECHNICALLY INFEASIBLE ALTERNATIVES

In this subsection, the technical feasibility of each of the emission reduction alternatives identified in the previous subsection is considered.

Good Combustion Practices

GCPs are a technically feasible method of limiting VOC and volatile TAP emissions from the turbine and are considered a baseline control alternative. Based on information from Solar (manufacturer of the Mars 100 turbine), a VOC emission rate of 0.90 pound per hour and a HCHO emission rate of 0.03 pound per hour is considered feasible for this unit.

Oxidation Catalyst

Oxidation catalysts are commonly used for utility-scale and industrial-scale turbines (>25 MW). The proposed turbine is smaller (approximately 13 MW), and oxidation catalysts are less commonly used for turbines of this size due to their cost and negative impacts on system performance. In spite of this, the use of an oxidation catalyst is considered to be technologically feasible for the proposed new turbine. Oxidation catalysts can achieve VOC concentrations as low as 1 ppm in the exhaust.

5.4.3 RANK REMAINING ALTERNATIVES BY EFFECTIVENESS

Effectiveness is defined by the ability of an emission reduction alternative to reduce the emission rate of a given pollutant or group of pollutants. The use of an oxidation catalyst is the most

effective control option and has been further evaluated below for additional impacts compared to the use of good combustion practices.

5.4.4 CONSIDERATION OF ECONOMIC, ENERGY, AND ENVIRONMENTAL FACTORS

This step of a BACT and tBACT analysis involves consideration of economic, energy, and environmental factors starting with the emission reduction alternative identified in the previous step to be the most effective.

Based on the information presented above, the use of an oxidation catalyst is evaluated here. Economic factors were considered using cost effectiveness as the criterion, which is calculated as the annualized cost of the emission reduction alternative divided by the annual tons of pollutant reduced by the emission reduction alternative.

Direct and indirect capital and operating costs were estimated based on the control cost estimation methodology provided by the USEPA's Air Pollution Control Cost Manual. The calculated annual cost to use add-on control options, which includes the capital cost of the equipment and installation costs amortized over the life of the equipment, as well as annual operating costs, was estimated for each option. These costs were then divided by the level of emission reduction below baseline levels achievable by each option. These calculations and the resulting cost-per-ton cost effectiveness values are presented in Appendix D2.

As seen in these calculations, the costs of an oxidation catalyst are anticipated to be \$158,482 per ton to remove VOCs. In its 2016 guidance entitled "BACT and tBACT Cost-Effectiveness Thresholds⁸," Ecology lists the BACT cost effectiveness threshold for VOC emission control options as \$10,000 to \$12,000 per ton. Since the cost of an oxidation catalyst is above the high end of this range, the use of this option is deemed to be not cost effective for this project.

Additionally shown in the calculations appended, the cost effectiveness of installation of a catalytic oxidizer to remove volatile TAPs that exceed *de minimis* values (1,3-butadiene, acetaldehyde, acrolein, benzene, ethylbenzene, and HCHO) results in anticipated cost of \$3,610,784 per ton. When considering the sum of criteria pollutants (CO and VOC) in addition to the above-mentioned volatile TAPs, based on estimated equipment cost to install and abate emissions, the resulting cost effectiveness amounts to \$16,494 per ton of emissions, still deemed not cost effective for this project.

5.4.5 PROPOSED BACT

Based on the analysis outlined above, BACT for VOC and tBACT for volatile TAP emissions from the new turbine is proposed to be the use of good combustion practices to achieve a design VOC emission rate of 0.90 pound per hour and a design HCHO emission rate of 0.03 pound per hour.

5.5 TURBINE – PM BACT

Particulate matter (PM) emissions from combustion turbine generators are a combination of filterable (front-half) and condensable (back-half) particles. Filterable PM is formed from

⁸ [Notice of Construction Application and Supporting Information Report](#)

impurities contained in the fuels and from incomplete combustion. Condensable particulate emissions, which are to be aggregated with filterable PM when quantifying PM₁₀ and PM_{2.5} emission rates, are attributable primarily to the formation of sulfates and possibly organic compounds. Only the filterable fraction of PM is used to quantify PM emission rates.

The following subsections present the BACT assessment for PM emissions. Emissions of PM₁₀, PM_{2.5} and total PM are evaluated collectively here, since emissions of all sizes of PM are assumed to be the same from natural gas combustion.

5.5.1 IDENTIFY COMMERCIALY AVAILABLE EMISSION REDUCTION ALTERNATIVES

When the NSPS for stationary combustion turbines (40 CFR 60 Subpart KKKK) were proposed in 2005, USEPA declined to establish emission limits on PM because "...particulate matter emissions are negligible with natural gas firing due to the low sulfur content of natural gas. Emissions of PM are only marginally significant with distillate oil firing because of the lower ash content..."⁹.

Additionally, USEPA found that no combustion turbines permitted since 2003 utilized add-on controls. Proper combustion control and the use of pipeline quality natural gas is the only control option that has been achieved in practice for this category of emissions.

Add-on PM controls, such as electrostatic precipitators or baghouses, have never been applied to commercial natural gas-fired combustion turbines. The use of electrostatic precipitators and baghouses are considered technically infeasible, and do not represent a commercially available control technology.

5.5.2 ELIMINATE TECHNICALLY INFEASIBLE ALTERNATIVES

The only commercially available control option for limiting PM emissions from natural gas combustion is the use of pipeline quality natural gas.

5.5.3 RANK REMAINING ALTERNATIVES BY EFFECTIVENESS

Effectiveness is defined by the ability of an emission reduction alternative to reduce the emission rate of a given pollutant or group of pollutants. Only one control option has been identified: the use of pipeline quality natural gas as a fuel. Since this option is incorporated into the project design, no further evaluation of economic, energy, and environmental factors is necessary.

5.5.4 PROPOSED BACT

Based on the analysis outlined above, BACT for PM emissions from the new turbine is proposed to be the use of pipeline quality natural gas as a fuel.

5.6 TURBINE – SO₂ BACT

SO₂ emissions are formed in combustion systems as a result of the oxidation of sulfur contained in the fuel. Control options therefore focus both on the use of low-sulfur fuels as a pollution

⁹ EPA, 70 FR 8314, February 2005

prevention measure, or, where necessary, add-on controls to remove SO₂ once it has been generated. The following subsections present the BACT assessment for SO₂ emissions.

5.6.1 IDENTIFY COMMERCIALY AVAILABLE EMISSION REDUCTION ALTERNATIVES

Natural gas is an inherently low-sulfur fuel. The sulfur present in pipeline quality natural gas is primarily the result of mercaptans added to the gas to give it an odor, for safety reasons.

Add-on SO₂ controls, such as scrubbers, have never been applied to commercial natural gas-fired combustion turbines. The use of scrubbers are considered technically infeasible, and do not represent a commercially available control technology for emissions from a natural gas-fired turbine.

5.6.2 ELIMINATE TECHNICALLY INFEASIBLE ALTERNATIVES

The only commercially available control option for limiting SO₂ emissions from natural gas combustion is the use of pipeline quality natural gas.

5.6.3 RANK REMAINING ALTERNATIVES BY EFFECTIVENESS

Effectiveness is defined by the ability of an emission reduction alternative to reduce the emission rate of a given pollutant or group of pollutants. Only one control option has been identified: the use of pipeline quality natural gas as a fuel. Since this option is incorporated into the project design, no further evaluation of economic, energy, and environmental factors is necessary.

5.6.4 PROPOSED BACT

Based on the analysis outlined above, BACT for SO₂ emissions from the new turbine is proposed to be the use of pipeline quality natural gas as a fuel.

6. AIR QUALITY IMPACT ANALYSIS

An air dispersion modelling analysis was conducted to assess the impact of air emissions resulting from the new Mars 100 turbine to confirm the upgrade would not violate the NAAQS or the acceptable source impact levels (ASIL) defined in WAC 173-460-150.

6.1 MODEL SELECTION AND METHODOLOGY

The most recent versions of the AERMOD Modelling System components were used. These include the existing regulatory components (AERMOD, AERMET, AERMAP, and Building Profile Input Program [BPIP]) and the USEPA recommended non-regulatory component AERSURFACE.

AERMOD (version 24142) was used in the modelling analyses. AERMOD is the USEPA preferred refined dispersion model for evaluating impacts of land-based stationary sources within 50 km of the source. AERMOD is one of the listed refined dispersion models in USEPA's Guideline on Air Quality Models (40 CFR Part 51 Appendix W)¹⁰ that are recommended to be used for NSR and PSD programs.

¹⁰ 40 CFR Part 51 Appendix W available at [appendix_w-2024.pdf](#). Accessed March 2025.

Default AERMOD control options were used, which included use of a rural dispersion coefficient. The USEPA-preferred land use classification technique in 40 CFR 51 Appendix W, known as the "Auer" method was used to determine the urban vs. rural land use classification for the modelling domain. This classification method involves assessing land use within a 3-km radius of the site. In most cases, USEPA recommends using the urban option in AERMOD if greater than 50 percent of the area is considered urban; otherwise, the default rural mode in AERMOD should be used. Based on a review of land use in the vicinity of the site using United States Geological Survey land use data and by inspecting aerial imagery, the area defined by a 3-km radius around the project site is classified as rural land use, and therefore AERMOD was executed in the default rural mode.

To demonstrate compliance with the NAAQS, first a Significant Impact Level (SIL) analysis was conducted to determine maximum impacts resulting from the new turbine emissions. Only pollutants that exceeded their respective SILs were included in the cumulative NAAQS modelling, which includes representative background monitor concentrations. In addition to criteria pollutant modelling, TAP modelling was also conducted in accordance with WAC 173-460-150 for HCHO, which exceeds its SQER. Model results are discussed in Section 6.2.

6.1.1 STACK PARAMETERS AND EMISSION RATES

For the air permit application, only the change in emissions from the project are required to be modelled. For this project, all criteria pollutant emissions went down as a result of replacing the existing Mars 90 with the new Mars 100, with the exception of SO₂. However, ERM conservatively modelled the Mars 100 emissions without subtracting the Mars 90 emissions to assess the turbine's impact. All criteria pollutants were modelled except for SO₂ which has a total PTE less than the exemption threshold in NWCAA 300.4.

For annual averages, emission rates from normal operation were used for the modelling. For short-term averages, startup and shutdown cycle rates were also evaluated to determine a worst-case emission rate to use for the modelling. Normal operation rates were the greatest for all pollutants except for CO, which had much higher rates for startup and shutdown. The maximum factor for CO assumed 15 minutes of startup, 30 minutes of normal operation, and 15 minutes of shutdown occurring in the same hour. It is unlikely that startup and shutdown would occur in the same hour, so this was a conservative approach. The emission rates used for criteria pollutant modelling is shown in Table 4 and stack parameters for the new turbine are shown in Table 5.

Ecology also requires modelling for any TAPs that exceed their SQER defined in WAC 173-460-150. The SQER exceedance evaluation conservatively used the full emission rates resulting from the new turbine without factoring in the emissions reductions from removing the existing Mars 90. The only TAP that exceeded its SQER and required modelling was HCHO. A summary of the SQER exceedance evaluation is shown in Table 2. The emission rate used to model annual HCHO is shown in Table 4.

TABLE 3 MODELLED EMISSIONS FOR NEW TURBINE

Model ID	Description	NO _x (short-term) (lb/hr)	NO _x (annual) (tpy)	CO (short-term) (lb/hr)	PM ₁₀ /PM _{2.5} (short-term) (lb/hr)	PM ₁₀ /PM _{2.5} (annual) (tpy)	HCHO (tpy)
9DTURB1	Compressor Turbine Solar Mars 100S	4.67	20.56	27.45 ¹	0.95	4.18	0.13

¹ Maximum emission rate for CO comes from operating scenario where startup and shutdown occur in the same hour for 15 minutes each, along with 30 minutes of normal operation. All other rates are from normal operation.

TABLE 4 MODELLED STACK PARAMETERS FOR NEW TURBINE

Model ID	Description	Stack Height (m)	Exhaust Temperature (K)	Exit Velocity (m/s)	Diameter (m)
9DTURB1	Compressor Turbine Solar Mars 100S	15.64	735.93	16.40	2.75

Notes: K = Kelvin m = meter; m/s = meters per second

6.1.2 NO₂ MODELLING METHODOLOGY

For the 1-hour and annual NO₂ modelling, the default Tier 2 Ambient Ratio Method Version 2 option for the conversion of NO_x to NO₂ was used.

6.1.3 RECEPTOR GRID

A comprehensive Cartesian receptor grid extending out approximately 10 km from the fence line was used in the AERMOD modelling analysis to assess maximum concentrations near the ground-level resulting from the new turbine. Receptor spacing aligns with the recommended spacing from Ecology's recommendation outlined in "AQP-GUI-2021 AERMOD APP Review"¹¹ with the following spacing:

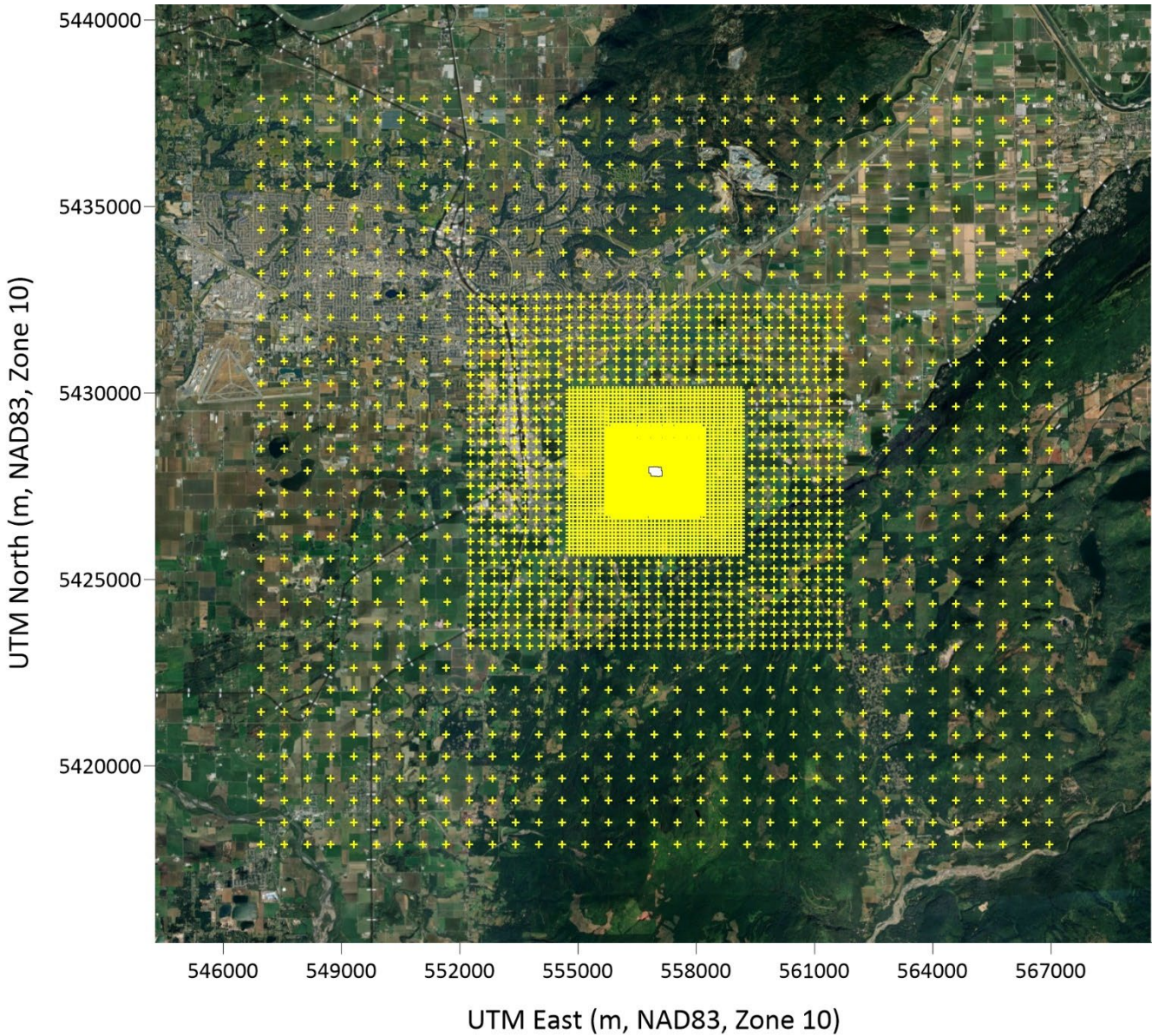
- 12.5-meter spacing along the fence line and out to approximately 150 meters
- 25-meter spacing from approximately 150 meters out to 400 meters
- 50-meter spacing from approximately 400 meters out to 900 meters
- 100-meter spacing from approximately 900 meters out to 2,000 meters
- 300-meter spacing from approximately 2,000 meters out to 4,500 meters
- 600-meter spacing from approximately 4,500 meters out to 10 km

Terrain elevations from National Elevation Data from United States Geological Survey were processed using the most recent version of AERMAP (24142) to develop the receptor terrain elevations and hill scales required by AERMOD. A flagpole height of 1.5 meters was used per

¹¹ Ecology "AQP-GUI-2021 AERMOD APP Review". <https://ecology.wa.gov/regulations-permits/laws-rules-rulemaking/rulemaking/index>. Received from NWCAA Feb. 2025.

Ecology’s recommendation, which is based on the average breathing zone of a human. The receptor grid is shown on Figure 1.

FIGURE 1 RECEPTOR GRID

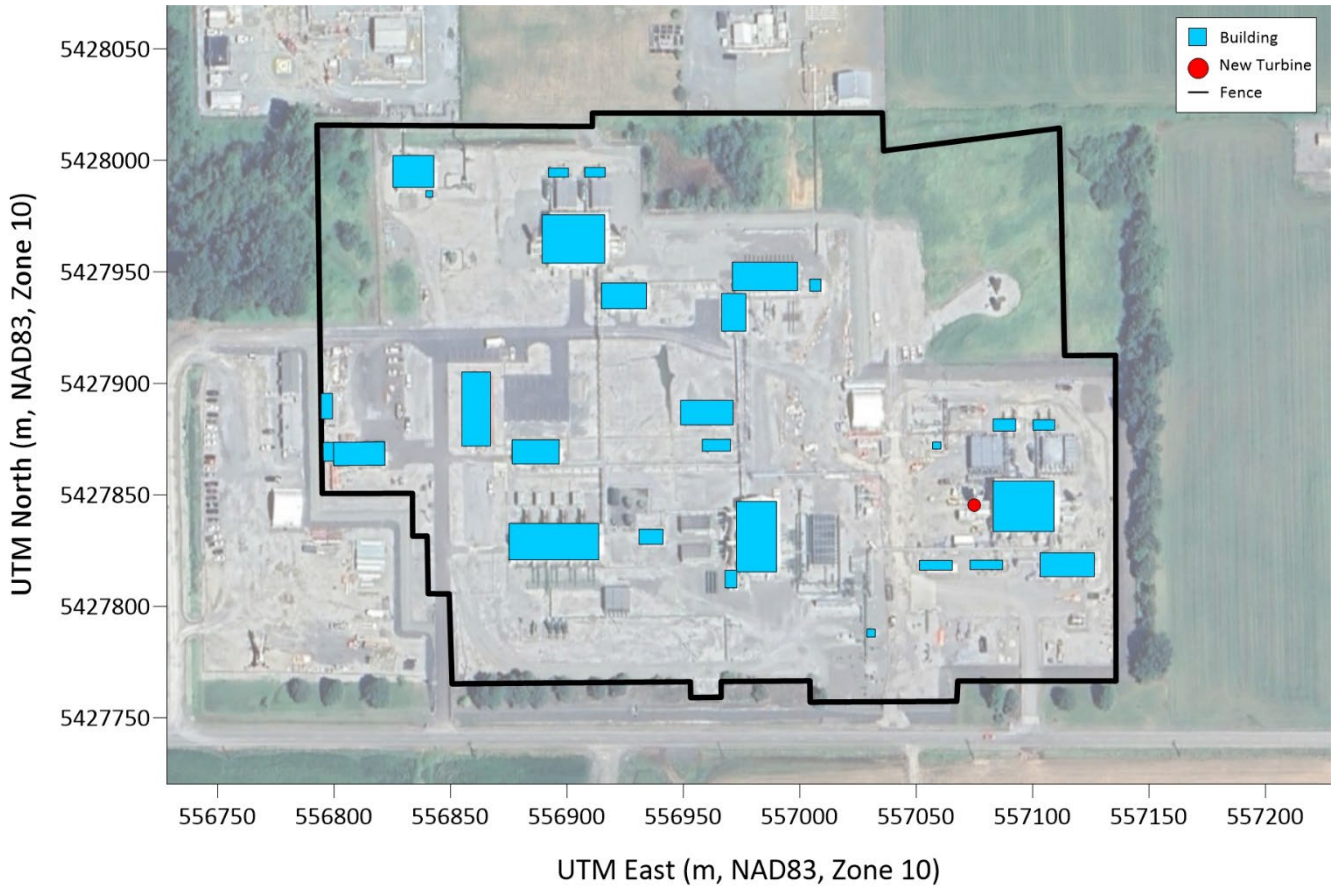


6.1.4 BUILDING DOWNWASH

The USEPA’s BPIP, Version 04274, was used to calculate downwash effects for the new turbine. The stack height is below the Good Engineering Practice formula height calculated by BPIP (65 meters) so the actual stack height was used. Building dimensions data output from BPIP were input into AERMOD to represent aerodynamic downwash effects. The buildings and structures included in the BPIP analysis, along with the proposed turbine location are shown on Figure 2.

Some of the existing buildings visible in Figure 2 – Site Layout are undergoing demolition and will no longer operate.

FIGURE 2 SITE LAYOUT



6.1.5 METEOROLOGICAL DATA

Meteorological surface data for the five most recent available years (2020-2024) was obtained from the National Weather Service station at the Seattle-Tacoma International Airport (KSEA, WBAN: 24233) along with the closest concurrent upper air sounding data from a station in Quillayute, Washington (KUIL, WBAN 94240). Meteorological stations closer to the site were considered but the Seattle station was selected over those stations because they did not have available AERMINUTE data for the full period, did not meet Ecology’s requirement to have less than 10 percent calm winds, or they could not be processed through AERSURFACE with National Land Cover Dataset (NLCD) data. The resulting wind rose from the Seattle-Tacoma Airport closely resembled the wind pattern at the Abbotsford Airport, which is located closest to the site but across the Canadian border where NLCD data are not available. The wind rose for the Seattle-Tacoma Airport for 2020-2024 is shown on Figure 3.

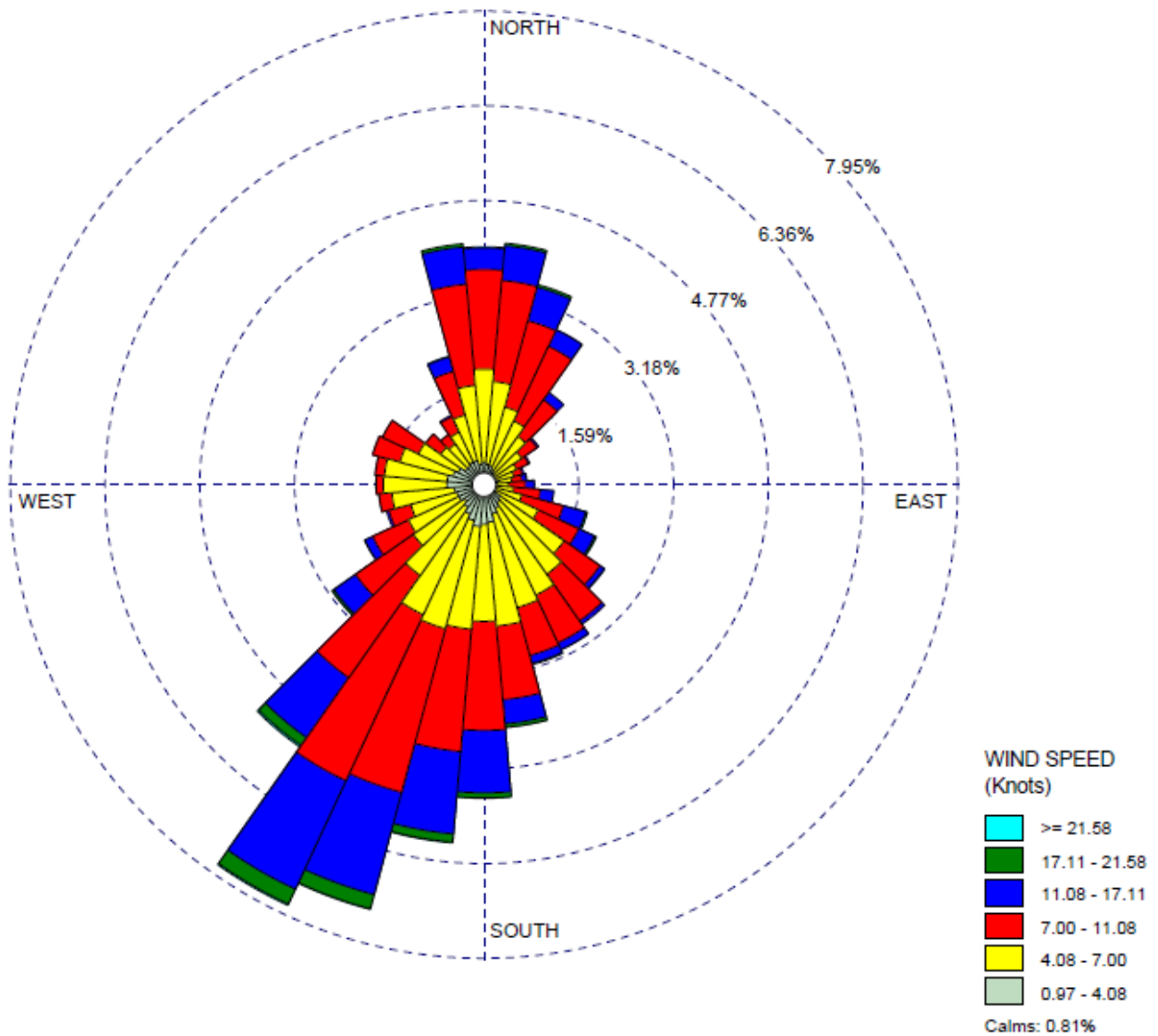
The surface parameters for this application were calculated using the latest version of AERSURFACE (24142). The input land use file was obtained from the 2023 NLCD data, which is the latest available. The radius of the surface roughness domain was set to 1 km and the domain

was divided into twelve 30-degree sectors starting at 0 degrees north and moving eastward. Sectors 120 through 240 were designated as having low surface roughness, while the remaining sectors were designated as high surface roughness. A default method (ZORAD) for determining surface roughness length was used in AERSURFACE and is based on an inverse distance-weighted geometric mean.

Surface moisture conditions at the site were determined for each month based on the precipitation data from the Seattle-Tacoma Airport. The moisture categories were determined based on the calculated 30-year (1995-2024) climatological normals for the Seattle area. Months with precipitation less than 30 percent of the climatological norm are considered dry; months with precipitation greater than 70 percent of the climatological norm are considered wet; months with precipitation between 30 and 70 percent of the climatological norm are considered average. The annual moisture condition used for the calculation of the Bowen ratio was designated average for years 2020-2022, and drier-than-average for 2023 and 2024. The default month-to-season distribution (DJF winter, MAM spring, JJA summer, SON autumn) was used. The AERSURFACE domain was centered at the location of Seattle-Tacoma Airport surface station. The region of Washington where the surface station is located is considered non-arid.

Surface hourly and upper air, twice-daily data were processed through the latest version of AERMET (24142) for the entire modelling period 2020-2024. The sub-hourly Automated Surface Observing System wind data were extracted and processed in AERMINUTE (version 15272). All the data were merged together and the appropriate surface parameters were incorporated, as calculated with the latest version of AERSURFACE (24142). A threshold of 0.5 meters per second was set for the Automated Surface Observing System wind speed. The wind speed was considered a scalar quantity and the appropriate adjustment of the friction velocity (ADJ_U^*) was applied.

FIGURE 3 SEATTLE/TACOMA INTERNATIONAL AIRPORT WIND ROSE 2020-2024



6.1.6 SECONDARY PM_{2.5} AND OZONE FORMATION

40 CFR Part 51 Appendix W Guidelines include a provision that requires major sources subject to NSR/PSD review to assess a project’s impacts on the formation of ozone and secondary PM_{2.5}. USEPA proposed a two-tiered approach for assessing the impacts of these pollutants:

- Tier 1 involves using known relationships between precursor emissions and a source’s impacts to qualitatively assess the impact on secondary PM_{2.5} and ozone formation.
- Tier 2 involves a more detailed analysis and could involve application of a photochemical grid model to determine the secondary PM_{2.5} and ozone impacts.

These analyses are only required if a project's emissions for ozone and PM_{2.5} precursors or if direct emissions of PM_{2.5} exceed a Significant Emission Rate (SER). The precursors for ozone that need to be evaluated are NO_x and VOCs, which both have a SER of 40 tpy. The precursors for PM_{2.5} are NO_x and SO₂, which both have a SER of 40 tpy. The SER to evaluate direct PM_{2.5} emissions is 10 tpy. If considering the emission sources being removed, the project leads to a reduction for NO_x and PM_{2.5}, and total SO₂ emissions are well below the SER threshold. If evaluating the potential to emit for the new turbine without considering the removal of existing sources, all pollutants (NO_x, VOCs, SO₂, and PM_{2.5}) are well below their respective SERs, and a secondary contribution analysis is not required.

6.2 MODEL RESULTS

6.2.1 SIL/NAAQS MODEL RESULTS

The impacts from the proposed turbine were first evaluated to identify the worst-case impact for each pollutant, or the overall maximum concentration. Model-predicted concentrations were predicted on the comprehensive receptor grid described in Section 6.1.3. The resulting maximum concentrations from the new turbine are summarized in Table 6 and compared to their respective SILs. If the pollutant did not exceed the SIL, no further analysis is necessary. For any pollutant that exceeds the SIL, NAAQS modelling was conducted. In this case the SIL was exceeded for 1-hour NO₂, and 24-hour and annual PM_{2.5}. NAAQS modelling was conducted for those pollutants, and results are compared to their respective NAAQS thresholds shown in Table 7.

TABLE 5 SIL MODEL RESULTS

Pollutant	Averaging Period	Rank	Maximum AERMOD Concentration (µg/m ³)	SIL (µg/m ³)	% of Criteria
NO ₂	1-hr	H1H	18.98	7.5	253
	Annual	H1H	0.73	1.0	73
PM ₁₀	24-hr	H1H	2.50	5.0	50
PM _{2.5}	24-hr	H1H	2.22	1.2	185
	Annual	H1H	0.13	0.13	102
CO	1-hr	H1H	133.24	2,000	7
	8-hr	H1H	110.46	500	22

Notes: µg/m³ = micrograms per cubic meter

TABLE 6 NAAQS MODEL RESULTS

Pollutant	Averaging Period	Rank of Model Impacts	Maximum AERMOD Predicted Concentration ($\mu\text{g}/\text{m}^3$)	Ambient Background Concentration ($\mu\text{g}/\text{m}^3$) ¹	Total Concentration ($\mu\text{g}/\text{m}^3$)	NAAQS ($\mu\text{g}/\text{m}^3$)	% of Criteria
NO ₂	1-hr	98th	16.53	95.88 ²	112.41	188	60
PM _{2.5}	24-hr	98th	1.28	29.00 ³	30.28	35	87
	Annual	H1H	0.13	8.20 ³	8.33	9.0	93

¹ Background monitor values come from USEPA's 2023 Design Value Reports. <https://www.epa.gov/air-trends/air-quality-design-values>. Accessed February 2025.

² Monitor value comes from monitor 53-033-0030, Seattle 10th & Weller. It was conservatively chosen as a representative background monitor for the site based on its proximity to the site and because it has the highest design value in Washington State.

³ Monitor value comes from monitor 53-061-1007 at Marysville High School and was chosen as a representative background monitor for the site based on its proximity to the site and similar land use.

The modelling results indicate that the model predicted impacts from the new turbine are either below the SIL, or not in violation of the NAAQS standard. Therefore, the proposed turbine is in compliance with the NAAQS and no further analysis is required.

6.2.2 FORMALDEHYDE (TAP) MODEL RESULTS

Model results for the TAP HCHO are shown in Table 8 and compared to its respective ASIL.

TABLE 7 TAP MODEL RESULTS

TAP	Averaging Period	Rank	Maximum AERMOD Concentration ($\mu\text{g}/\text{m}^3$)	ASIL	% of Criteria
Formaldehyde (HCHO)	Annual	H1H	0.00418	0.17 ¹	2.46

¹ The ASIL for HCHO is defined in WAC 173-460-150.

Model Results indicate that impacts from HCHO from the new turbine would be far below the ASIL. Therefore, results are considered acceptable in Washington State and no further analysis is required.



APPENDIX A FORMS



1600 South Second Street
 Mount Vernon, WA 98273-5202
 ph 360-428-1617
 fax 360-428-1620
 info@nwcleanairwa.gov
 www.nwcleanairwa.gov

General Permit Application

SECTION A:

1. Facility information:

Facility name: <u>Sumas Compressor Station</u>	Facility owner: <u>Northwest Pipeline, LLC</u>
Owner agent: <u>N/A</u>	Contact person: <u>Kirsten Derr</u>
Contact phone: <u>303-475-0989</u>	Contact email: <u>kirsten.derr@williams.com</u>
Facility address: <u>4738 Jones Road</u>	
City: <u>Sumas</u>	State: <u>WA</u> ZIP: <u>98295</u>
Mailing/Billing address (if different): _____	
City: _____	State: _____ ZIP: _____
Desired start of construction: _____	
Facility NAICS code: <u>486210</u>	

2. Fee: Permit filing fee of \$1,479. NWCAA will invoice you for any additional fees according to the NWCAA [permit fee schedule](#).

3. SEPA environmental checklist: If another agency has issued a SEPA determination for this project include a copy of the determination instead.

4. Type of project: Is this an approval for new equipment? Yes No

OR Is this a permit revision to a current NWCAA permit? Yes No If yes, include the NWCAA permit number: _____

5. Describe the project: Include a list of process equipment and any proposed air pollution controls:

Include equipment capacity (i.e. lb wood/ hr for a chipper)

This project will replace one existing turbine with one new turbine. All equipment at the site (existing and new) is fired on natural gas.

Will equipment vent through a stack? Yes No

If yes, include the following: Stack diameter (ft): 10.8 Stack flow rate (cfm): 203,836 Stack temperature (°F): 865

How far will stack extend above building? (ft): 63.1 Discharge orientation: Vertical Horizontal

NWCAA Office Use Only

NOC No.: _____ SEPA checklist date: _____
 Fee received: _____ New source? Yes No
 Date received: _____ If yes: Added to Stratus database
 Receipt No.: _____ Created digital folder

Notes



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 fax 360-428-1620
 info@nwcleanairwa.gov
 www.nwcleanairwa.gov

General Permit Application

SECTION B: Specific equipment.

If your project fits one of the following, fill out the appropriate application (link below) and attach it. Then skip to Section D.

[Baghouse Cartridge-type](#) [Gas station Stage I & II](#) [Gas station Stage II removal](#) [Rock crusher](#) [Spray coating operation](#)

SECTION C: If you provided specific equipment form Section B, Skip this section.

- 1. Calculate and attach mass emission rate increases (and stack concentrations, if available) for all air pollutants (e.g., NO_x, SO₂, VOC, CO, PM_{2.5}, PM₁₀, toxic pollutants, hazardous air pollutants) due to the project for comparison against minor NSR and PSD applicability thresholds.
- 2. Attach a description of why the proposed air pollution emission control strategy is the best available for the process at the time of application submittal. This can take the form of a written explanation or, for larger projects, a top-down best available control technology analysis (BACT).
- 3. Attach an ambient impact analysis for the project.
- 4. List of all federal regulations that would apply to the project, ([NSPS](#), [NESHAP](#), and [MACT](#)). Attach pages if needed.

See attached report.

SECTION D: Signature

I certify, based on information and belief formed after reasonable inquiry, the statements and information in this application are true, accurate and complete.

By [NWCAA Regulation 300.1](#), construction cannot begin until after permit has been issued.

Kirsten Derr
 Applicant name or authorized representative

Environmental Specialist
 Title

Signed by:

 Signature

5/9/2025 | 3:46 PM CDT
 Date

If you have any questions or need assistance please do not hesitate to call us at 360-428-1617.

Print Form



APPENDIX B EMISSIONS CALCULATIONS

Northwest Pipeline LLC
Sumas Compressor Station
 Notice of Intent to Construct Application

Solar Mars 100 Specific SQER Evaluation

Pollutant	CAS #	TAP?	SQER (lbs/yr)	SQER (lbs/24-hr)	SQER (lbs/hr)	ASIL (µg/m3)	PTE Estimates			Tier 1 Review (pass/model)	Model Results (µg/m3)	AERMODRe view (pass/fail)
							(lbs/hr)	(lbs/24-hr)	(lbs/yr)			
1,3-Butadiene	106-99-0	✓	5.40	-	-	0.03	6E-05	1E-03	0.54	pass	-	-
Acetaldehyde	75-07-0	✓	60.00	-	-	0.37	0.01	0.14	50.42	pass	-	-
Acrolein	107-02-8	✓	-	0.03	-	0.35	9E-04	0.02	8.07	pass	-	-
Benzene	71-43-2	✓	21.00	-	-	0.13	2E-03	0.04	15.13	pass	-	-
Ethylbenzene	100-41-4	✓	65.00	-	-	0.40	5E-03	0.11	40.34	pass	-	-
Formaldehyde	50-00-0	✓	27.00	-	-	0.17	0.03	0.73	264.72	model	0.0042	pass
Methyl alcohol (methanol)	67-56-1	✓	-	1500.00	-	20000.00	0E+00	0E+00	0.00	pass	-	-
n-Hexane	110-54-3	✓	-	52.00	-	700.00	0E+00	0E+00	0.00	pass	-	-
Toluene	108-88-3	✓	-	370.00	-	5000.00	0.02	0.45	163.88	pass	-	-
Xylenes	1330-20-7	✓	-	16.00	-	220.00	9E-03	0.22	80.68	pass	-	-

Northwest Pipeline LLC
Sumas Compressor Station
 Notice of Intent to Construct Application

Controlled PTE in TPY ¹

Source ID	Status	Description	Criteria Pollutants			HAP		GHG
			NOX tpy	CO tpy	VOC ² tpy	HCHO ³ tpy	Tot HAP ⁴ tpy	CO2e ⁵ tpy
Existing Equipment								
7 C-Plant	Existing	Compressor Turbine Solar Mars 90	42.31	66.57	3.59	0.09	0.24	52,039
8 C-Plant	Existing	Compressor Turbine Solar Mars 90	42.31	66.57	3.59	0.09	0.24	52,039
10 D-Plant	Existing	Compressor Turbine Solar Mars 100S	20.52	37.00	4.32	1.63	1.81	67,030
12 C-Plant	Existing	Caterpillar 3412 Emergency Generator	2.11	3.54	0.03	0.02	0.03	112
CATHTR	Existing	Catalytic Heaters (Insignificant Sources)	0.69	0.58	0.04	<0.01	0.01	886
TKS	Existing	Tanks (Insignificant Sources)	---	---	<0.01	---	<0.01	---
TSS	Existing	Compressor Turbine Start/Stop (4 Units)	Turbine Start/Stop (TSS) is Included in Compressor Turbine (7,8,9,X)					
SG	Existing	Compressor Turbine Start Gas (2 Units)	---	---	0.02	---	<0.01	10
DGS	Existing	Centrifugal Compressor Dry Gas Seal Leaks	---	---	27.18	---	0.40	10,986
BD	Existing	Blowdowns	---	---	0.41	---	<0.01	162
PNE	Existing	Pneumatic Devices	---	---	0.49	---	<0.01	197
PIG	Existing	Pigging Operations (2 Units)	---	---	0.67	---	<0.01	272
FUG ⁶	Existing	Piping and Equipment Leaks - Gas	---	---	2.70	---	0.04	1,091
Equipment Proposed to be Removed								
9 D-Plant	Remove	Compressor Turbine Solar Mars 90	42.31	66.57	3.59	0.09	0.24	52,039
11 D-Plant	Remove	Waukesha VGF-P48SE Emergency Generator	1.63	3.25	0.81	0.07	0.10	376
⁷ CURRENT TOTAL PTE:			151.87	244.09	44.73	2.00	3.15	236,145
Equipment Proposed to be Added								
11 D-Plant	New	Cummins QSK60G Emergency Generator	1.08	2.15	0.75	0.02	0.03	112
X D-Plant	New	Compressor Turbine Solar Mars 100S	20.56	37.00	4.32	0.13	0.34	74,410
⁸ PROPOSED TOTAL PTE:			129.57	213.42	45.41	1.99	3.17	258,252
Lesser of NSR, HAP, GHG, and TVOP Thresholds:			100	100	100	10	25	na
TOTAL PTE DIFFERENCES:			-22.30	-30.67	+0.68	-0.01	+0.02	+22,107

- Notes: 1 - Emissions are based on operation at 100% of rated load for 8,760 hrs/yr, except TSS, BD and PIG which are intermittent.
 2 - VOC is volatile organic compounds, as defined by EPA, and includes HCHO (formaldehyde).
 3 - HCHO is formaldehyde and is the individual HAP with the highest PTE.
 4 - Total HAP includes, but not limited to, HCHO (formaldehyde), n-hexane, BTEX (benzene, toluene, ethylbenzene, xylene), 2,2,4-TMP (i-octane), acetaldehyde, acrolein, and MeOH.
 5 - CO2e is aggregated Greenhouse Gas (GHG), comprised of carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O), as adjusted for Global Warming Potential (GWP).
 6 - Current Total PTE = Existing Equipment + Equipment Proposed to be Removed
 7 - Proposed Total PTE = Existing Equipment + Equipment Proposed to be Added
 8 - The current and proposed total PTE excludes fugitive emissions per WAC 173-401-200(19)(b) as fugitive emissions at transmission storage compressor stations are not a source category.

Northwest Pipeline LLC
Sumas Compressor Station
 Notice of Intent to Construct Application

Criteria Pollutants - Controlled¹

Source ID	Status	Description	Site Rating	NOX		CO		VOC		SO2		PM10/2.5	
				lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy
Existing Equipment													
7 C-Plant	Existing	Compressor Turbine Solar Mars 90	12,841 bhp (0oF)	9.60	42.31	14.00	66.57	0.70	3.59	0.06	0.26	1.01	4.41
8 C-Plant	Existing	Compressor Turbine Solar Mars 90	12,841 bhp (0oF)	9.60	42.31	14.00	66.57	0.70	3.59	0.06	0.26	1.01	4.41
10 D-Plant	Existing	Compressor Turbine Solar Mars 100S	17,022 bhp (0oF)	4.66	20.52	7.89	37.00	0.90	4.32	0.08	0.33	0.86	3.76
12 C-Plant	Existing	Caterpillar 3412 Emergency Generator	600 bhp	8.42	2.11	14.17	3.54	0.11	0.03	<0.01	<0.01	0.07	0.02
CATHTR	Existing	Catalytic Heaters (Insignificant Sources)	24 Units	0.16	0.69	0.13	0.58	<0.01	0.04	<0.01	<0.01	0.01	0.05
TKS	Existing	Tanks (Insignificant Sources)	4 Units	---	---	---	---	<0.01	<0.01	---	---	---	---
TSS	Existing	Compressor Turbine Start/Stop (4 Units)	104 Ev/yr/turbine	Turbine Start/Stop (TSS) is Included in Compressor Turbine (7,8,9,X)									
SG	Existing	Compressor Turbine Start Gas (2 Units)	208 Total starts	---	---	---	---	---	0.02	---	---	---	---
DGS	Existing	Centrifugal Compressor Dry Gas Seal Leaks	---	---	---	---	---	6.20	27.18	---	---	---	---
BD	Existing	Blowdowns	121 events/yr	---	---	---	---	6.76	0.41	---	---	---	---
PNE	Existing	Pneumatic Devices	17 Units	---	---	---	---	0.11	0.49	---	---	---	---
PIG	Existing	Pigging Operations (2 Units)	14 events/yr	---	---	---	---	0.15	0.67	---	---	---	---
FUG ²	Existing	Piping and Equipment Leaks - Gas	4,334 Units	---	---	---	---	0.62	2.70	---	---	---	---
Equipment Proposed to be Removed													
9 D-Plant	Remove	Compressor Turbine Solar Mars 90	12,841 bhp (0oF)	9.60	42.31	14.00	66.57	0.70	3.59	0.06	0.26	1.01	4.41
11 D-Plant	Remove	Waukesha VGF-P48SE Emergency Generator	1,475 bhp	6.50	1.63	13.01	3.25	3.25	0.81	<0.01	<0.01	0.25	0.06
³ CURRENT TOTAL PTE:				48.54	151.87	77.20	244.09	19.60	44.73	0.26	1.12	4.21	17.12
Equipment Proposed to be Added													
11 D-Plant	New	Cummins QSK60G Emergency Generator	1,953 bhp	4.31	1.08	8.61	2.15	3.01	0.75	<0.01	<0.01	0.13	0.03
X D-Plant	New	Compressor Turbine Solar Mars 100S	17,549 bhp (0oF)	4.67	20.56	7.89	37.00	0.90	4.32	0.08	0.37	0.95	4.18
⁴ PROPOSED TOTAL PTE:				41.42	129.57	66.70	213.42	19.57	45.41	0.29	1.23	4.04	16.86
Title V Major Source Thresholds:				100		100		100		100		100	
TOTAL PTE DIFFERENCES:				-7.13	-22.30	-10.51	-30.67	-0.03	+0.68	+0.03	+0.11	-0.17	-0.26

- Notes: 1 - The emissions shown are based on operation at 100% of rated load for 8,760 hr/yr (including TSS, CBD, TLO, and PIG which are intermittent).
 2 - The current and proposed total PTE excludes fugitive emissions per WAC 173-401-200(19)(b) as fugitive emissions at transmission storage compressor stations are not a source category.
 3 - Current Total PTE = Existing Equipment + Equipment Proposed to be Removed
 4 - Proposed Total PTE = Existing Equipment + Equipment Proposed to be Added

Northwest Pipeline LLC
Sumas Compressor Station
 Notice of Intent to Construct Application

Hazardous Air Pollutants (HAP) - Controlled - 01 of 02¹

Source ID	Status	Description	Site Rating	Acetaldehyde		Acrolein		Benzene		Butadiene, 1,3-		Ethylbenzene		HCHO		n-Hexane		
				lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr
Existing Equipment																		
7 C-Plant	Existing	Compressor Turbine Solar Mars 90	12,841 bhp (0oF)	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.01	0.02	0.09	0.11	<0.01	
8 C-Plant	Existing	Compressor Turbine Solar Mars 90	12,841 bhp (0oF)	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.01	0.02	0.09	0.11	<0.01	
10 D-Plant	Existing	Compressor Turbine Solar Mars 100S	17,022 bhp (0oF)	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.37	1.63	---	---	
12 C-Plant	Existing	Caterpillar 3412 Emergency Generator	600 bhp	0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.08	0.02	---	---	
CATHTR	Existing	Catalytic Heaters (Insignificant Sources)	24 Units	---	---	---	---	<0.01	<0.01	---	---	---	---	<0.01	<0.01	<0.01	0.01	
TKS	Existing	Tanks (Insignificant Sources)	4 Units	---	---	---	---	<0.01	<0.01	---	---	<0.01	<0.01	---	---	<0.01	<0.01	
TSS	Existing	Compressor Turbine Start/Stop (4 Units)	104 Ev/yr/turbine	Turbine Start/Stop (TSS) is Included in Compressor Turbine (7,8,9,X)														
SG	Existing	Compressor Turbine Start Gas (3 Units)	312 Total starts	---	---	---	---	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	---	---	<0.01	<0.01	
DGS	Existing	Centrifugal Compressor Dry Gas Seal Leaks	---	---	---	---	---	<0.01	0.02	---	---	<0.01	0.02	---	---	0.07	0.29	
BD	Existing	Blowdowns	121 events/yr	---	---	---	---	<0.01	<0.01	---	---	<0.01	<0.01	---	---	0.07	<0.01	
PNE	Existing	Pneumatic Devices	17 Units	---	---	---	---	<0.01	<0.01	---	---	<0.01	<0.01	---	---	<0.01	<0.01	
PIG	Existing	Pigging Operations (2 Units)	14 events/yr	---	---	---	---	<0.01	<0.01	---	---	<0.01	<0.01	---	---	<0.01	<0.01	
FUG ²	Existing	Piping and Equipment Leaks - Gas	4,334 Units	---	---	---	---	<0.01	<0.01	---	---	<0.01	<0.01	---	---	<0.01	0.03	
Equipment Proposed to be Removed																		
9 D-Plant	Remove	Compressor Turbine Solar Mars 90	12,841 bhp (0oF)	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.01	0.02	0.09	0.11	<0.01	
11 D-Plant	Remove	Waukesha VGF-P48SE Emergency Generator	1,475 bhp	0.04	<0.01	0.03	<0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	0.26	0.07	---	---	
³ CURRENT TOTAL PTE:				0.06	0.09	0.05	0.02	0.06	0.05	0.01	<0.01	0.05	0.08	0.78	2.00	0.48	0.37	
Equipment Proposed to be Added																		
11 D-Plant	New	Cummins QSK60G Emergency Generator	1,953 bhp	0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.08	0.02	---	---	
X D-Plant	New	Compressor Turbine Solar Mars 100S	17,549 bhp (0oF)	<0.01	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.03	0.13	<0.01	<0.01	
⁴ PROPOSED TOTAL PTE:				0.04	0.09	0.02	0.02	0.04	0.05	<0.01	<0.01	0.04	0.09	0.60	1.99	0.37	0.37	
Title V Major Source Thresholds:				na		na		na		na		na		na		na		
TOTAL PTE DIFFERENCES:				-0.02	+<0.01	-0.02	<-0.01	-0.02	<-0.01	<-0.01	<-0.01	-0.01	+0.01	-0.18	-0.01	-0.11	<-0.01	

- Notes: 1 - The emissions shown are based on operation at 100% of rated load for 8,760 hr/yr (including TSS, CBD, TLO, and PIG which are intermittent).
 2 - For Title V purposes, all fugitive emissions of hazardous air pollutants are to be considered in determining whether a stationary source is a major source according to the EPA, 22.100(455B)Definitions for Title V Operating Permits.
 3 - Current Total PTE = Existing Equipment + Equipment Proposed to be Removed
 4 - Proposed Total PTE = Existing Equipment + Equipment Proposed to be Added

Northwest Pipeline LLC
Sumas Compressor Station
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Hazardous Air Pollutants (HAP) - Controlled - 02 of 02¹

Source ID	Status	Description	Site Rating	Methanol		POM		Toluene		TMP, 2,2,4-		Xylenes		Other HAP		TOTAL HAPs	
				lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy
Existing Equipment																	
7 C-Plant	Existing	Compressor Turbine Solar Mars 90	12,841 bhp (0oF)	<0.01	<0.01	<0.01	<0.01	0.02	0.06	<0.01	<0.01	0.01	0.03	<0.01	0.01	0.19	0.24
8 C-Plant	Existing	Compressor Turbine Solar Mars 90	12,841 bhp (0oF)	<0.01	<0.01	<0.01	<0.01	0.02	0.06	<0.01	<0.01	0.01	0.03	<0.01	0.01	0.19	0.24
10 D-Plant	Existing	Compressor Turbine Solar Mars 100S	17,022 bhp (0oF)	<0.01	<0.01	<0.01	<0.01	0.02	0.07	<0.01	<0.01	<0.01	0.04	<0.01	0.02	0.41	1.81
12 C-Plant	Existing	Caterpillar 3412 Emergency Generator	600 bhp	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	---	---	<0.01	<0.01	<0.01	<0.01	0.12	0.03
CATHTR	Existing	Catalytic Heaters (Insignificant Sources)	24 Units	---	---	<0.01	<0.01	<0.01	<0.01	---	---	---	---	<0.01	<0.01	<0.01	0.01
TKS	Existing	Tanks (Insignificant Sources)	4 Units	<0.01	<0.01			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			<0.01	<0.01
TSS	Existing	Compressor Turbine Start/Stop (4 Units)	104 Ev/yr/turbine	Turbine Start/Stop (TSS) is Included in Compressor Turbine (7,8,9,X)													
SG	Existing	Compressor Turbine Start Gas (3 Units)	312 Total starts	---	---	---	---	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	---	---	<0.01	<0.01
DGS	Existing	Centrifugal Compressor Dry Gas Seal Leaks	---	<0.01	<0.01	---	---	<0.01	0.02	<0.01	0.02	<0.01	0.02	---	---	0.09	0.40
BD	Existing	Blowdowns	121 events/yr	<0.01	<0.01	---	---	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	---	---	0.10	<0.01
PNE	Existing	Pneumatic Devices	17 Units	<0.01	<0.01	---	---	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	---	---	<0.01	<0.01
PIG	Existing	Pigging Operations (2 Units)	14 events/yr	<0.01	<0.01	---	---	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	---	---	<0.01	<0.01
FUG ²	Existing	Piping and Equipment Leaks - Gas	4,334 Units	<0.01	<0.01	---	---	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	---	---	<0.01	0.04
Equipment Proposed to be Removed																	
9 D-Plant	Remove	Compressor Turbine Solar Mars 90	12,841 bhp (0oF)	<0.01	<0.01	<0.01	<0.01	0.02	0.06	<0.01	<0.01	0.01	0.03	<0.01	0.01	0.19	0.24
11 D-Plant	Remove	Waukesha VGF-P48SE Emergency Generator	1,475 bhp	0.04	<0.01	<0.01	<0.01	<0.01	<0.01	---	---	<0.01	<0.01	<0.01	<0.01	0.42	0.10
³ CURRENT TOTAL PTE:				0.06	0.02	<0.01	0.01	0.09	0.27	0.03	0.02	0.06	0.15	0.02	0.06	1.73	3.15
Equipment Proposed to be Added																	
11 D-Plant	New	Cummins QSK60G Emergency Generator	1,953 bhp	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	---	---	<0.01	<0.01	<0.01	<0.01	0.12	0.03
X D-Plant	New	Compressor Turbine Solar Mars 100S	17,549 bhp (0oF)	<0.01	<0.01	<0.01	<0.01	0.02	0.08	<0.01	<0.01	<0.01	0.04	<0.01	0.02	0.08	0.34
⁴ PROPOSED TOTAL PTE:				0.03	0.02	<0.01	0.01	0.09	0.30	0.02	0.02	0.05	0.16	0.02	0.06	1.33	3.17
Title V Major Source Thresholds:				na		na		na		na		na		na		na	
TOTAL PTE DIFFERENCES:				-0.03	<0.01	<0.01	+<0.01	<0.01	+0.02	-0.01	<0.01	<0.01	+0.01	<0.01	+<0.01	-0.41	+0.02

- Notes: 1 - The emissions shown are based on operation at 100% of rated load for 8,760 hr/yr (including TSS, CBD, TLO, and PIG which are intermittent).
 2 - For Title V purposes, all fugitive emissions of hazardous air pollutants are to be considered in determining whether a stationary source is a major source according to the EPA, 22.100(455B) *Definitions for Title V Operating Permits*.
 3 - Current Total PTE = Existing Equipment + Equipment Proposed to be Removed
 4 - Proposed Total PTE = Existing Equipment + Equipment Proposed to be Added

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Sumas Compressor Station
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Greenhouse Gas Pollutants (GHG) - Controlled¹

Source ID	Status	Description	Site Rating	Heat Input MMBtu/hr (HHV)	Hours of Operation hr/yr	CO2 GWP: tpy	CO2e 1 tpy	CH4 GWP: tpy	CO2e 28 tpy	N2O GWP: tpy	CO2e 265 tpy	TOTAL CO2e lb/hr* tpy	
Existing Equipment													
7 C-Plant	Existing	Compressor Turbine Solar Mars 90	12,841 bhp (0oF)	101	8,760	51,633	51,633	14	380	0.1	26	11,881	52,039
8 C-Plant	Existing	Compressor Turbine Solar Mars 90	12,841 bhp (0oF)	101	8,760	51,633	51,633	14	380	0.1	26	11,881	52,039
10 D-Plant	Existing	Compressor Turbine Solar Mars 100S	17,022 bhp (0oF)	130	8,760	66,411	66,411	17	480	0.1	33	15,304	67,030
12 C-Plant	Existing	Caterpillar 3412 Emergency Generator	600 bhp	3.8	500	111	111	<0.01	<0.1	<0.01	0.1	25	112
CATHTR	Existing	Catalytic Heaters (Insignificant Sources)	24 Units	1.7	8,760	202	885	<0.01	0.02	<0.01	<0.01	202	886
TKS	Existing	Tanks (Insignificant Sources)	4 Units	---	8,760	---	---	---	---	---	---	---	---
TSS	Existing	Compressor Turbine Start/Stop (4 Units)	104 Ev/yr/turbine	Turbine Start/Stop (TSS) is Included in Compressor Turbine (7,8,9,X)									
SG	Existing	Compressor Turbine Start Gas (3 Units)	312 Total starts	---	---	<0.1	<0.1	0.3	10	---	---	2.2	10
DGS	Existing	Centrifugal Compressor Dry Gas Seal Leaks	---	---	---	3.4	3.4	392	10,982	---	---	2,508	10,986
BD	Existing	Blowdowns	121 events/yr	---	---	0.1	0.1	5.9	165	---	---	37	162
PNE	Existing	Pneumatic Devices	17 Units	---	8,760	0.1	0.1	7.0	197	---	---	45	197
PIG	Existing	Pigging Operations (2 Units)	14 events/yr	---	8,760	0.1	0.1	9.7	272	---	---	62	272
FUG ²	Existing	Piping and Equipment Leaks - Gas	4,334 Units	---	8,760	0.3	0.3	39	1,090	---	---	249	1,091
Equipment Proposed to be Removed													
9 D-Plant	Remove	Compressor Turbine Solar Mars 90	12,841 bhp (0oF)	101	8,760	51,633	51,633	14	380	0.1	26	11,881	52,039
11 D-Plant	Remove	Waukesha VGF-P48SE Emergency Generator	1,475 bhp	12.8	500	376	376	<0.01	0.20	<0.01	0.19	1,504	376
³ CURRENT TOTAL PTE:						222,003	222,686	473.0	13,245	0.4	110.7	55,332	236,145
Equipment Proposed to be Added													
11 D-Plant	New	Cummins QSK60G Emergency Generator	1,953 bhp	13.1	500	111	111	<0.01	<0.1	<0.01	0.1	25	112
X D-Plant	New	Compressor Turbine Solar Mars 100S	17,549 bhp (0oF)	144	8,760	73,788	73,788	17	480	0.1	37	16,989	74,410
⁴ PROPOSED TOTAL PTE:						243,894	244,577	476.6	13,345	0.5	121.6	58,962	258,252
Title V Major Source Thresholds:						na	na	na	na	na	na	na	na
TOTAL PTE DIFFERENCES:						+21,891	+21,891	+3.57	+99.93	+0.04	+10.93	+3,630	+22,107

- Notes: 1 - The emissions shown are based on operation at 100% of rated load for 8,760 hr/yr (including TSS, CBD, TLO, and PIG which are intermittent).
 2 - The current and proposed total PTE excludes fugitive emissions per WAC 173-401-200(19)(b) as fugitive emissions at transmission storage compressor stations are not a source category.
 3 - Current Total PTE = Existing Equipment + Equipment Proposed to be Removed
 4 - Proposed Total PTE = Existing Equipment + Equipment Proposed to be Added

Northwest Pipeline LLC
Sumas Compressor Station
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Criteria Pollutants - Pre-Controlled

Source ID	Status	Description	Site Rating	NOX		CO		VOC		HCHO		TOTAL HAPs		CO2e	
				lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy
Existing Equipment															
7 C-Plant	Existing	Compressor Turbine Solar Mars 90	12,841 bhp (0oF)	9.60	42.31	14.00	66.57	0.70	3.59	0.02	0.09	0.19	0.24	13,763	52,039
8 C-Plant	Existing	Compressor Turbine Solar Mars 90	12,841 bhp (0oF)	9.60	42.31	14.00	66.57	0.70	3.59	0.02	0.09	0.19	0.24	13,763	52,039
10 D-Plant	Existing	Compressor Turbine Solar Mars 100S	17,022 bhp (0oF)	4.66	20.52	7.89	37.00	0.90	4.32	0.37	1.63	0.41	1.81	15,258	67,030
12 C-Plant	Existing	Caterpillar 3412 Emergency Generator	600 bhp	8.42	2.11	14.17	3.54	0.11	0.03	0.08	0.02	0.12	0.03	446	112
CATHTR	Existing	Catalytic Heaters (Insignificant Sources)	24 Units	0.16	0.69	0.13	0.58	0.01	0.04	<0.01	<0.01	<0.01	0.01	202	886
TKS	Existing	Tanks (Insignificant Sources)	4 Units	---	---	---	---	<0.01	<0.01	---	---	---	---	---	---
TSS	Existing	Compressor Turbine Start/Stop (4 Units)	104 Ev/yr/turbine	Turbine Start/Stop (TSS) is Included in Compressor Turbine (7,8,9,X)											
SG	Existing	Compressor Turbine Start Gas (3 Units)	312 Total starts	---	---	---	---	---	0.02	---	---	---	---	2.2	10
DGS	Existing	Centrifugal Compressor Dry Gas Seal Leaks	---	---	---	---	---	6.20	27.18	---	---	0.09	0.40	2,508	10,986
BD	Existing	Blowdowns	121 events/yr	---	---	---	---	6.76	0.41	---	---	0.10	0.01	2,676	162
PNE	Existing	Pneumatic Devices	17 Units	---	---	---	---	0.00	0.00	---	---	0.00	0.00	0	0
PIG	Existing	Pigging Operations (2 Units)	14 events/yr	---	---	---	---	0.15	0.67	---	---	0.00	0.01	62	272
FUG ²	Existing	Piping and Equipment Leaks - Gas	4,334 Units	---	---	---	---	0.00	0.00	---	---	0.01	0.04	222	1,091
Equipment Proposed to be Removed															
9 D-Plant	Remove	Compressor Turbine Solar Mars 90	12,841 bhp (0oF)	9.60	42.31	14.00	66.57	0.70	3.59	0.02	0.09	0.19	0.24	11,859	51,943
11 D-Plant	Remove	Waukesha VGF-P48SE Emergency Generator	1,475 bhp	6.50	1.63	13.01	3.25	3.25	0.81	0.26	0.07	0.42	0.10	1,504	376
³ CURRENT TOTAL PTE:				48.54	151.87	77.20	244.09	19.49	44.24	0.78	2.00	1.72	3.10	62,043	235,853
Equipment Proposed to be Added															
11 D-Plant	New	Cummins QSK60G Emergency Generator	1,953 bhp	4.31	1.08	8.61	2.15	3.01	0.75	0.69	0.17	0.00	0.00	1,530	383
X D-Plant	New	Compressor Turbine Solar Mars 100S	17,549 bhp (0oF)	4.67	20.56	7.89	37.00	0.90	4.32	0.03	0.13	0.08	0.34	16,943	74,410
⁴ PROPOSED TOTAL PTE:				41.42	129.57	66.70	213.42	19.46	44.92	1.21	2.14	1.20	3.09	67,153	258,327
Title V Major Source Thresholds:				100		100		100		na		na		na	
TOTAL PTE DIFFERENCES:				-7.13	-22.30	-10.51	-30.67	-0.03	+0.68	+0.44	+0.15	-0.53	-0.01	+5,110	+22,474

- Notes: 1 - The emissions shown are based on operation at 100% of rated load for 8,760 hr/yr (including TSS, CBD, TLO, and PIG which are intermittent).
 2 - The current and proposed total PTE excludes fugitive emissions per WAC 173-401-200(19)(b) as fugitive emissions at transmission storage compressor stations are not a source category.
 3 - Current Total PTE = Existing Equipment + Equipment Proposed to be Removed
 4 - Proposed Total PTE = Existing Equipment + Equipment Proposed to be Added

Northwest Pipeline LLC
Sumas Compressor Station
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Compressor Turbine (Mars 100-16000S) Emissions

Source ID	Description	Reference	Pollutant	Pre-Controlled Emissions			Control Efficiency	Controlled Emissions w/o TSS		Controlled Emissions w/ TSS	
				lb/MMBtu	lb/hr (0°F)	tpy (0°F)		lb/hr (0°F)	tpy (0°F)	lb/hr (0°F)	tpy (0°F)
X D-Plant (new)	Compressor Turbine	Solar Exhaust Analysis	NOx (9 ppm)	---	4.67	20.45	---	4.67	20.45	4.67	20.56
		Solar Exhaust Analysis	CO (25 ppm)	---	7.89	34.56	---	7.89	34.56	7.89	37.00
	Solar Mars 100-16000S	Solar Exhaust Analysis	UHC	---	4.52	19.80	---	4.52	19.80	3.62	17.14
		Solar Exhaust Analysis	VOC (UHC*20%)	---	0.90	3.96	---	0.90	3.96	0.90	4.32
	17,549 bhp (Max @ 0 oF)	AP-42 Table 3.1-2a	SO2	5.9E-04	0.08	0.37	---	0.08	0.37	0.08	0.37
		AP-42 Table 3.1-2a	PM10/2.5	6.6E-03	0.95	4.18	---	0.95	4.18	0.95	4.18
	8,760 hr/yr	AP-42 Table 3.1-3	Acetaldehyde	4.0E-05	6E-03	0.03	---	6E-03	0.03	6E-03	0.03
		AP-42 Table 3.1-3	Acrolein	6.4E-06	9E-04	4E-03	---	9E-04	4E-03	9E-04	4E-03
	9,390 rpm (Max @ 0 oF)	AP-42 Table 3.1-3	Benzene	1.2E-05	2E-03	8E-03	---	2E-03	8E-03	2E-03	8E-03
		AP-42 Table 3.1-3	Butadiene, 1,3-	4.3E-07	6E-05	3E-04	---	6E-05	3E-04	6E-05	3E-04
	Manufactured ≥ 02/18/05 NSPS KKKK Affected	AP-42 Table 3.1-3	Ethylbenzene	3.2E-05	5E-03	0.02	---	5E-03	0.02	5E-03	0.02
		Vendor Data (PIL 168)	Formaldehyde	2.1E-04	0.03	0.13	---	0.03	0.13	0.03	0.13
	865 Exhaust Temp (0 oF)	AP-42 Table 3.1-3	n-Hexane	---	---	---	---	---	---	0E+00	4E-03
		AP-42 Table 3.1-3	Methanol	---	---	---	---	---	---	0E+00	8E-06
	366,331 Exhaust Flow (lbm/hr)	AP-42 Table 3.1-3	POM/PAH	3.5E-06	5E-04	0.00	---	5E-04	0.00	5E-04	2E-03
		AP-42 Table 3.1-3	Toluene	1.3E-04	0.02	0.08	---	0.02	0.08	0.02	0.08
	7,380 Btu/bhp-hr (LHV)	AP-42 Table 3.1-3	TMP, 2,2,4-	---	---	---	---	---	---	0E+00	3E-04
		AP-42 Table 3.1-3	Xylenes	6.4E-05	9E-03	0.04	---	9E-03	0.04	9E-03	0.04
	143.90 MMBtu/hr (Max @ 0oF)	AP-42 Table 3.1-3	Other/Trace HAP	2.9E-05	4E-03	0.02	---	4E-03	0.02	4E-03	0.02
		Sum	Total HAP	5.3E-04	0.08	0.33	---	0.08	0.33	0.08	0.34
131,297 scf/hr (Max @ 0oF)	GHGRP Table C-1	CO2 (GWP=1)	117	16,833	73,729	---	16,833	73,729	16,833	73,788	
	GHGRP Table C-2	CH4 (GWP=28)	2.2E-03	3.62	15.84	---	3.62	15.84	3.62	17.14	
1,096 Btu/scf (HHV)	GHGRP Table C-2	N2O (GWP=265)	2.2E-04	0.03	0.14	---	0.03	0.14	0.03	0.14	
	Weighted Sum	CO2e	117	16,943	74,209	---	16,943	74,209	16,943	74,410	

- Notes:
- 1 - The emissions shown are based on operation at 100% of rated load for 8,760 hr/yr.
 - 2 - PM10/2.5 is filterable and condensable particulate matter; including PM10 and PM2.5
 - 3 - "Other/Trace HAPs" includes: Carbon Tetrachloride, Chlorobenzene, Chloroform, Dichloropropene, 1,3-Dichloropropene, Ethylene Dibromide, Methylene Chloride, Phenol, Propylene Oxide, Styrene, 1,1,2,2-Tetrachloroethane, 1,1,2-Trichloroethane, and Vinyl Chloride (as per AP-42).
 - 4 - Total VOC, HCHO, HAP and CO2e emissions include Compressor Turbine Operations (X), Compressor Turbine Start+Stop (TSS)
 - 5 - The fuel heating value will vary, 1,096 Btu/scf (HHV) is at the low end of the range and results in a high (conservative) fuel consumption estimate.
 - 6 - The AP-42 EFs are based on HHV while Solar data is based on LHV. The Solar data has been adjusted by assuming LHV is 90% of HHV.
 - 7 - GHG emission factors used are the same as GHG emission factors used for Washington's Cap and Trade: GHG Reporting Factors from Code of Federal Regulations Title 40 Part 98 Subpart C. <https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-98/subpart-C>
 - 8 - Solar Exhaust Analysis is based on manufacturer performance specifications for this Solar Mars 100-16000S. See Appendix E - Equipment Manufacturer Specifications.
 - 9 - Formaldehyde emission factor is taken from Solar Product Information Letter (PIL) 168. See Appendix E- Equipment Manufacturer Specifications.

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Compressor Turbine (Mars 90) Emissions

Source ID	Description	Reference	Pollutant	Pre-Controlled Emissions			Control Efficiency	Controlled Emissions w/o TSS		Controlled Emissions w/ TSS	
				lb/MMBtu	lb/hr (0°F)	tpy (0°F)		lb/hr (0°F)	tpy (0°F)	lb/hr (0°F)	tpy (0°F)
7 C-Plant 8 C-Plant 9 D-Plant (removal)	Mars 90 S	Permit Limit	NOx (25 ppm)	---	9.60	42.05	---	9.60	42.05	9.60	42.31
		Permit Limit	CO (50 ppm)	---	14.00	61.32	---	14.00	61.32	14.00	66.57
	Solar Mars 90-13000S	Vendor Data	UHC	---	3.50	15.33	---	3.50	15.33	30	13.56
		Vendor Data (PIL 168)	VOC (UHC*20%)	---	0.70	3.07	---	0.70	3.07	0.70	3.59
	12,841 bhp (Max @ 0oF)	AP-42 Table 3.1-2a	SO2	5.9E-04	0.06	0.26	---	0.06	0.26	0.06	0.26
		Vendor Data (PIL 171)	PM10/2.5	0.01	1.01	4.41	---	1.01	4.41	1.01	4.41
	8,760 hr/yr	AP-42 Table 3.1-3	Acetaldehyde	4.0E-05	4E-03	0.02	---	4E-03	0.02	4E-03	0.02
	8,959 rpm (Max @ 0oF)	AP-42 Table 3.1-3	Acrolein	6.4E-06	6E-04	3E-03	---	6E-04	3E-03	6E-04	3E-03
		AP-42 Table 3.1-3	Benzene	1.2E-05	1E-03	5E-03	---	1E-03	5E-03	8E-03	6E-03
	Manufactured ≥ 02/18/05 NSPS GG Affected	AP-42 Table 3.1-3	Butadiene, 1,3-	4.3E-07	4E-05	2E-04	---	4E-05	2E-04	4E-05	2E-04
		AP-42 Table 3.1-3	Ethylbenzene	3.2E-05	3E-03	0.01	---	3E-03	0.01	0.01	0.01
	825 Exhaust Temp (oF)	Vendor Data (PIL 168)	Formaldehyde	2.1E-04	0.02	0.09	---	0.02	0.09	0.02	0.09
		AP-42 Table 3.1-3	n-Hexane	---	---	---	---	---	---	0.11	6E-03
	352,530 Exhaust Flow (lb/hr)	AP-42 Table 3.1-3	Methanol	---	---	---	---	---	---	1E-04	1E-05
		AP-42 Table 3.1-3	POM/PAH	3.5E-06	4E-04	2E-03	---	4E-04	2E-03	4E-04	2E-03
	7,839 Btu/bhp-hr (HHV)	AP-42 Table 3.1-3	Toluene	1.3E-04	0.01	0.06	---	0.01	0.06	0.02	0.06
		AP-42 Table 3.1-3	TMP, 2,2,4-	---	---	---	---	---	---	5E-03	4E-04
	100.66 MMBtu/hr (Max @ 0oF)	AP-42 Table 3.1-3	Xylenes	6.4E-05	6E-03	0.03	---	6E-03	0.03	1E-02	0.03
		AP-42 Table 3.1-3	Other/Trace HAP	2.9E-05	3E-03	0.01	---	3E-03	0.01	3E-03	0.01
	91,844 scf/hr (Max @ 0oF)	Sum	Total HAP	5.3E-04	0.05	0.23	---	0.05	0.23	0.19	0.24
		GHGRP Table C-1	CO2 (GWP=1)	117	11,775	51,574	---	11,775	51,574	12,913	51,633
	1,096 Btu/scf (HHV)	GHGRP Table C-2	CH4 (GWP=28)	2.2E-03	2.80	12.26	---	2.80	12.26	30.16	13.56
		GHGRP Table C-2	N2O (GWP=265)	2.2E-04	0.02	0.10	---	0.02	0.10	0.02	0.10
		Weighted Sum	CO2e	117	11,859	51,943	---	11,859	51,943	13,763	52,039

- Notes: 1 - The emissions shown are based on operation at 100% of rated load for 8,760 hr/yr.
 2 - PM10/2.5 is filterable and condensable particulate matter; including PM10 and PM2.5
 3 - "Other/Trace HAPs" includes: Carbon Tetrachloride, Chlorobenzene, Chloroform, Dichloropropene, 1,3-Dichloropropene, Ethylene Dibromide, Methylene Chloride, Phenol, Propylene Oxide, Styrene, 1,1,2,2-Tetrachloroethane, 1,1,2-Trichloroethane, and Vinyl Chloride (as per AP-42).
 4 - The fuel heating value will vary, 1,096 Btu/scf (HHV) is at the low end of the range and results in a high (conservative) fuel consumption estimate.
 5 - The AP-42 EFs are based on HHV while Solar data is based on LHV. The Solar data has been adjusted by assuming LHV is 90% of HHV.
 6 - GHG emission factors used are the same as GHG emission factors used for Washington's Cap and Trade: GHG Reporting Factors from Code of Federal Regulations Title 40 Part 98 Subpart C. <https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-98/subpart-C>

Northwest Pipeline LLC
Sumas Compressor Station
 Notice of Intent to Construct Application

Compressor Turbine (Mars 100-16000S) Emissions

Source ID	Description	Reference	Pollutant	Pre-Controlled Emissions			Control Efficiency	Controlled Emissions w/o TSS		Controlled Emissions w/ TSS	
				lb/MMBtu	lb/hr (0°F)	tpy (0°F)		lb/hr (0°F)	tpy (0°F)	lb/hr (0°F)	tpy (0°F)
10 D-Plant	Compressor Turbine	Solar Exhaust Analysis	NOx (9 ppm)	---	4.66	20.42	---	4.66	20.42	4.66	20.52
		Solar Exhaust Analysis	CO (25 ppm)	---	7.89	34.56	---	7.89	34.56	7.89	37.00
	Solar Mars 100-16000S	Solar Exhaust Analysis	UHC	---	4.52	19.80	---	4.52	19.80	3.62	17.14
		Vendor Data (PIL 168)	VOC (UHC*20%)	---	0.90	3.96	---	0.90	3.96	0.90	4.32
	17,022 bhp (Max @ 0 oF)	AP-42 Table 3.1-3	SO2	5.9E-04	0.08	0.33	---	0.08	0.33	0.08	0.33
		Vendor Data (PIL 171)	PM10/2.5	6.6E-03	0.86	3.76	---	0.86	3.76	0.86	3.76
	8,760 hr/yr	AP-42 Table 3.1-3	Acetaldehyde	4.0E-05	5E-03	0.02	---	5E-03	0.02	5E-03	0.02
		AP-42 Table 3.1-3	Acrolein	6.4E-06	8E-04	4E-03	---	8E-04	4E-03	8E-04	4E-03
	9,390 rpm (Max @ 0 oF)	AP-42 Table 3.1-3	Benzene	1.2E-05	2E-03	7E-03	---	2E-03	7E-03	2E-03	7E-03
		AP-42 Table 3.1-3	Butadiene, 1,3-	4.3E-07	6E-05	2E-04	---	6E-05	2E-04	6E-05	2E-04
	Manufactured ≥ 02/18/05 NSPS KKKK Affected	AP-42 Table 3.1-3	Ethylbenzene	3.2E-05	4E-03	0.02	---	4E-03	0.02	4E-03	0.02
		Vendor Data (PIL 168)	Formaldehyde	2.9E-03	0.37	1.63	---	0.37	1.63	0.37	1.63
	865 Exhaust Temp (0 oF)	AP-42 Table 3.1-3	n-Hexane	---	---	---	---	---	---	---	---
		AP-42 Table 3.1-3	Methanol	---	---	---	---	---	---	0E+00	8E-06
	366,332 Exhaust Flow (lb/hr)	AP-42 Table 3.1-3	POM/PAH	3.5E-06	5E-04	2E-03	---	5E-04	2E-03	5E-04	2E-03
		AP-42 Table 3.1-3	Toluene	1.3E-04	0.02	0.07	---	0.02	0.07	0.02	0.07
	7,608 Btu/bhp-hr (LHV)	AP-42 Table 3.1-3	TMP, 2,2,4-	---	---	---	---	---	---	0E+00	3E-04
		AP-42 Table 3.1-3	Xylenes	6.4E-05	8E-03	0.04	---	8E-03	0.04	8E-03	0.04
	129.50 MMBtu/hr (Max @0oF)	AP-42 Table 3.1-3	Other/Trace HAP	2.9E-05	4E-03	0.02	---	4E-03	0.02	4E-03	0.02
		Sum	Total HAP	3.2E-03	0.41	1.81	---	0.41	1.81	0.41	1.81
	118,160 scf/hr (Max @ 0oF)	GHGRP Table C-1	CO2 (GWP=1)	117	15,149	66,352	---	15,149	66,352	15,149	66,411
		GHGRP Table C-2	CH4 (GWP=28)	2.2E-03	3.62	15.84	---	3.62	15.84	3.62	17.14
	1,096 Btu/scf (HHV)	GHGRP Table C-2	N2O (GWP=265)	2.2E-04	0.03	0.13	---	0.03	0.13	0.03	0.13
Weighted Sum		CO2e	117	15,258	66,828	---	15,258	66,828	15,258	67,030	

- Notes:
- 1 - The emissions shown are based on operation at 100% of rated load for 8,760 hr/yr.
 - 2 - PM10/2.5 is filterable and condensable particulate matter; including PM10 and PM2.5
 - 3 - "Other/Trace HAPs" includes: Carbon Tetrachloride, Chlorobenzene, Chloroform, Dichloropropene, 1,3-Dichloropropene, Ethylene Dibromide, Methylene Chloride, Phenol, Propylene Oxide, Styrene, 1,1,2,2-Tetrachloroethane, 1,1,2-Trichloroethane, and Vinyl Chloride (as per AP-42).
 - 4 - The fuel heating value will vary, 1,096 Btu/scf (HHV) is at the low end of the range and results in a high (conservative) fuel consumption estimate.
 - 5 - The AP-42 EFs are based on HHV while Solar data is based on LHV. The Solar data has been adjusted by assuming LHV is 90% of HHV.
 - 6 - Total VOC, HCHO, HAP and CO2e emissions include Compressor Turbine Operations (X), Compressor Turbine Start+Stop (TSS)
 - 7 - GHG emission factors used are the same as GHG emission factors used for Washington's Cap and Trade: GHG Reporting Factors from Code of Federal Regulations Title 40 Part 98 Subpart C. <https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-98/subpart-C>

Northwest Pipeline LLC
Sumas Compressor Station
 Notice of Intent to Construct Application

Waukesha VGF-P48SE Emergency Generator

Source ID	Description	Reference	Pollutant	Pre-Controlled Emissions				Control Efficiency	Controlled Emissions	
				lb/MMBtu	g/bhp-hr	lb/hr	tpy		lb/hr	tpy
11 D-Plant (Removal)	Waukesha VGF-P48SE 1,000 ekW 1,475 bhp	Vendor Data	NOX	---	2.0	6.50	1.63	---	6.50	1.63
		Vendor Data	CO	---	4.0	13.01	3.25	---	13.01	3.25
		Vendor Data	VOC	---	1.0	3.25	0.81	---	3.25	0.81
		AP-42 Table 3.2-3	SO2	5.9E-04	---	7.6E-03	1.9E-03	---	7.6E-03	1.9E-03
		AP-42 Table 3.2-3	PM10/2.5	1.9E-02	---	0.25	0.06	---	0.25	0.06
		AP-42 Table 3.2-3	Acetaldehyde	2.8E-03	---	0.04	0.01	---	0.04	0.01
		AP-42 Table 3.2-3	Acrolein	2.6E-03	---	0.03	8.4E-03	---	0.03	0.01
		AP-42 Table 3.2-3	Benzene	1.6E-03	---	0.02	5.1E-03	---	0.02	5.1E-03
		AP-42 Table 3.2-3	Butadiene, 1,3-	6.6E-04	---	8.5E-03	2.1E-03	---	8.5E-03	2.1E-03
		AP-42 Table 3.2-3	Ethylbenzene	2.5E-05	---	3.2E-04	8.0E-05	---	3.2E-04	8.0E-05
	AP-42 Table 3.2-3	Formaldehyde	2.1E-02	---	0.26	0.07	---	0.26	0.07	
	AP-42 Table 3.2-3	n-Hexane	---	---	---	---	---	---	---	
	AP-42 Table 3.2-3	Methanol	3.1E-03	---	0.04	9.8E-03	---	0.04	9.8E-03	
	AP-42 Table 3.2-3	POM	2.4E-04	---	3.1E-03	7.6E-04	---	3.1E-03	7.6E-04	
	AP-42 Table 3.2-3	Toluene	5.6E-04	---	7.2E-03	1.8E-03	---	7.2E-03	1.8E-03	
	AP-42 Table 3.2-3	TMP, 2,2,4-	---	---	---	---	---	---	---	
	AP-42 Table 3.2-3	Xylenes	2.0E-04	---	2.5E-03	6.3E-04	---	2.5E-03	6.3E-04	
	AP-42 Table 3.2-3	Other/Trace HAP	1.8E-04	---	2.3E-03	5.8E-04	---	2.3E-03	5.8E-04	
		Sum	Total HAP	3.2E-02	---	0.42	0.10	---	0.42	0.10
		GHGRP Table C-1	CO2 (GWP=1)	117	---	1,502	376	---	1,502	376
	GHGRP Table C-2	CH4 (GWP=28)	2.2E-03	---	0.03	7.1E-03	---	0.03	7.1E-03	
	GHGRP Table C-2	N2O (GWP=265)	2.2E-04	---	2.8E-03	7.1E-04	---	2.8E-03	7.1E-04	
	Weighted Sum	CO2e	117	---	1,504	376	---	1,504	376	

- Notes:
- 1 - PM10/2.5 is filterable and condensable particulate matter; including PM10 and PM2.5
 - 2 - The fuel heating value will vary, 1,096 Btu/scf (HHV) is at the low end of the range and results in a high (conservative) fuel consumption estimate.
 - 3 - The AP-42 EFs are based on HHV while vendor data is based on LHV. The vendor data has been adjusted by assuming LHV is 90% of HHV.

Northwest Pipeline LLC
Sumas Compressor Station
 Notice of Intent to Construct Application

Cummins QSK60G Emergency Generator

Source ID	Description	Reference	Pollutant	Pre-Controlled Emissions				Control Efficiency	Controlled Emissions	
				lb/MMBtu	g/bhp-hr	lb/hr	tpy		lb/hr	tpy
11 D-Plant (New)	Cummins QSK60G	Vendor Data	NOX	---	1.0	4.31	1.08	---	4.31	1.08
		Vendor Data	CO	---	2.0	8.61	2.15	---	8.61	2.15
		Vendor Data	VOC	---	0.7	3.01	0.75	---	3.01	0.75
	1,953 bhp	AP-42 Table 3.2-2	SO2	5.9E-04	---	7.7E-03	1.9E-03	---	7.7E-03	1.9E-03
		AP-42 Table 3.2-2	PM10/2.5	1.0E-02	---	0.13	0.03	---	0.13	0.03
		AP-42 Table 3.2-2	Acetaldehyde	8.4E-03	---	0.11	0.03	---	0.11	0.03
		AP-42 Table 3.2-2	Acrolein	5.1E-03	---	0.07	1.7E-02	---	0.07	0.02
		AP-42 Table 3.2-2	Benzene	4.4E-04	---	0.01	1.4E-03	---	0.01	1.4E-03
		AP-42 Table 3.2-2	Butadiene, 1,3-	2.7E-04	---	3.5E-03	8.7E-04	---	3.5E-03	8.7E-04
		AP-42 Table 3.2-2	Ethylbenzene	4.0E-05	---	5.2E-04	1.3E-04	---	5.2E-04	1.3E-04
		AP-42 Table 3.2-2	Formaldehyde	5.3E-02	---	0.69	0.17	---	0.69	0.17
		AP-42 Table 3.2-2	n-Hexane	1.1E-03	---	0.01	3.6E-03	---	0.01	3.6E-03
		AP-42 Table 3.2-2	Methanol	2.5E-03	---	0.03	8.2E-03	---	0.03	8.2E-03
	500 hr/yr	AP-42 Table 3.2-2	POM	2.7E-05	---	3.5E-04	8.8E-05	---	3.5E-04	8.8E-05
		AP-42 Table 3.2-2	Toluene	4.1E-04	---	5.3E-03	1.3E-03	---	5.3E-03	1.3E-03
		AP-42 Table 3.2-2	TMP, 2,2,4-	2.5E-04	---	3.3E-03	8.2E-04	---	3.3E-03	8.2E-04
		AP-42 Table 3.2-2	Xylenes	1.8E-04	---	2.4E-03	6.0E-04	---	2.4E-03	6.0E-04
		AP-42 Table 3.2-2	Other/Trace HAP	1.8E-04	---	2.4E-03	6.0E-04	---	2.4E-03	6.0E-04
		Sum	Total HAP	3.2E-04	---	4.2E-03	1.0E-03	---	0.94	0.23
		GHGRP Table C-1	CO2 (GWP=1)	117	---	1,529	382	---	1,529	382
6,022 Btu/bhp-hr (LHV) 13.07 MMBtu/hr 11,923 scf/hr 5.96 MMscf/yr 1,096 Btu/scf (HHV)	GHGRP Table C-2	CH4 (GWP=28)	2.2E-03	---	0.03	7.2E-03	---	0.03	7.2E-03	
	GHGRP Table C-2	N2O (GWP=265)	2.2E-04	---	2.9E-03	7.2E-04	---	2.9E-03	7.2E-04	
	Weighted Sum	CO2e	117	---	1,530	383	---	1,530	383	

- Notes:
- 1 - PM10/2.5 is filterable and condensable particulate matter; including PM10 and PM2.5
 - 2 - The fuel heating value will vary, 1,096 Btu/scf (HHV) is at the low end of the range and results in a high (conservative) fuel consumption estimate.
 - 3 - The AP-42 EFs are based on HHV while vendor data is based on LHV. The vendor data has been adjusted by assuming LHV is 90% of HHV.

Northwest Pipeline LLC
Sumas Compressor Station
 Notice of Intent to Construct Application
Caterpillar 3412 Emergency Generator

Source ID	Description	Reference	Pollutant	Pre-Controlled Emissions			Control Efficiency	Controlled Emissions	
				lb/MMBtu	lb/hr	tpy		lb/hr	tpy
12-C-Plant	Caterpillar 3412	AP-42 Table 3.2-3	NOX	2.21	8.42	2.11	---	8.42	2.11
		AP-42 Table 3.2-3	CO	3.72	14.17	3.54	---	14.17	3.54
		AP-42 Table 3.2-3	VOC	0.03	0.11	0.03	---	0.11	0.03
		AP-42 Table 3.2-3	SO2	5.9E-04	2.2E-03	5.6E-04	---	2.2E-03	5.6E-04
	448 ekW 600 bhp	AP-42 Table 3.2-3	PM10/2.5	0.02	0.07	0.02	---	0.07	0.02
		AP-42 Table 3.2-3	Acetaldehyde	2.8E-03	1.06E-02	2.66E-03	---	0.01	2.66E-03
		AP-42 Table 3.2-3	Acrolein	2.6E-03	1.00E-02	2.51E-03	---	0.01	2.51E-03
		AP-42 Table 3.2-3	Benzene	1.6E-03	6.02E-03	1.5E-03	---	6.0E-03	1.5E-03
		AP-42 Table 3.2-3	Butadiene, 1,3-	6.6E-04	2.53E-03	6.3E-04	---	2.5E-03	6.3E-04
		AP-42 Table 3.2-3	Ethylbenzene	2.5E-05	9.45E-05	2.4E-05	---	9.4E-05	2.4E-05
		AP-42 Table 3.2-3	Formaldehyde	0.02	0.08	0.02	---	0.08	0.02
		AP-42 Table 3.2-3	n-Hexane	---	---	---	---	---	---
		AP-42 Table 3.2-3	Methanol	3.1E-03	1.17E-02	2.9E-03	---	0.01	2.9E-03
		AP-42 Table 3.2-3	POM	2.4E-04	9.07E-04	2.3E-04	---	9.1E-04	2.3E-04
	500 hr/yr	AP-42 Table 3.2-3	Toluene	5.6E-04	2.13E-03	5.3E-04	---	2.1E-03	5.3E-04
		AP-42 Table 3.2-3	TMP, 2,2,4-	---	---	---	---	---	---
		AP-42 Table 3.2-3	Xylenes	2.0E-04	7.43E-04	1.9E-04	---	7.4E-04	1.9E-04
		AP-42 Table 3.2-3	Other/Trace HAP	1.8E-04	6.83E-04	1.7E-04	---	6.8E-04	1.7E-04
		Sum	Total HAP	0.03	0.12	0.03	---	0.12	0.03
		GHGRP Table C-1	CO2 (GWP=1)	117	446	111	---	446	111
GHGRP Table C-2		CH4 (GWP=28)	2.2E-03	0.01	2.1E-03	---	0.01	2.1E-03	
GHGRP Table C-2		N2O (GWP=265)	2.2E-04	8.4E-04	2.1E-04	---	8.4E-04	2.1E-04	
	Weighted Sum	CO2e	117	446	112	---	446	112	

- Notes:
- 1 - PM10/2.5 is filterable and condensable particulate matter; including PM10 and PM2.5
 - 2 - The fuel heating value will vary, 1,096 Btu/scf (HHV) is at the low end of the range and results in a high (conservative) fuel consumption estimate.
 - 3 - The AP-42 EFs are based on HHV while vendor data is based on LHV. The vendor data has been adjusted by assuming LHV is 90% of HHV.

Northwest Pipeline LLC
Sumas Compressor Station
 Notice of Intent to Construct Application

Catalytic Heater (CATHTR)

Source ID	Description	Reference	Pollutant	Emission Factor		Emissions	
				lb/MMscf	lb/MMBtu	lb/hr	tpy
CATHTR	Catalytic Heaters 24 Individual Heaters at 72,000 Btu/hr, each Capacity: 1.73 MMBtu/hr (HHV) 1,096 Btu/scf (HHV) 8,760 hr/yr 7,059 scf/hr 61.84 MMscf/yr 67,773 MMBtu/yr	AP-42 Table 1.4-1	NOx	100.00	9.1E-02	0.16	0.69
		AP-42 Table 1.4-1	CO	84.00	7.7E-02	0.13	0.58
		AP-42 Table 1.4-1	NMNEHC	---	---	---	---
		AP-42 Table 1.4-1	VOC	5.50	5.0E-03	0.01	0.04
		AP-42 Table 1.4-1	SO2	0.60	5.5E-04	9E-04	4E-03
		AP-42 Table 1.4-1	PM10/2.5	---	6.9E-03	0.01	0.05
		AP-42 Table 1.4-1	Acetaldehyde	---	---	---	---
		AP-42 Table 1.4-1	Acrolein	---	---	---	---
		AP-42 Table 1.4-1	Benzene	2E-03	1.9E-06	3E-06	1E-05
		AP-42 Table 1.4-1	1,3-Butadiene	---	---	---	---
		AP-42 Table 1.4-1	Ethylbenzene	---	---	---	---
		AP-42 Table 1.4-1	Formaldehyde	0.08	6.8E-05	1E-04	5E-04
		AP-42 Table 1.4-1	n-Hexane	1.80	1.6E-03	3E-03	0.01
		AP-42 Table 1.4-1	Methanol	---	---	---	---
		AP-42 Table 1.4-1	POM/PAH	7E-04	6.4E-07	1E-06	5E-06
		AP-42 Table 1.4-1	Toluene	3E-03	3.1E-06	5E-06	2E-05
		AP-42 Table 1.4-1	2,2,4-TMP	---	---	---	---
	AP-42 Table 1.4-1	Xylenes	---	---	---	---	
	AP-42 Table 1.4-1	Other/Trace HAP	1E-03	1.1E-06	2E-06	8E-06	
		Sum	Total HAP	1.88	1.7E-03	3E-03	0.01
	GHGRP Table C-1	CO2 (GWP=1)	---	117	202.13	885.35	
	GHGRP Table C-2	CH4 (GWP=28)	---	2E-03	4E-03	0.02	
	GHGRP Table C-2	N2O (GWP=265)	---	2E-04	4E-04	2E-03	
	Weighted Sum	CO2e	---	117	202.34	886.26	

- Notes:
- 1 - The emissions shown are based on operation at 100% of rated load for 8,760 hr/yr.
 - 2 - The fuel heating value will vary, 1,096 Btu/scf (HHV) is at the low end of the range and results in a high (conservative) fuel consumption estimate.
 - 3 - PM10/2.5 is filterable and condensable particulate matter; including PM10 and PM2.5
 - 4 - "Other/Trace HAPs" includes: Carbon Tetrachloride, Chlorobenzene, Chloroform, Dichloropropene, 1,3-Dichloropropene, Ethylene Dibromide, Methylene Chloride, Phenol, Propylene Oxide, Styrene, 1,1,2,2-Tetrachloroethane, 1,1,2-Trichloroethane, and Vinyl Chloride (as per AP-42).

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Compressor Turbine Start/Stop (TSS)

Source ID	Unit ID	Description	Start+Stop per year	NOx		CO		VOC	
				5 lb/(Start+Stop) 2 lb/(Start+Stop) lb/hr* tpy	101 lb/(Start+Stop) 47 lb/(Start+Stop) lb/hr* tpy	10 lb/(Start+Stop) 7 lb/(Start+Stop) lb/hr* tpy	10 lb/(Start+Stop) 7 lb/(Start+Stop) lb/hr* tpy		
TSS	7 C-Plant	Mars 90	104	5	0.3	101	5.3	10	0.5
	8 C-Plant	Mars 90	104	5	0.3	101	5.3	10	0.5
	X D-Plant	Mars 100	104	2	0.1	47	2.4	7	0.4
	10 D-Plant	Mars 100	104	2	0.1	47	2.4	7	0.4
TOTAL:			104	14	0.7	296	15.4	34	1.8

*lb/hr emissions are summations of (start+stop) emissions

CO2		CH4		CO2e	
1,027 lb/(Start+Stop) 1,138 lb/(Start+Stop) lb/hr* tpy	53 59 tpy	38 lb/(Start+Stop) 25 lb/(Start+Stop) lb/hr* tpy	48 2.0 tpy	2,371 lb/(Start+Stop) 2,034 lb/(Start+Stop) lb/hr* tpy	123 106 tpy
1,027	53	48	2.0	2,227	123
1,138	59	24	1.3	1,738	106
1,138	59	24	1.3	1,738	106
4,330	225	144	6.6	7,930	458

TOTAL:

Source ID	Unit ID	Benzene 0.07% VOC		Ethylbenzene 0.07% VOC		n-Hexane 1.08% VOC		Methanol 0.00% VOC		Toluene 0.07% VOC		2,2,4-TMP 0.07% VOC		Xylene 0.07% VOC		Total HAP 1.47% VOC	
		lb/hr* tpy	4E-04	7E-03	4E-04	0.11	6E-03	2E-04	1E-05	7E-03	4E-04	7E-03	4E-04	7E-03	4E-04	0.15	8E-03
TSS	7 C-Plant	7E-03	4E-04	7E-03	4E-04	0.11	6E-03	2E-04	1E-05	7E-03	4E-04	7E-03	4E-04	7E-03	4E-04	0.15	8E-03
	8 C-Plant	7E-03	4E-04	7E-03	4E-04	0.11	6E-03	2E-04	1E-05	7E-03	4E-04	7E-03	4E-04	7E-03	4E-04	0.15	8E-03
	X D-Plant	5E-03	3E-04	5E-03	3E-04	0.08	4E-03	1E-04	8E-06	5E-03	3E-04	5E-03	3E-04	5E-03	3E-04	0.10	5E-03
	10 D-Plant	5E-03	3E-04	5E-03	3E-04	0.08	4E-03	1E-04	8E-06	5E-03	3E-04	5E-03	3E-04	5E-03	3E-04	0.10	5E-03
TOTAL:		0.02	1E-03	0.02	1E-03	0.37	2E-02	7E-04	4E-05	0.02	1E-03	2E-02	1E-03	2E-02	1E-03	0.50	0.03

Notes: 1 - Using summation of max start+stop emissions for lb/hr emissions is conservative.

3 - The results of a representative Inlet Gas Analysis were used to determine the following worst-case VOC and HAP components (See Appendix G - Gas Composition):

2 - The emission factors for start-up and shutdown events are provided by the vendor in PIL 170, summarized below: (See Appendix E - Equipment Manufacturer Specifications).

Start/Stop Emissions Rate in lb/Event	Table 2 - Mars 90 13000S CS/MD (w/o Enhanced Emissions Control)					
	NOX	CO	VOC	CO2	UHC	CO2e
lb/Start	4	45	4	437	20	997
lb/Stop	1	56	6	590	28	1,374
Total lb/(Start+Stop)	5	101	10	1,027	48	2,371

Start/Stop Emissions Rate in lb/Event	Table 4 - Mars 100 16000S CS/MD (w/ Enhanced Emissions Control)					
	NOX	CO	VOC	CO2	UHC	CO2e
lb/Start	1	19	3	496	13	860
lb/Stop	1	28	4	642	19	1,174
Total lb/(Start+Stop)	2	47	7	1,138	32	2,034

Pollutant	Inlet Gas	Minimum Contingency:		
		Worst Case	%Total	5% %VOC
CO2	332 lb/MMscf	350 lb/MMscf	0.74%	---
Methane	38,207 lb/MMscf	40,120 lb/MMscf	85.36%	---
N2/Water/Ethane/Etc	5,752 lb/MMscf	--- lb/MMscf	---	---
VOC	2,643 lb/MMscf	2,780 lb/MMscf	5.91%	100.00%
TOTAL GAS	46,935 lb/MMscf	47,000 lb/MMscf	100.00%	---
Benzene	--- lb/MMscf	2.00 lb/MMscf	0.00%	0.07%
Ethylbenzene	--- lb/MMscf	2.00 lb/MMscf	0.00%	0.07%
n-Hexane	20.39 lb/MMscf	30.00 lb/MMscf	0.06%	1.08%
Methanol	--- lb/MMscf	1.00 lb/MMscf	50.00%	0.00%
Toluene	--- lb/MMscf	2.00 lb/MMscf	0.00%	0.07%
2,2,4-Trimethylpentane	--- lb/MMscf	2.00 lb/MMscf	0.00%	0.07%
Xylenes	--- lb/MMscf	2.00 lb/MMscf	0.00%	0.07%
Total HAP	20.39 lb/MMscf	41.00 lb/MMscf	0.09%	1.47%

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Compressor Turbine Start Gas

Source ID	Unit ID	Description	SCF per start	Starts per year	VOC 2,643 lb/MMscf 2.06 mol %		CO2 332 lb/MMscf 0.29 mol %		CH4 38,207 lb/MMscf 90.40 mol %	
					lb/start	tpy	lb/start	tpy	lb/start	tpy
SG	7 C-Plant	Mars 90	87.92	104	0.23	0.01	0.03	0.00	3.36	0.17
	8 C-Plant	Mars 90	87.92	104	0.23	0.01	0.03	0.00	3.36	0.17
TOTAL:				208	0.46	0.02	0.06	0.00	6.72	0.35

- Notes: 1 - lb/MMscf and mol % are provided in the inlet gas summary. See Appendix G - Gas Composition.
 2 - SCF per start was provided by Williams.
 3 - The summation of max start+stop emissions was used for lb/hr emissions. The time to start is minutes, so lb/hr was not calculated.
 4 - HAP content and totals are <0.1 lb/start event so were not calculated.

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Centrifugal Compressor Dry Gas Seals (DGS)

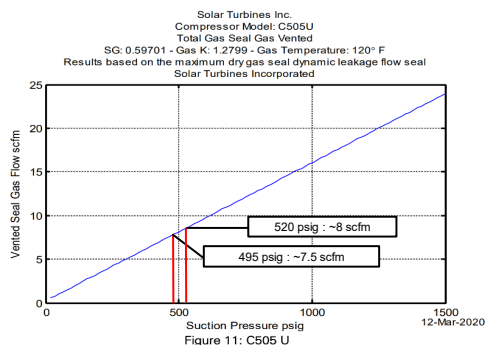
Source ID	Unit ID	Unit Description (Compressor Dry Gas Seals)	Operating Time Hours	Leak Rate (Solar PIL 251)		Pre-Control VOC 2,780 lb/MMscf		Control %	VOC 2,780 lb/MMscf		CO2 350 lb/MMscf		CH4 40,120 lb/MMscf		CO2e CH4 GWP = 28	
				scfm	MMscf/yr	lb/hr*	tpy		lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy
DGS	7 C-Plant	Mars 90	8,760	9.60	5.05	1.60	7.01	0%	1.60	7.01	0.20	0.88	23.11	101.22	647.26	2,835
	8 C-Plant	Mars 90	8,760	9.60	5.05	1.60	7.01	0%	1.60	7.01	0.20	0.88	23.11	101.22	647.26	2,835
	10 D-Plant	Mars 100	8,760	9.00	4.73	1.50	6.58	0%	1.50	6.58	0.19	0.83	21.66	94.89	606.80	2,658
	X D-Plant	Mars 100	8,760	9.00	4.73	1.50	6.58	0%	1.50	6.58	0.19	0.83	21.66	94.89	606.80	2,658
TOTAL:						6.20	27.18	TOTAL:	6.20	27.18	0.78	3.42	89.55	392	2,508	10,986

Source ID	Unit ID	Benzene 2.00 lb/MMscf		Ethylbenzene 2.00 lb/MMscf		n-Hexane 30.00 lb/MMscf		Methanol 1.00 lb/MMscf		Toluene 2.00 lb/MMscf		2,2,4-TMP 2.00 lb/MMscf		Xylene 2.00 lb/MMscf		Total HAP 41.00 lb/MMscf	
		lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy
DGS	7 C-Plant	1E-03	5E-03	1E-03	5E-03	2E-02	8E-02	6E-04	3E-03	1E-03	5E-03	1E-03	5E-03	1E-03	5E-03	2E-02	1E-01
	8 C-Plant	1E-03	5E-03	1E-03	5E-03	2E-02	8E-02	6E-04	3E-03	1E-03	5E-03	1E-03	5E-03	1E-03	5E-03	2E-02	1E-01
	10 D-Plant	1E-03	5E-03	1E-03	5E-03	2E-02	7E-02	5E-04	2E-03	1E-03	5E-03	1E-03	5E-03	1E-03	5E-03	2E-02	1E-01
	X D-Plant	1E-03	5E-03	1E-03	5E-03	2E-02	7E-02	5E-04	2E-03	1E-03	5E-03	1E-03	5E-03	1E-03	5E-03	2E-02	1E-01
TOTAL:		4E-03	0.02	4E-03	0.02	0.07	0.29	2E-03	0.01	4E-03	0.02	4E-03	0.02	4E-03	0.02	0.09	0.40

Notes: 1 - The Solar Mars 90 and Solar Mars 100 turbines each drive one (1) Solar C505 centrifugal compressor. The Solar Mars 100 compressors each operate at an average suction of 495 psig. The Solar Mars 90 compressors are estimated to operate at an average suction of 520 psig.

3 - The results of a representative Inlet Gas Analysis were used to determine the following worst-case VOC and HAP components (See Appendix G - Gas Composition):

2 - Dry gas seal leak rate provided by Solar Turbines and based on PIL 251 and historical suction pressure. A conservative contingency has been added to the estimated leak rate. See Appendix E - Equipment Manufacturer Specifications.



8 scfm * 120% Contingency	=	9.60 scfm	Turbines 7, 8
7.5 scfm * 120% Contingency	=	9.00 scfm	Turbine 9, X

Pollutant	Ext. Gas Analysis	Minimum Contingency: 5%		
		Worst-Case	Wgt%	W%VOC
CO2	332 lb/MMscf	350 lb/MMscf	0.74%	---
Methane	38,207 lb/MMscf	40,120 lb/MMscf	85.36%	---
N2/Water/Ethane/Etc	5,752 lb/MMscf	--- lb/MMscf	---	---
VOC	2,643 lb/MMscf	2,780 lb/MMscf	5.91%	100.00%
TOTAL GAS	46,935 lb/MMscf	47,000 lb/MMscf	100.00%	---
Benzene	--- lb/MMscf	2.00 lb/MMscf	0.00%	0.07%
Ethylbenzene	--- lb/MMscf	2.00 lb/MMscf	0.00%	0.07%
n-Hexane	20.39 lb/MMscf	30.00 lb/MMscf	0.06%	1.08%
Methanol	--- lb/MMscf	1.00 lb/MMscf	50.00%	0.00%
Toluene	--- lb/MMscf	2.00 lb/MMscf	0.00%	0.07%
2,2,4-Trimethylpentane	--- lb/MMscf	2.00 lb/MMscf	0.00%	0.07%
Xylenes	--- lb/MMscf	2.00 lb/MMscf	0.00%	0.07%
Total HAP	20.39 lb/MMscf	41.00 lb/MMscf	0.09%	1.47%

4 - A dry seal recompression system is used to capture the centrifugal compressor dry gas seal leaks for reinjection to the station suction or discharge header. This recompression system achieves 100% capture of the seal leaks. There will be occasional maintenance performed on the recompression system and it is assumed up to 18 days (432 hours) of recompression system downtime may occur over the course of a year.

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Blowdowns (BD)

Source ID	Unit Description	CBD and ESD Events/yr	BD Gas scf/BD	Total Gas Vented MMscf/yr	Control Efficiency	VOC 2,780 lb/MMscf		CO2 350 lb/MMscf		CH4 40,120 lb/MMscf		CO2e CH4 GWP = 28		
						lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	
CBD	Turbine Compressor 7	12	911	0.01	na	2.53	0.02	0.32	2E-03	36.5	0.22	914	5.5	
	Turbine Compressor 8	12	911	0.01		2.53	0.02	0.32	2E-03	36.5	0.22	914	5.5	
	Turbine Compressor 9	12	1,420	0.02		3.95	0.02	0.50	3E-03	57.0	0.34	1,424	8.5	
	Turbine Compressor X	12	1,420	0.02		3.95	0.02	0.50	3E-03	57.0	0.34	1,424	8.5	
	Turbine Compressor 7 - Backup Seal Pump	12	13	2E-04		0.03	2E-04	4E-03	3E-05	0.50	3E-03	12.5	0.1	
	Turbine Compressor 8 - Backup Seal Pump	12	13	2E-04		0.03	2E-04	4E-03	3E-05	0.50	3E-03	14.0	0.1	
	Turbine Compressor 9 - Backup Seal Pump	12	13	2E-04		0.03	2E-04	4E-03	3E-05	0.50	3E-03	14.0	0.1	
	Turbine Compressor X - Backup Seal Pump	12	13	2E-04		0.03	2E-04	4E-03	3E-05	0.50	3E-03	14.0	0.1	
	Plant C - Suction / Discharge	12	8,463	0.10		23.53	0.14	2.96	0.02	339.5	2.04	9,509	57.1	
	Plant D - Suction / Discharge	12	9,450	0.11		26.27	0.16	3.31	0.02	379.1	2.27	10,619	63.7	
	Emergency S/D Test	1	22,624	0.02		62.89	0.03	7.92	4E-03	907.7	0.45	25,423	12.7	
TOTAL:		121	TOTAL:	0.29	TOTAL:	6.76	0.41	TOTAL:	0.85	0.05	98	6	2,676	162

* lb/hr is found by assuming 1 hr per BD

Unit ID	Unit Description (Compressor Blowdown - Raw Natural Gas)	Benzene 2		E-Benzene 2		n-Hexane 30		Methanol 1		Toluene 2		2,2,4-TMP 2		Xylene 2		Total HAP 41	
		lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy
CBD	Turbine Compressor 7	2E-03	1E-05	2E-03	1E-05	3E-02	2E-04	9E-04	5E-06	2E-03	1E-05	2E-03	1E-05	2E-03	1E-05	4E-02	2E-04
	Turbine Compressor 8	2E-03	1E-05	2E-03	1E-05	3E-02	2E-04	9E-04	5E-06	2E-03	1E-05	2E-03	1E-05	2E-03	1E-05	4E-02	2E-04
	Turbine Compressor 9	3E-03	2E-05	3E-03	2E-05	4E-02	3E-04	1E-03	9E-06	3E-03	2E-05	3E-03	2E-05	3E-03	2E-05	6E-02	3E-04
	Turbine Compressor X	3E-03	2E-05	3E-03	2E-05	4E-02	3E-04	1E-03	9E-06	3E-03	2E-05	3E-03	2E-05	3E-03	2E-05	6E-02	3E-04
	Turbine Compressor 7 - Backup Seal Pump	3E-05	2E-07	3E-05	2E-07	4E-04	2E-06	1E-05	8E-08	3E-05	2E-07	3E-05	2E-07	3E-05	2E-07	5E-04	3E-06
	Turbine Compressor 8 - Backup Seal Pump	3E-05	2E-07	3E-05	2E-07	4E-04	2E-06	1E-05	8E-08	3E-05	2E-07	3E-05	2E-07	3E-05	2E-07	5E-04	3E-06
	Turbine Compressor 9 - Backup Seal Pump	3E-05	2E-07	3E-05	2E-07	4E-04	2E-06	1E-05	8E-08	3E-05	2E-07	3E-05	2E-07	3E-05	2E-07	5E-04	3E-06
	Turbine Compressor X - Backup Seal Pump	3E-05	2E-07	3E-05	2E-07	4E-04	2E-06	1E-05	8E-08	3E-05	2E-07	3E-05	2E-07	3E-05	2E-07	5E-04	3E-06
	Plant C - Suction / Discharge	2E-02	1E-04	2E-02	1E-04	3E-01	2E-03	8E-03	5E-05	2E-02	1E-04	2E-02	1E-04	2E-02	1E-04	3E-01	2E-03
	Plant D - Suction / Discharge	2E-02	1E-04	2E-02	1E-04	3E-01	2E-03	9E-03	6E-05	2E-02	1E-04	2E-02	1E-04	2E-02	1E-04	4E-01	2E-03
	Emergency S/D Test	5E-02	2E-05	5E-02	2E-05	7E-01	3E-04	2E-02	1E-05	5E-02	2E-05	5E-02	2E-05	5E-02	2E-05	9E-01	5E-04
TOTAL:		5E-03	3E-04	5E-03	3E-04	7E-02	4E-03	2E-03	1E-04	5E-03	3E-04	5E-03	3E-04	5E-03	3E-04	1E-01	6E-03

* lb/hr is found by assuming 1 hr per BD

- Notes: 1 - CBD Emissions are the sum of:
 (a) All turbines have compressed air or electric starters which do not have pollution emissions.
 (b) Natural gas that is purged (aka blowdown) from compressors, piping, and equipment.
 (c) Emergency Shut-Down (ESD) Event/Test.

2 - Blowdown volumes estimated based on GHG Volume Database from Williams. Turbine compressors 9 and X are assumed to have the same blowdown volume per event.

Unit	Type of Blowdown	V (mscf)	V (scf)
Turbine Compressor 7	Main Unit Blowdown	0.91	910.73
Turbine Compressor 8	Main Unit Blowdown	0.91	910.73
Turbine Compressor 9	Main Unit Blowdown	1.42	1419.70
Turbine Compressor 7	Backup Seal Pump	0.01	12.50
Turbine Compressor 8	Backup Seal Pump	0.01	12.50
Turbine Compressor 9	Backup Seal Pump	0.01	12.50
Plant C	Station Suction	4.80	4795.73
Plant C	Station Discharge	3.67	3666.84
Plant D	Station Suction	2.03	2028.26
Plant D	Station Discharge	7.42	7422.04

3 - With the seal recovery and process vent recompression skid, the number of non-ESD blowdowns vented to atmosphere will be minimized. It is assumed up to 12 non-ESD blowdown events to atmosphere per year.

4 - The results of a representative Inlet Gas Analysis were used to determine the following worst-case VOC and HAP components (See Appendix G - Gas Composition):

Pollutant	Inlet Gas	Minimum Contingency:		5%
		Worst Case	%Total	
CO2	332 lb/MMscf	350 lb/MMscf	0.74%	---
Methane	38,207 lb/MMscf	40,120 lb/MMscf	85.36%	---
N2/Water/Ethane/Etc	5,752 lb/MMscf	---	---	---
VOC	2,643 lb/MMscf	2,780 lb/MMscf	5.91%	100.00%
TOTAL GAS	46,935 lb/MMscf	47,000 lb/MMscf	100.00%	---
Benzene	---	2.00 lb/MMscf	0.00%	0.07%
Ethylbenzene	---	2.00 lb/MMscf	0.00%	0.07%
n-Hexane	20.39 lb/MMscf	30.00 lb/MMscf	0.06%	1.08%
Methanol	---	1.00 lb/MMscf	50.00%	0.00%
Toluene	---	2.00 lb/MMscf	0.00%	0.07%
2,2,4-TMP	---	2.00 lb/MMscf	0.00%	0.07%
Xylenes	---	2.00 lb/MMscf	0.00%	0.07%
Total HAP	20.39 lb/MMscf	41.00 lb/MMscf	0.09%	1.47%

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Pneumatic Devices (PNE)

Source ID	Description	Device Type (Gas)	Unit Count	Hours of Operation hr/yr	Emission Factor scf/hr/unit	Control Efficiency	Total Gas/Vapor		VOC		CO2		CH4		CO2e GWP = 28	
							scf/hr	MMscf/yr	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy
PNE	Pneumatic Devices	Low Bleed	---	8,760	1.39	---	---	---	---	---	---	---	---	---	---	---
		High Bleed	---	8,760	18.20	---	---	---	---	---	---	---	---	---	---	---
		Intermittent	17	8,760	2.35	---	39.95	0.35	0.11	0.49	0.01	0.06	1.60	7.02	40.08	196.63
TOTAL:			17				39.95	0.35	0.11	0.49	0.01	0.06	1.603	7.02	40.08	196.63

Source ID	Device Type (Gas)	Benzene 2.00 lb/MMscf		Ethylbenzene 2.00 lb/MMscf		n-Hexane 30.00 lb/MMscf		Methanol 1.00 lb/MMscf		Toluene 2.00 lb/MMscf		2,2,4-TMP 2.00 lb/MMscf		Xylenes 2.00 lb/MMscf		Tot HAP 41.00 lb/MMscf	
		lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy
PNE	Low Bleed	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	High Bleed	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	Intermittent	8E-05	3E-04	8E-05	3E-04	1E-03	5E-03	4E-05	2E-04	8E-05	3E-04	8E-05	3E-04	8E-05	3E-04	2E-03	7E-03
TOTAL:		8E-05	3E-04	8E-05	3E-04	1E-03	5E-03	4E-05	2E-04	8E-05	3E-04	8E-05	3E-04	8E-05	3E-04	2E-03	7E-03

Notes: 1 - Assumed 8,760 hours per year of pneumatic device operations.

3 - The results of a representative Inlet Gas Analysis were used to determine the following worst-case components (See Appendix G - Gas Composition):

2 - Gas/Vapor emissions calculated using Table W-3B to Subpart W of 40CFR98.

Default Total Hydrocarbon Population Emission Factors for Onshore Natural Gas Transmission Compression	Emission Factor
Low Continuous Bleed Pneumatic Device	1.37 scfh/unit
High Continuous Bleed Pneumatic Device	18.20 scf/hr/unit
Intermittent Bleed Pneumatic Device	2.35 scf/hr/unit

Pollutant	Inlet Gas	Minimum Contingency:		5%
		Worst Case	%Total	%VOC
CO2	332 lb/MMscf	350 lb/MMscf	0.74%	---
Methane	38,207 lb/MMscf	40,120 lb/MMscf	85.36%	---
N2/Water/Ethane/Etc	5,752 lb/MMscf	--- lb/MMscf	---	---
VOC	2,643 lb/MMscf	2,780 lb/MMscf	5.91%	100.00%
TOTAL GAS	46,935 lb/MMscf	47,000 lb/MMscf	100.00%	---
Benzene	--- lb/MMscf	2.00 lb/MMscf	0.00%	0.07%
Ethylbenzene	--- lb/MMscf	2.00 lb/MMscf	0.00%	0.07%
n-Hexane	20.39 lb/MMscf	30.00 lb/MMscf	0.06%	1.08%
Methanol	--- lb/MMscf	1.00 lb/MMscf	50.00%	0.00%
Toluene	--- lb/MMscf	2.00 lb/MMscf	0.00%	0.07%
2,2,4-Trimethylpentane	--- lb/MMscf	2.00 lb/MMscf	0.00%	0.07%
Xylenes	--- lb/MMscf	2.00 lb/MMscf	0.00%	0.07%
Total HAP	20.39 lb/MMscf	41.00 lb/MMscf	0.09%	1.47%

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Pigging Operations (PIG)

Source ID	Description	PIG Volume scf/Event	No. of Units	Pigging Events/yr	Total Gas/Vapor Mscf/yr	Control %	VOC (w/HCHO) 2,780 lb/MMscf	
							lb/hr*	tpy
PIG	30" Pig Launcher	34,421	1	7	241	na	0.08	0.33
	36" Pig Launcher	34,639	1	7	242	na	0.08	0.34
	Total:			14	483	---	0.15	0.67

CO2 (w/o Control) 350 lb/MMscf		CH4 40,120 lb/MMscf		CO2e CH4 GWP = 28	
lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy
0.01	0.04	1.10	4.83	30.91	135.38
0.01	0.04	1.11	4.86	31.10	136.24
0.02	0.08	2.2	9.7	62	272

TOTAL:

*lb/hr is tpy average over 8,760 hr/yr

Source ID	Description	Benzene 2.00 lb/MMscf		E-Benzene 2.00 lb/MMscf		n-Hexane 30.00 lb/MMscf		Methanol 1.00 lb/MMscf		Toluene 2.00 lb/MMscf		2,2,4-TMP 2.00 lb/MMscf		Xylene 2.00 lb/MMscf		Tot HAP 41.00 lb/MMscf	
		lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy	lb/hr*	tpy
PIG	30" Pig Launcher	6E-05	2E-04	6E-05	2E-04	8E-04	4E-03	3E-05	1E-04	6E-05	2E-04	6E-05	2E-04	6E-05	2E-04	1E-03	5E-03
	36" Pig Launcher	6E-05	2E-04	6E-05	2E-04	8E-04	4E-03	3E-05	1E-04	6E-05	2E-04	6E-05	2E-04	6E-05	2E-04	1E-03	5E-03
	Total:	1E-04	5E-04	1E-04	5E-04	2E-03	7E-03	6E-05	2E-04	1E-04	5E-04	1E-04	5E-04	1E-04	5E-04	2E-03	0.01

Notes: 1 - Hourly emissions based on 8,760 hr/yr. Actual Pigging Operations (PIG) are intermittent and would grossly distort the "normal" operating emissions.

2 - Blowdown volumes estimated as follows:

$$V_{scf} = V_{acf} * 528 / (ToF + 460) * (P_{psig} + 14.70) / 14.70 / Z$$

Compressibility Factor (Z) from <https://checcalc.com/solved/naturalgasZ.html>

Description	V (acf)	T (oF)	P (psig)	Z	scf
30" Pig Launcher	500	50	963	1.00	34,421
36" Pig Launcher	503	50	963	1.00	34,639

3 - The results of a representative Inlet Gas Analysis were used to determine the following worst-case VOC and HAP components (See Appendix G - Gas Composition):

Pollutant	Inlet Gas	Minimum Contingency: 5%		
		Worst Case	%Total	%VOC
CO2	332 lb/MMscf	350 lb/MMscf	0.74%	---
Methane	38,207 lb/MMscf	40,120 lb/MMscf	85.36%	---
N2/Water/Ethane/Etc	5,752 lb/MMscf	--- lb/MMscf	---	---
VOC	2,643 lb/MMscf	2,780 lb/MMscf	5.91%	100.00%
TOTAL GAS	46,935 lb/MMscf	47,000 lb/MMscf	100.00%	---
Benzene	--- lb/MMscf	2.00 lb/MMscf	0.00%	0.07%
Ethylbenzene	--- lb/MMscf	2.00 lb/MMscf	0.00%	0.07%
n-Hexane	20.39 lb/MMscf	30.00 lb/MMscf	0.06%	1.08%
Methanol	--- lb/MMscf	1.00 lb/MMscf	50.00%	0.00%
Toluene	--- lb/MMscf	2.00 lb/MMscf	0.00%	0.07%
2,2,4-Trimethylpentane	--- lb/MMscf	2.00 lb/MMscf	0.00%	0.07%
Xylenes	--- lb/MMscf	2.00 lb/MMscf	0.00%	0.07%
Total HAP	20.39 lb/MMscf	41.00 lb/MMscf	0.09%	1.47%

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Process Piping and Equipment Leaks (FUG) – Gas

Source ID	Description	Component (Unit) Type (Gas)	Unit Count	Safety Multiplier 150%	EPA Em. Fact. lb/hr/Unit	LDAR Control Credit	Total Fugitive Emissions		VOC (w/HCHO) 5.915 Wgt%		CO2 0.745 Wgt%		CH4 85.362 Wgt%		CO2e CH4 GWP = 28	
							lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy
FUG	Process Piping and Equipment Leaks (Gas)	Valves	832	1,248	9.9E-03	---	8.26	36.16	0.49	2.14	0.06	0.27	7.05	30.87	176	865
		Pump Seals	---	---	---	---	---	---	---	---	---	---	---	---	---	---
		Other	28	42	0.02	---	0.54	2.38	0.03	0.14	4E-03	0.02	0.46	2.03	12	57
		Connectors	3,274	4,911	4.4E-04	---	1.44	6.32	0.09	0.37	0.01	0.05	1.23	5.40	31	151
		Flanges	200	300	8.6E-04	---	0.17	0.75	0.01	4E-02	1E-03	6E-03	0.15	0.64	3.67	18
		Open-End Lines	0	0	4.4E-03	---	---	---	---	---	---	---	---	---	---	---
TOTAL:			4,334	6,501				0.62	2.7	0.08	0.34	8.89	38.94	222	1,091	

Source ID	Description	Component (Unit) Type (Gas)	Benzene 0.00 Wgt%		Ethylbenzene 0.00 Wgt%		n-Hexane 0.06 Wgt%		Methanol 0.00 Wgt%		Toluene 0.00 Wgt%		2,2,4-TMP 0.00 Wgt%		Xylenes 0.00 Wgt%		Total HAP 0.09 Wgt%		
			lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	
FUG	Process Piping and Equipment Leaks (Gas)	Valves	4E-04	2E-03	4E-04	2E-03	5E-03	0.02	2E-04	8E-04	4E-04	2E-03	4E-04	2E-03	4E-04	2E-03	7E-03	0.03	
		Pump Seals	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
		Other	2E-05	1E-04	2E-05	1E-04	3E-04	2E-03	1E-05	5E-05	2E-05	1E-04	2E-05	1E-04	2E-05	1E-04	5E-04	2E-03	
		Connectors	6E-05	3E-04	6E-05	3E-04	9E-04	4E-03	3E-05	1E-04	6E-05	3E-04	6E-05	3E-04	6E-05	3E-04	1E-03	6E-03	
		Flanges	7E-06	3E-05	7E-06	3E-05	1E-04	5E-04	4E-06	2E-05	7E-06	3E-05	7E-06	3E-05	7E-06	3E-05	2E-04	7E-04	
		Open-End Lines	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL:			4E-04	2E-03	4E-04	2E-03	7E-03	3E-02	2E-04	1E-03	4E-04	2E-03	4E-04	2E-03	4E-04	2E-03	0.01	0.04	

- Notes: 1 - Assumed 8,760 hours per year of fugitive emissions.
 2 - Gas/Vapor emissions calculated using EPA Protocol for Equipment Leak Emission Estimates, EPA-453/R-95-017, Nov 1995; Table 2-4, Oil and Gas Production Operations:

Equipment Type	Gas		Light Oil		Water/Oil	
	kg/hr	lb/hr/unit	kg/hr	lb/hr/unit	kg/hr	lb/hr/unit
Valves	4.50E-03	9.92E-03	2.50E-03	5.51E-03	9.80E-05	2.16E-04
Pump Seals	na	na	1.30E-02	2.87E-02	2.40E-05	5.29E-05
Others	8.80E-03	1.94E-02	7.50E-03	1.65E-02	1.40E-02	3.09E-02
Connectors	2.00E-04	4.41E-04	2.10E-04	4.63E-04	1.10E-04	2.43E-04
Flanges	3.90E-04	8.60E-04	1.10E-04	2.43E-04	2.90E-06	6.39E-06
Open-Ended Lines	2.00E-03	4.41E-03	1.40E-03	3.09E-03	2.50E-04	5.51E-04

3 - "Other" components include compressor seals, relief valves, diaphragms, drains, meters, etc.

- 4 - The results of a representative Inlet Gas Analysis were used to determine the following worst-case VOC and HAP components (See Appendix G - Gas Composition):

Pollutant	Inlet Gas	Minimum Contingency: 5%		
		Worst Case	%Total	%VOC
CO2	332 lb/MMscf	350 lb/MMscf	0.74%	---
Methane	38,207 lb/MMscf	40,120 lb/MMscf	85.36%	---
N2/Water/Ethane/Etc	5,752 lb/MMscf	--- lb/MMscf	---	---
VOC	2,643 lb/MMscf	2,780 lb/MMscf	5.91%	100.00%
TOTAL GAS	46,935 lb/MMscf	47,000 lb/MMscf	100.00%	---
Benzene	--- lb/MMscf	2.00 lb/MMscf	0.00%	0.07%
Ethylbenzene	--- lb/MMscf	2.00 lb/MMscf	0.00%	0.07%
n-Hexane	20.39 lb/MMscf	30.00 lb/MMscf	0.06%	1.08%
Methanol	--- lb/MMscf	1.00 lb/MMscf	0.00%	0.00%
Toluene	--- lb/MMscf	2.00 lb/MMscf	0.00%	0.07%
2,2,4-TMP	--- lb/MMscf	2.00 lb/MMscf	0.00%	0.07%
Xylenes	--- lb/MMscf	2.00 lb/MMscf	0.00%	0.07%
Total HAP	20.39 lb/MMscf	41.00 lb/MMscf	0.09%	1.47%

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Storage Tanks (TK-01 thru TK-04)

Source ID	Material Stored	Capacity bbl	Turnovers T-O/yr	T-Put bbl/yr	PRE-CONTROL (VOC)				Control Efficiency	VOC 100% VOC		
					Working lb/yr	Breathing lb/yr	Flash lb/yr	Total lb/yr tpy		lb/hr	tpy	
TK-01 (C-Plant)	Lube Oil	12	1	12	<0.01	<0.01	na	<0.01	<0.01	<0.01	<0.01	
TK-02 (D-Plant)	Lube Oil	12	1	12	<0.01	<0.01		<0.01	<0.01	<0.01	<0.01	
TK-03 (C-Plant)	Oily Water	210	1	210	<0.01	<0.01		<0.01	<0.01	<0.01	<0.01	
TK-04 (D-Plant)	Oily Water	119	1	119	<0.01	<0.01		<0.01	<0.01	<0.01	<0.01	
		119	1	119					<0.01	<0.01	<0.01	<0.01

CH4 na lb/bbl-T-Put		CO2e CH4 GWP = 28	
lb/hr	tpy	lb/hr	tpy
---	---	---	---
---	---	---	---
---	---	---	---
---	---	---	---
---	---	---	---

TOTAL: Pre-Control: 0.00 0.00 Pre-Control: --- --- --- ---

Source ID	Benzene 0.07% VOC		Ethylbenzene 0.07% VOC		n-Hexane 1.08% VOC		Methanol 0.04% VOC		Toluene 0.07% VOC		2,2,4-TMP 0.07% VOC		Xylene 0.07% VOC		Total HAP 1.47% VOC	
	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy	lb/hr	tpy
TK-01 (C-Plant)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TK-02 (D-Plant)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TK-03 (C-Plant)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TK-04 (D-Plant)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
TOTAL:	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Pre-Control: 0E+00 0E+00 0E+00 0E+00 0.00 0.00 0E+00 0E+00 0E+00 0E+00 0E+00 0E+00 0E+00 0E+00 0.00 0.00

- Notes:
- 1 - The Emission Master - Tanks program was used to determine working and breathing losses from the storage tank. See next page for Emission Master Report.
 - 2 - The results of a representative Inlet Gas Analysis were used to determine the following worst-case VOC and HAP components (See Appendix G - Gas Composition):

Pollutant	Inlet Gas	Minimum Contingency: 5%		
		Worst Case	%Total	%VOC
CO2	332.12 lb/MMscf	350.00 lb/MMscf	0.01	---
Methane (CH4)	38,207 lb/MMscf	40,120 lb/MMscf	0.85	---
N2/Water/Ethane/Etc	5,752 lb/MMscf	---	---	---
VOC	2,642.92 lb/MMscf	2,780.00 lb/MMscf	0.06	1.00
TOTAL Gas	46,935 lb/MMscf	47,000 lb/MMscf	100%	---
Benzene	---	2.00 lb/MMscf	0.00	0.00
Ethylbenzene	---	2.00 lb/MMscf	0.00	0.00
n-Hexane	20.39 lb/MMscf	30.00 lb/MMscf	0.00	0.01
Methanol	---	1.00 lb/MMscf	0.00	0.00
Toluene	---	2.00 lb/MMscf	0.00	0.00
2,2,4-TMP	---	2.00 lb/MMscf	0.00	0.00
Xylenes	---	2.00 lb/MMscf	0.00	0.00
Total HAP	20.39 lb/MMscf	41.00 lb/MMscf	0.00	0.01

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Emission Master Tank Report (Insignificant Sources)

Tank ID	Storage Tank Parameters										
	Vessel Type	Diameter	Straight Side (ft)	Roof Height (ft)	Effective Tank Height (ft)	Void Volume (gal)	Maximum Working Volume (gal)	Isothermal Yes/No	Conservation Vent		Paint Solar Absorptance
		D (ft)							Low (psig)	High (psig)	
TK-01 (C-Plant) - Lube Oil Tank	Dome Roof Storage	5.54	2.77	0.74	3.15	568.00	500.00	Normal	-0.30	0.30	0.25
TK-03 (C-Plant) - Oily Water	Dome Roof Storage	11.94	5.97	1.60	6.79	5686.38	5000.00	Normal	-0.30	0.30	0.25
TK-04 (D-Plant) - Oily Water	Dome Roof Storage	14.42	7.20	1.93	8.19	10004.22	8820.00	Normal	-0.30	0.30	0.25
TK-02 (D-Plant) - Lube Oil Tank	Dome Roof Storage	5.54	2.77	0.74	3.15	568.00	500.00	Normal	-0.30	0.30	0.25

Tank ID	Material Stored			Annual Standing Storage Losses (Uncontrolled)				
	Material Type	Material Name	Composition Reference	Vapor Space	Vapor Density	Vapor Space Expansion Factor	Vented Vapor Saturation Factor	VOC Standing Losses
				Vv (ft^3)	Wv (lb/ft^3)	KE dimensionless	Ks dimensionless	Ls (lb/yr)
TK-01 (C-Plant) - Lube Oil Tank	Compound	LUBRIZOL 2002D CHEV-TEX	composition link	9.09	0.00	0.00	1.00	0.00
TK-03 (C-Plant) - Oily Water	Mixture	Mixture	composition link	91.76	0.00	0.00	0.99	0.00
TK-04 (D-Plant) - Oily Water	Mixture	Mixture	composition link	158.31	0.00	0.00	0.99	0.00
TK-02 (D-Plant) - Lube Oil Tank	Compound	LUBRIZOL 2002D CHEV-TEX	composition link	9.09	0.00	0.00	1.00	0.00

Tank ID	Annual Working Losses (Uncontrolled)							Loading Operation			
	Tia (°F)	Vapor Molecular Weight Mv (lb/lb-mole)	VP at Tia Pva (psia)	Throughput		Turnover Factor Kn dimensionless	Crude Oil Factor Kp dimensionless	Working Losses VOC Lw (lb/yr)	Pump-In Rate (gph)	VOC Rate Uncontrolled (lb/hr)	VOC Rate Controlled (lb/hr)
				Q (gal/yr)	Q (bbl/yr)						
TK-01 (C-Plant) - Lube Oil Tank	54.28	0.00	0.00	500.00	11.90	1.00	1.00	<0.01	--	--	--
TK-03 (C-Plant) - Oily Water	54.28	18.02	0.19	5000.00	119.05	1.00	1.00	<0.01	--	--	--
TK-04 (D-Plant) - Oily Water	54.28	18.02	0.19	8820.00	210.00	1.00	1.00	<0.01	--	--	--
TK-02 (D-Plant) - Lube Oil Tank	54.28	0.00	0.00	500.00	11.90	1.00	1.00	<0.01	--	--	--

Tank ID	Annual Emissions		Annual Emissions	
	Uncontrolled VOC	Controlled VOC	Uncontrolled VOC	Controlled VOC
	(lb)	(lb)	(tpy)	(tpy)
TK-01 (C-Plant) - Lube Oil Tank	<0.01	<0.01	<0.01	<0.01
TK-03 (C-Plant) - Oily Water	<0.01	<0.01	<0.01	<0.01
TK-04 (D-Plant) - Oily Water	<0.01	<0.01	<0.01	<0.01
TK-02 (D-Plant) - Lube Oil Tank	<0.01	<0.01	<0.01	<0.01



APPENDIX C STATE ENVIRONMENTAL POLICY ACT
CHECKLIST

SEPA¹ Environmental Checklist

Purpose of checklist

Governmental agencies use this checklist to help determine whether the environmental impacts of your proposal are significant. This information is also helpful to determine if available avoidance, minimization, or compensatory mitigation measures will address the probable significant impacts or if an environmental impact statement will be prepared to further analyze the proposal.

Instructions for applicants

This environmental checklist asks you to describe some basic information about your proposal. Please answer each question accurately and carefully, to the best of your knowledge. You may need to consult with an agency specialist or private consultant for some questions. **You may use “not applicable” or “does not apply” only when you can explain why it does not apply and not when the answer is unknown.** You may also attach or incorporate by reference additional studies reports. Complete and accurate answers to these questions often avoid delays with the SEPA process as well as later in the decision-making process.

The checklist questions apply to **all parts of your proposal**, even if you plan to do them over a period of time or on different parcels of land. Attach any additional information that will help describe your proposal or its environmental effects. The agency to which you submit this checklist may ask you to explain your answers or provide additional information reasonably related to determining if there may be significant adverse impact.

Instructions for lead agencies

Please adjust the format of this template as needed. Additional information may be necessary to evaluate the existing environment, all interrelated aspects of the proposal and an analysis of adverse impacts. The checklist is considered the first but not necessarily the only source of information needed to make an adequate threshold determination. Once a threshold determination is made, the lead agency is responsible for the completeness and accuracy of the checklist and other supporting documents.

Use of checklist for nonproject proposals

For nonproject proposals (such as ordinances, regulations, plans and programs), complete the applicable parts of sections A and B, plus the Supplemental Sheet for Nonproject Actions (Part D). Please completely answer all questions that apply and note that the words "project," "applicant," and "property or site" should be read as "proposal," "proponent," and "affected geographic area," respectively. The lead agency may exclude (for non-projects) questions in “Part B: Environmental Elements” that do not contribute meaningfully to the analysis of the proposal.

¹ <https://ecology.wa.gov/Regulations-Permits/SEPA/Environmental-review/SEPA-guidance/Checklist-guidance>

A. Background

[Find help answering background questions²](#)

1. Name of proposed project, if applicable:

Huntingdon Connector Project – Sumas Compressor Station (Project)

2. Name of applicant:

Williams' Northwest Pipeline LLC (Northwest)

3. Address and phone number of applicant and contact person:

Toby Schwalbe (environmental)
650 S Main Street, Ste. 300
Salt Lake City, UT 84101
385-799-5898
toby.schwalbe@williams.com

Kirsten Derr (air quality)
650 S Main Street, Ste. 300
Salt Lake City, UT 84101
303-475-0989
Kirsten.derr@williams.com

4. Date checklist prepared:

April 30, 2025

5. Agency requesting checklist:

Northwest Clean Air Agency

6. Proposed timing of schedule (including phasing, if applicable):

Proposed construction start: April 15, 2026
Proposed target in service date: November 1, 2026

(If some of the Project facilities necessary to provide the Service have been completed and are ready, Northwest Pipeline will look to bring the project on early.)

7. Do you have any plans for future additions, expansion, or further activity related to or connected with this proposal? If yes, explain.

No

8. List any environmental information you know about that has been prepared, or will be prepared, directly related to this proposal.

An air permit application has been submitted with this SEPA checklist.

9. Do you know whether applications are pending for governmental approvals of other proposals directly affecting the property covered by your proposal? If yes, explain.

No

² <https://ecology.wa.gov/Regulations-Permits/SEPA/Environmental-review/SEPA-guidance/SEPA-checklist-guidance/SEPA-Checklist-Section-A-Background>

10. List any government approvals or permits that will be needed for your proposal, if known.

Notice of Construction air permit from NWCAA.

The Project will be constructed under Northwest's blanket certificate with the Federal Energy Regulatory Commission (FERC) through the Prior Notice process.

11. Give brief, complete description of your proposal, including the proposed uses and the size of the project and site. There are several questions later in this checklist that ask you to describe certain aspects of your proposal. You do not need to repeat those answers on this page. (Lead agencies may modify this form to include additional specific information on project description.)

The Project is an expansion of Williams' Northwest Pipeline (Northwest) to provide up to 78 MDth/d of incremental firm transportation of natural gas in western Washington. The Project is designed to transport additional natural gas supplies from Northwest's interconnect with the Enbridge Westcoast system at Huntingdon/Sumas, Washington, to markets on Northwest along the I-5 corridor.

The energy markets in the western United States are experiencing a paradigm shift, leading to a significant increase in both market demand and volatility. Contributing factors include the electrification of the market through aggressive solar and wind capacity development within the Western Electricity Coordinating Council, the retirement of coal and nuclear facilities, and potential data center growth in the region. This continued expansion of power generation has resulted in tighter balancing and flexibility requirements on the pipeline, making additional firm transportation capacity essential for effectively managing the ensuing volatility.

Shippers unable to contract directly with the transporter for firm transportation capacity must negotiate with other shippers holding firm transportation capacity to transport their natural gas through constrained areas on Northwest's system. This method can incur higher costs and does not guarantee that firm capacity will be available for purchase on peak utilization days. By subscribing for firm transportation capacity directly with the transporter, which the Project will allow, shippers can secure their ability to transport natural gas along the Project's path even on peak days, thereby mitigating the risk of having their requested transportation curtailed or incurring additional costs to seek capacity from other shippers, if available.

By increasing primary firm pipeline capacity, the Project will provide shippers firm access to secure gas supplies, thereby enhancing overall reliability. The Project will also assist in reducing NOx emissions from their existing levels at each of the compressor stations where the Project's upgrades are being implemented.

The Project will consist of additional primary firm transportation service on Northwest's System extending along three paths.

Path 1: Sumas Primary Receipt Point at milepost 1484.6 in Whatcom County, Washington to the Bellingham In-Line Transfer Primary Delivery Point at milepost 1472.2 in Whatcom County, Washington. The total additional primary firm transportation service for Path 1 is 35,000 dth/d.

Path 2: Sumas Primary Receipt Point at milepost 1484.6 in Whatcom County, Washington to the Sedro Woolley Primary Delivery Point, in Skagit County, Washington. The total additional primary firm transportation service for Path 2 is 22,860 dth/d.

Path 3: Sumas Primary Receipt at milepost 1484.6 in Whatcom County, Washington to the Grays Harbor Meter Station Primary Delivery Point, in Whatcom County, Washington. The total additional primary firm transportation service for Path 3 is 20,139 dth/d.

The maximum fuel rate modeled at the Sumas Compressor Station would rise 3.7% and the overall fuel rate in Washington state would rise 2.4% as a result of the Project. However, actual fuel consumption at the station will be less than the maximum modeled fuel rate due to varying seasonal and contractual demands.

The following upgrades are proposed at the Sumas Compressor Station (Whatcom County, WA) within the existing graded, graveled/paved, fenced facility.

- Turbine Upgrade
 - Existing turbine and compressor Unit No. 9 will be upgraded from a Mars 90 25PPM NOx to a Mars 100-T16000 9PPM NOx within the existing compressor station building.
 - Replace Inlet Air filter. This will require a new foundation approximately 20' x 50'.
- Re-stage existing compressor to allow for the incremental increase of gas flow.
- Replace Inlet Gas filter. This will require a new foundation approximately 15' x 18'.
- Replace twelve (12) existing orifice meters with 6-Coriolis meters within the existing Sumas meter building.

12. Location of the proposal. Give sufficient information for a person to understand the precise location of your proposed project, including a street address, if any, and section, township, and range, if known. If a proposal would occur over a range of area, provide the range or boundaries of the site(s). Provide a legal description, site plan, vicinity map, and topographic map, if reasonably available. While you should submit any plans required by the agency, you are not required to duplicate maps or detailed plans submitted with any permit applications related to this checklist.

The Sumas Compressor Station is located at 4738 Jones Road, Sumas, WA 98295. It is approximately 2 miles east of Sumas on Jones Road from the intersection of State Route 9 in Section 36, T. 41 N., R. 4 E. (see Map 1 and Map 2 in Attachment A).

B. Environmental Elements

1. Earth

[Find help answering earth questions](#)³

a. General description of the site:

The site is an existing, active natural gas compressor station, which is graded, graveled/paved, diked, and fenced.

Circle or highlight one: Flat, rolling, hilly, steep slopes, mountainous, other:

b. What is the steepest slope on the site (approximate percent slope)?

0% slope – the site is flat.

c. What general types of soils are found on the site (for example, clay, sand, gravel, peat, muck)? If you know the classification of agricultural soils, specify them, and note any agricultural land of long-term commercial significance and whether the proposal results in removing any of these soils.

The upgrades will occur within the graded/graveled/paved existing facility. The entire Project area is underlain by Puget silt loam, drained, 0 to 2 percent slopes which has been converted to industrial use. No soils will be removed.

d. Are there surface indications or history of unstable soils in the immediate vicinity? If so, describe.

No

³ <https://ecology.wa.gov/regulations-permits/sepa/environmental-review/sepa-guidance/sepa-checklist-guidance/sepa-checklist-section-b-environmental-elements/environmental-elements-earth>

- e. Describe the purpose, type, total area, and approximate quantities and total affected area of any filling, excavation, and grading proposed. Indicate source of fill.**

No significant filling, grading, or excavation is proposed, as the site has previously been graded, graveled/paved. Excavation for the new foundation (20' x 50') required for replacing inlet air filter is estimated to be 30 cubic yards and 7 cubic yards for the inlet gas filter foundation (15' x 18'). Map 2 in Attachment A shows the locations of the proposed foundations within the existing compressor station facility.

- f. Could erosion occur because of clearing, construction, or use? If so, generally describe.**

No

- g. About what percent of the site will be covered with impervious surfaces after project construction (for example, asphalt or buildings)?**

Upgrades will occur on or within existing impervious surfaces within the existing facility.

- h. Proposed measures to reduce or control erosion, or other impacts to the earth, if any.**

Facility upgrades will occur within the existing graded and graveled/paved compressor station facility. No disturbance will occur to undisturbed areas. Erosion is not anticipated, but silt fence, straw wattles, or other sedimentation and erosion control devices will be installed if needed to minimize potential transport of sediment from the construction area and entering the compressor station's existing stormwater retention pond.

2. Air

[Find help answering air questions](#)⁴

- a. What types of emissions to the air would result from the proposal during construction, operation, and maintenance when the project is completed? If any, generally describe and give approximate quantities if known.**

The Project will have a temporary, localized increase in the number of vehicles on-site each day (e.g., workers transport, some heavy equipment). Some dust may be generated during construction from movement on graveled surfaces. . The Project, although increasing horsepower, will actually have very little effect on criteria or TAP pollutants with some individual pollutants decreasing slightly and some increasing slightly, but will result in an increase of GHG emissions.

- b. Are there any off-site sources of emissions or odor that may affect your proposal? If so, generally describe.**

No

⁴ <https://ecology.wa.gov/Regulations-Permits/SEPA/Environmental-review/SEPA-guidance/SEPA-checklist-guidance/SEPA-Checklist-Section-B-Environmental-elements/Environmental-elements-Air>

c. Proposed measures to reduce or control emissions or other impacts to air, if any:

Vehicle and equipment travel within the compressor station are confined to existing graveled/paved travel ways, and speeds are restricted within the facility. Additionally, vehicle and equipment travel within the facility will be limited to the immediate work area; excavation is only required to install small foundations which will minimize the potential for fugitive dust

3. Water

[Find help answering water questions⁵](#)

a. Surface:

[Find help answering surface water questions⁶](#)

1. Is there any surface water body on or in the immediate vicinity of the site (including year-round and seasonal streams, saltwater, lakes, ponds, wetlands)? If yes, describe type and provide names. If appropriate, state what stream or river it flows into.

There is one Category II wetland and two Category III wetlands located adjacent to the Sumas Compressor Station diked facility boundary. PEM wetlands (Category III) are northeast of facility and in an agriculture field/ditch west of the facility. A PFO wetland (Category II) is north of the agricultural field to the west. The most recent wetland delineation report was completed for a previous project at the compressor station site; however, it provides an accurate delineation of the wetlands in the vicinity of the facility (see Attachment B). The Project will not impact wetlands or wetland buffers (see Map 2 in Attachment A.)

2. Will the project require any work over, in, or adjacent to (within 200 feet) the described waters? If yes, please describe and attach available plans.

The Project's replacement of the inlet air filter is within approximately 140 feet of a PEM wetland (Category III). However, the replacement activities will occur within the existing graveled/paved facility boundary, which is separated from the wetland by a dike. The wetland will not be affected.

3. Estimate the amount of fill and dredge material that would be placed in or removed from surface water or wetlands and indicate the area of the site that would be affected. Indicate the source of fill material.

None

⁵ <https://ecology.wa.gov/Regulations-Permits/SEPA/Environmental-review/SEPA-guidance/SEPA-checklist-guidance/SEPA-Checklist-Section-B-Environmental-elements/Environmental-elements-3-Water>

⁶ <https://ecology.wa.gov/Regulations-Permits/SEPA/Environmental-review/SEPA-guidance/SEPA-checklist-guidance/SEPA-Checklist-Section-B-Environmental-elements/Environmental-elements-3-Water/Environmental-elements-Surface-water>

- 4. Will the proposal require surface water withdrawals or diversions? Give a general description, purpose, and approximate quantities if known.**

No

- 5. Does the proposal lie within a 100-year floodplain? If so, note location on the site plan.**

Yes. The entire facility is located within the Sumas River and Saar Creek 100-year floodplain - Zone A. The facility is protected from potential flood flows by a dike that surrounds the compressor station site.

- 6. Does the proposal involve any discharges of waste materials to surface waters? If so, describe the type of waste and anticipated volume of discharge.**

No

b. Ground:

[Find help answering ground water questions](#)⁷

- 1. Will groundwater be withdrawn from a well for drinking water or other purposes? If so, give a general description of the well, proposed uses and approximate quantities withdrawn from the well. Will water be discharged to groundwater? Give a general description, purpose, and approximate quantities if known.**

No

- 2. Describe waste material that will be discharged into the ground from septic tanks or other sources, if any (domestic sewage; industrial, containing the following chemicals...; agricultural; etc.). Describe the general size of the system, the number of such systems, the number of houses to be served (if applicable), or the number of animals or humans the system(s) are expected to serve.**

The existing facility is on a septic system for sanitary waste only and connected to a few bathrooms, sinks, and a kitchen on the site. The Project will have no effect on discharge sources or volumes.

c. Water Runoff (including stormwater):

- 1. Describe the source of runoff (including storm water) and method of collection and disposal, if any (include quantities, if known). Where will this water flow? Will this water flow into other waters? If so, describe.**

A berm/dike surrounds the facility. On-site sheet flow drains to sumps which are pumped to a retention pond on the north site boundary. Stormwater in the areas east and west of the facility boundary drain to a ditch along Jones Rd to the south.

⁷ <https://ecology.wa.gov/Regulations-Permits/SEPA/Environmental-review/SEPA-guidance/SEPA-checklist-guidance/SEPA-Checklist-Section-B-Environmental-elements/Environmental-elements-3-Water/Environmental-elements-Groundwater>

2. Could waste materials enter ground or surface waters? If so, generally describe.

No. During operations, all bulk materials (mostly lube oil) kept onsite are in secondary containment and subject to the Sumas Compressor Station's site-specific Spill Plan requirements, including regular inspections. During construction, best management practices will be implemented as outlined in the Project's Spill Plan (see Attachment C) to prevent and/or mitigate any spills that may occur.

3. Does the proposal alter or otherwise affect drainage patterns in the vicinity of the site? If so, describe.

No

d. Proposed measures to reduce or control surface, ground, and runoff water, and drainage pattern impacts, if any:

The current compressor station drainage system is adequate; no new modification measures are needed.

4. Plants

[Find help answering plants questions](#)

a. Check the types of vegetation found on the site:

There is no vegetation within the graded and graveled/paved compressor station boundary.

- deciduous tree: alder, maple, aspen, other**
- evergreen tree: fir, cedar, pine, other**
- shrubs**
- grass**
- pasture**
- crop or grain**
- orchards, vineyards, or other permanent crops.**
- wet soil plants: cattail, buttercup, bullrush, skunk cabbage, other**
- water plants: water lily, eelgrass, milfoil, other**
- other types of vegetation**

b. What kind and amount of vegetation will be removed or altered?

No vegetation will be removed in association with the Project.

c. List threatened and endangered species known to be on or near the site.

None known.

d. Proposed landscaping, use of native plants, or other measures to preserve or enhance vegetation on the site, if any.

None. The perimeter of the existing compressor station facility is screened with trees, shrubs, with an understory of grasses, which will not be disturbed. The Project area is covered by gravel/pavement, concrete foundations, and buildings.

e. List all noxious weeds and invasive species known to be on or near the site.

None. The compressor station facility surfaces are maintained to be weed/vegetation free to prevent a potential fire hazard.

5. Animals

[Find help answering animal questions](#)⁸

a. List any birds and other animals that have been observed on or near the site or are known to be on or near the site.

Not applicable. The compressor station does not provide habitat for animals. Song birds pass through the area and may use the vegetation screening around the facility for foraging, roosting, and nesting.

Examples include:

- ~~Birds: hawk, heron, eagle, songbirds, other:~~
- ~~Mammals: deer, bear, elk, beaver, other:~~
- ~~Fish: bass, salmon, trout, herring, shellfish, other:~~

b. List any threatened and endangered species known to be on or near the site.

None known. No suitable habitat is present for threatened and endangered species within or near the site (see Table 7 in Attachment B).

c. Is the site part of a migration route? If so, explain.

Migratory birds pass through the area within the Pacific Flyway.

d. Proposed measures to preserve or enhance wildlife, if any.

None. The Project is within an existing graded and graveled/paved facility.

e. List any invasive animal species known to be on or near the site.

None. The compressor station facilities surfaces are maintained to be weed/vegetation free to prevent a potential fire hazard.

⁸ <https://ecology.wa.gov/Regulations-Permits/SEPA/Environmental-review/SEPA-guidance/SEPA-checklist-guidance/SEPA-Checklist-Section-B-Environmental-elements/Environmental-elements-5-Animals>

6. Energy and natural resources

[Find help answering energy and natural resource questions](#)⁹

- a. **What kinds of energy (electric, natural gas, oil, wood stove, solar) will be used to meet the completed project's energy needs? Describe whether it will be used for heating, manufacturing, etc.**

The current and new compression equipment and generators are fired by natural gas.

- b. **Would your project affect the potential use of solar energy by adjacent properties? If so, generally describe.**

No

- c. **What kinds of energy conservation features are included in the plans of this proposal? List other proposed measures to reduce or control energy impacts, if any.**

See Project Description in Section A.11.

7. Environmental health

[Health Find help with answering environmental health questions](#)¹⁰

- a. **Are there any environmental health hazards, including exposure to toxic chemicals, risk of fire and explosion, spill, or hazardous waste, that could occur because of this proposal? If so, describe.**

Natural gas is an inherently flammable product, but risks of fire and explosion are very low given the safety features/policies and redundancies in place at the facility.

1. **Describe any known or possible contamination at the site from present or past uses.**

Under the Washington Department of Ecology Voluntary Cleanup Program, Northwest completed four rounds of site investigation to delineate the nature and extent of soil and groundwater contamination at the site between 2005 and 2010. In 2018, interim remedial actions (excavation and disposal) were completed in eleven areas for cadmium, lead, and chromium, arsenic, and mercury under the Model Toxics Control Act at the Sumas Compressor Station (Cleanup Site ID 3838). (<https://apps.ecology.wa.gov/cleanupsearch/site/3838#site-documents>)

2. **Describe existing hazardous chemicals/conditions that might affect project development and design. This includes underground hazardous liquid and gas transmission pipelines located within the project area and in the vicinity.**

Natural gas pipelines are connected to the facility, and numerous lines are located within the facility. Any subsurface work would be supervised by Northwest's operation inspection staff according to Northwest's operational procedures to

⁹ <https://ecology.wa.gov/Regulations-Permits/SEPA/Environmental-review/SEPA-guidance/SEPA-checklist-guidance/SEPA-Checklist-Section-B-Environmental-elements/Environmental-elements-6-Energy-natural-resou>

¹⁰ <https://ecology.wa.gov/Regulations-Permits/SEPA/Environmental-review/SEPA-guidance/SEPA-checklist-guidance/SEPA-Checklist-Section-B-Environmental-elements/Environmental-elements-7-Environmental-health>

ensure safety and would be conducted using non-invasive (e.g., hydroexcavation) confirmation procedures to ensure that no lines are present.

3. Describe any toxic or hazardous chemicals that might be stored, used, or produced during the project's development or construction, or at any time during the operating life of the project.

Fuel for equipment used during construction may be stored on site temporarily. Materials used for fabrication, coatings, lubrication, etc. will be on-site as needed during construction and operations. Northwest would implement the Project Spill Plan (see Attachment C) to prevent or mitigate any spills that may occur during the Project.

4. Describe special emergency services that might be required.

Northwest Pipeline's inspection staff and contractor will be trained to rapidly and appropriately respond to any type of emergency that could potentially occur during the Project and will follow Northwest's emergency response procedures during any incident.

5. Proposed measures to reduce or control environmental health hazards, if any.

The Project Spill Plan (see Attachment C) details the measures that will be followed to prevent and/or mitigate any spills that may occur during the Project.

b. Noise

1. What types of noise exist in the area which may affect your project (for example: traffic, equipment, operation, other)?

None known. The Project is in a rural area with low levels of traffic and noise, mostly associated with agricultural uses. Primary industrial operations in the area are energy-related.

2. What types and levels of noise would be created by or associated with the project on a short-term or a long-term basis (for example: traffic, construction, operation, other)? Indicate what hours noise would come from the site)?

There could be a temporary, local increase in noise associated with worker traffic and equipment use during construction. Noise levels associated with the facility upgrades will be designed to be the same as or lower than current levels following implementation of the Project.

3. Proposed measures to reduce or control noise impacts, if any:

Work and traffic will only occur during normal daytime business hours. The turbine upgrades will occur within the existing compressor station building which is sealed and includes noise insulation and exhaust noise reduction technology. The compressor station facility is also screened by noise-reducing trees and other vegetation.

8. Land and shoreline use

[Find help answering land and shoreline use questions](#)¹¹

- a. What is the current use of the site and adjacent properties? Will the proposal affect current land uses on nearby or adjacent properties? If so, describe.**

The current use of the site is a natural gas compressor station. Adjacent parcels are used for agriculture and natural gas transmission. The Project will not affect land uses in the vicinity of the site.

- b. Has the project site been used as working farmlands or working forest lands? If so, describe. How much agricultural or forest land of long-term commercial significance will be converted to other uses because of the proposal, if any? If resource lands have not been designated, how many acres in farmland or forest land tax status will be converted to nonfarm or nonforest use?**

The site is an existing fenced and graded and graveled/paved compressor station. No impacts to resource lands (farmland or forest land) will occur.

- 1. Will the proposal affect or be affected by surrounding working farm or forest land normal business operations, such as oversize equipment access, the application of pesticides, tilling, and harvesting? If so, how?**

The Project will not affect nor be affected by farm or forest land operations.

- c. Describe any structures on the site.**

Please refer to Map 2 in Attachment A. The compressor station is developed with numerous buildings and assets associated with receipt, compression and transmission of natural gas including an office building.

- d. Will any structures be demolished? If so, what?**

No

- e. What is the current zoning classification of the site?**

AG

- f. What is the current comprehensive plan designation of the site?**

AG

- g. If applicable, what is the current shoreline master program designation of the site?**

Not applicable. The area is not designated as a shoreline.

- h. Has any part of the site been classified as a critical area by the city or county? If so, specify.**

Per County Critical Area maps, the site is in critical areas of "Frequently Flooded" and aquifer recharge (high).

¹¹ <https://ecology.wa.gov/Regulations-Permits/SEPA/Environmental-review/SEPA-guidance/SEPA-checklist-guidance/SEPA-Checklist-Section-B-Environmental-elements/Environmental-elements-8-Land-shoreline-use>

i. Approximately how many people would reside or work in the completed project?

The pre- and post-construction operational staff would remain the same – between 10 and 20 people. Although the station is manned 24 hours a day, no one resides at the station.

j. Approximately how many people would the completed project displace?

None

k. Proposed measures to avoid or reduce displacement impacts, if any.

Not applicable.

l. Proposed measures to ensure the proposal is compatible with existing and projected land uses and plans, if any.

Land uses would remain the same before and after construction.

m. Proposed measures to reduce or control impacts to agricultural and forest lands of long-term commercial significance, if any:

The Project would not affect agricultural or forest lands.

9. Housing

[Find help answering housing questions](#)¹²

a. Approximately how many units would be provided, if any? Indicate whether high, middle, or low-income housing.

Not applicable.

b. Approximately how many units, if any, would be eliminated? Indicate whether high, middle, or low-income housing.

Not applicable.

c. Proposed measures to reduce or control housing impacts, if any:

Not applicable.

10. Aesthetics

[Find help answering aesthetics questions](#)¹³

a. What is the tallest height of any proposed structure(s), not including antennas; what is the principal exterior building material(s) proposed?

The heights of the replaced structures will be the same pre-construction and post-construction. The upgraded turbine will be replaced within the existing station building.

¹² <https://ecology.wa.gov/Regulations-Permits/SEPA/Environmental-review/SEPA-guidance/SEPA-checklist-guidance/SEPA-Checklist-Section-B-Environmental-elements/Environmental-elements-9-Housing>

¹³ <https://ecology.wa.gov/Regulations-Permits/SEPA/Environmental-review/SEPA-guidance/SEPA-checklist-guidance/SEPA-Checklist-Section-B-Environmental-elements/Environmental-elements-10-Aesthetics>

b. What views in the immediate vicinity would be altered or obstructed?

Views would not be affected by the Project.

c. Proposed measures to reduce or control aesthetic impacts, if any:

None needed.

11. Light and glare

[Find help answering light and glare questions](#)¹⁴

a. What type of light or glare will the proposal produce? What time of day would it mainly occur?

The Project would not result in light or glare impacts. Construction is planned during the day during normal business hours.

b. Could light or glare from the finished project be a safety hazard or interfere with views?

No

c. What existing off-site sources of light or glare may affect your proposal?

None

d. Proposed measures to reduce or control light and glare impacts, if any:

None

12. Recreation

[Find help answering recreation questions](#)

a. What designated and informal recreational opportunities are in the immediate vicinity?

None within the immediate vicinity of the Project. Surrounding properties are used for agriculture and natural gas transmission.

b. Would the proposed project displace any existing recreational uses? If so, describe.

No

c. Proposed measures to reduce or control impacts on recreation, including recreation opportunities to be provided by the project or applicant, if any:

None

¹⁴ <https://ecology.wa.gov/Regulations-Permits/SEPA/Environmental-review/SEPA-guidance/SEPA-checklist-guidance/SEPA-Checklist-Section-B-Environmental-elements/Environmental-elements-11-Light-glare>

13. Historic and cultural preservation

[Find help answering historic and cultural preservation questions](#)¹⁵

- a. **Are there any buildings, structures, or sites, located on or near the site that are over 45 years old listed in or eligible for listing in national, state, or local preservation registers? If so, specifically describe.**

While the original site for the compressor station was developed in the late 1950's, it is a working facility, and the buildings are not eligible for listing.

- b. **Are there any landmarks, features, or other evidence of Indian or historic use or occupation? This may include human burials or old cemeteries. Are there any material evidence, artifacts, or areas of cultural importance on or near the site? Please list any professional studies conducted at the site to identify such resources.**

No

- c. **Describe the methods used to assess the potential impacts to cultural and historic resources on or near the project site. Examples include consultation with tribes and the department of archeology and historic preservation, archaeological surveys, historic maps, GIS data, etc.**

Company records since 1950s when facility was built and cultural resource reports completed for various past Northwest projects have all had findings of “no effect to historic properties” under Section 106 NHPA consultation. Additionally, as required for the FERC Prior Notice, Northwest is required to complete NHPA Section 106 consultation with SHPOs and THPOs prior to submitting the Prior Notice anticipated in February 2026. Northwest has an MOU with the DAHP and this Project will apply to that cultural review process for compliance with Section 106. Northwest plans to complete the MOU cultural review process during the fall of 2025.

- d. **Proposed measures to avoid, minimize, or compensate for loss, changes to, and disturbance to resources. Please include plans for the above and any permits that may be required.**

Not applicable

14. Transportation

[Find help with answering transportation questions](#)¹⁶

- a. **Identify public streets and highways serving the site or affected geographic area and describe proposed access to the existing street system. Show on site plans, if any.**

The only public street that serves the Project is Jones Road (to the south, via driveways). Existing driveways provide access.

¹⁵ <https://ecology.wa.gov/Regulations-Permits/SEPA/Environmental-review/SEPA-guidance/SEPA-checklist-guidance/SEPA-Checklist-Section-B-Environmental-elements/Environmental-elements-13-Historic-cultural-p>

¹⁶ <https://ecology.wa.gov/Regulations-Permits/SEPA/Environmental-review/SEPA-guidance/SEPA-checklist-guidance/SEPA-Checklist-Section-B-Environmental-elements/Environmental-elements-14-Transportation>

- b. Is the site or affected geographic area currently served by public transit? If so, generally describe. If not, what is the approximate distance to the nearest transit stop?**

No

- c. Will the proposal require any new or improvements to existing roads, streets, pedestrian, bicycle, or state transportation facilities, not including driveways? If so, generally describe (indicate whether public or private).**

No

- d. Will the project or proposal use (or occur in the immediate vicinity of) water, rail, or air transportation? If so, generally describe.**

No

- e. How many vehicular trips per day would be generated by the completed project or proposal? If known, indicate when peak volumes would occur and what percentage of the volume would be trucks (such as commercial and nonpassenger vehicles). What data or transportation models were used to make these estimates?**

The completed Project will not generate additional vehicular trips. Post construction will be the same as pre-construction.

- f. Will the proposal interfere with, affect, or be affected by the movement of agricultural and forest products on roads or streets in the area? If so, generally describe.**

No

- g. Proposed measures to reduce or control transportation impacts, if any:**

None

15. Public services

[Find help answering public service questions¹⁷](#)

- a. Would the project result in an increased need for public services (for example: fire protection, police protection, public transit, health care, schools, other)? If so, generally describe.**

No

- b. Proposed measures to reduce or control direct impacts on public services, if any.**

None

¹⁷ <https://ecology.wa.gov/regulations-permits/sepa/environmental-review/sepa-guidance/sepa-checklist-guidance/sepa-checklist-section-b-environmental-elements/environmental-elements-15-public-services>

16. Utilities

[Find help answering utilities questions¹⁸](#)

- a. Circle utilities currently available at the site: **electricity, natural gas, water, refuse service, telephone, sanitary sewer, septic system, other:**

- b. Describe the utilities that are proposed for the project, the utility providing the service, and the general construction activities on the site or in the immediate vicinity which might be needed.

Puget Sound Energy is the existing electricity provider. Natural gas for the turbines is self-supplied. There will be no change to the electrical service at the facility. No new electrical equipment will be installed as part of the project.

C. Signature

[Find help about who should sign¹⁹](#)

The above answers are true and complete to the best of my knowledge. I understand that the lead agency is relying on them to make its decision.



Type name of signee: Toby Schwalbe

Position and agency/organization: Sr. Environmental Specialist
Williams Northwest Pipeline LLC

Date submitted: May 1, 2025

¹⁸ <https://ecology.wa.gov/regulations-permits/sepa/environmental-review/sepa-guidance/sepa-checklist-guidance/sepa-checklist-section-b-environmental-elements/environmental-elements-16-utilities>

¹⁹ <https://ecology.wa.gov/Regulations-Permits/SEPA/Environmental-review/SEPA-guidance/SEPA-checklist-guidance/SEPA-Checklist-Section-C-Signature>

D. Supplemental sheet for nonproject actions

[Find help for the nonproject actions worksheet²⁰](#)

Do not use this section for project actions.

Because these questions are very general, it may be helpful to read them in conjunction with the list of the elements of the environment.

When answering these questions, be aware of the extent the proposal, or the types of activities likely to result from the proposal, would affect the item at a greater intensity or at a faster rate than if the proposal were not implemented. Respond briefly and in general terms.

1. How would the proposal be likely to increase discharge to water; emissions to air; production, storage, or release of toxic or hazardous substances; or production of noise?

The Project will not result in increased discharge to water and will result in the potential for increased GHG emissions. The potential to emit for other pollutants does not change significantly.

• **Proposed measures to avoid or reduce such increases are:**

Not applicable.

2. How would the proposal be likely to affect plants, animals, fish, or marine life?

No effect.

• **Proposed measures to protect or conserve plants, animals, fish, or marine life are:**

Not applicable.

3. How would the proposal be likely to deplete energy or natural resources?

No effect.

• **Proposed measures to protect or conserve energy and natural resources are:**

Not applicable.

4. How would the proposal be likely to use or affect environmentally sensitive areas or areas designated (or eligible or under study) for governmental protection, such as parks, wilderness, wild and scenic rivers, threatened or endangered species habitat, historic or cultural sites, wetlands, floodplains, or prime farmlands?

No effect.

• **Proposed measures to protect such resources or to avoid or reduce impacts are:**

Not applicable.

²⁰ <https://ecology.wa.gov/regulations-permits/sepa/environmental-review/sepa-guidance/sepa-checklist-guidance/sepa-checklist-section-d-non-project-actions>

5. How would the proposal be likely to affect land and shoreline use, including whether it would allow or encourage land or shoreline uses incompatible with existing plans?

No effect.

- **Proposed measures to avoid or reduce shoreline and land use impacts are:**

Not applicable.

6. How would the proposal be likely to increase demands on transportation or public services and utilities?

No effect.

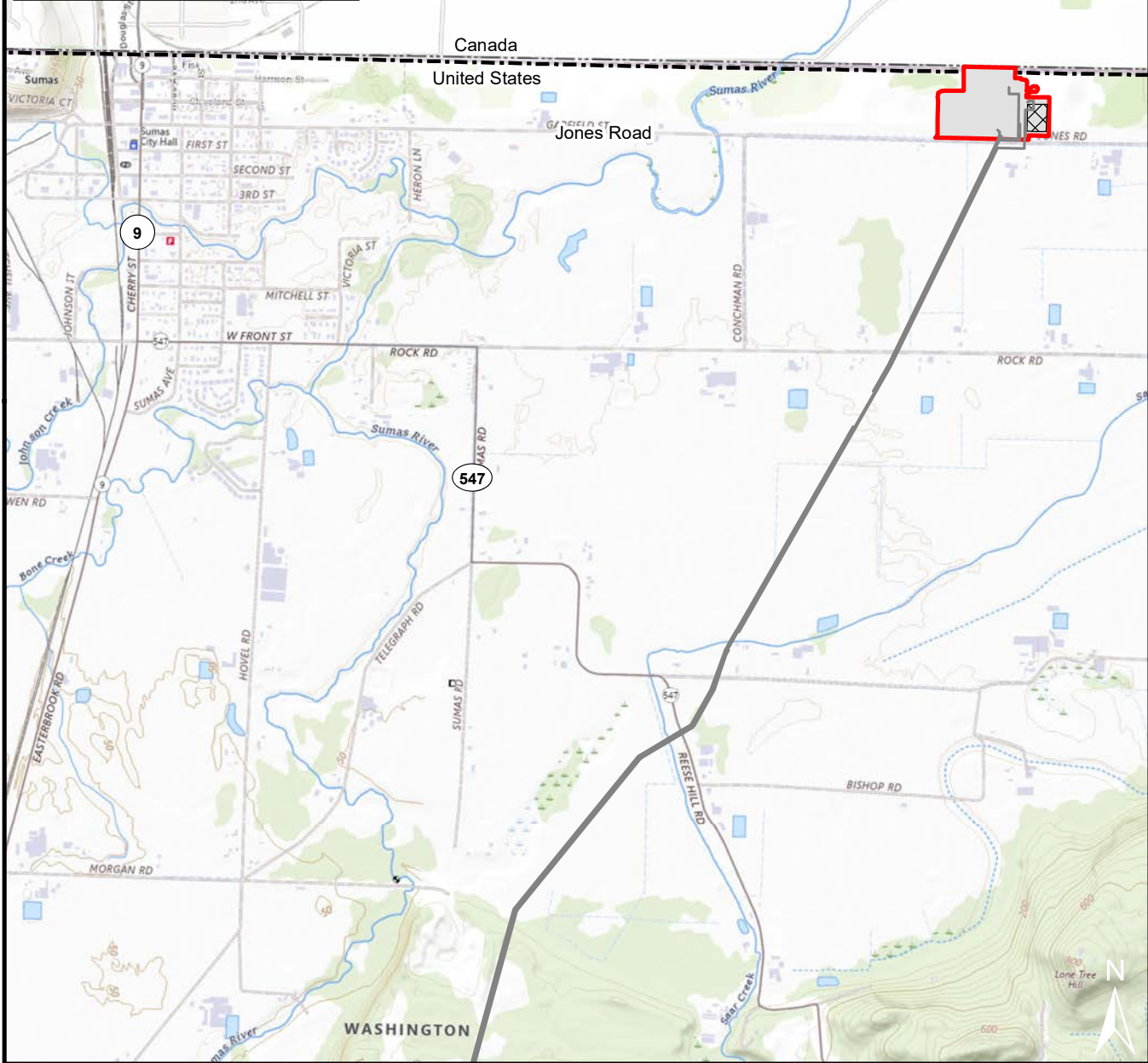
- **Proposed measures to reduce or respond to such demand(s) are:**

Not applicable.




7. Identify, if possible, whether the proposal may conflict with local, state, or federal laws or requirements for the protection of the environment.

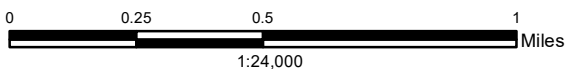
No conflicts.

ATTACHMENT A
Project Maps



Legend

-  Williams Existing Pipeline System
-  Project Limits
-  Sumas Compressor Station



Huntingdon Project
Sumas Compressor Station
Map 1 - General Location

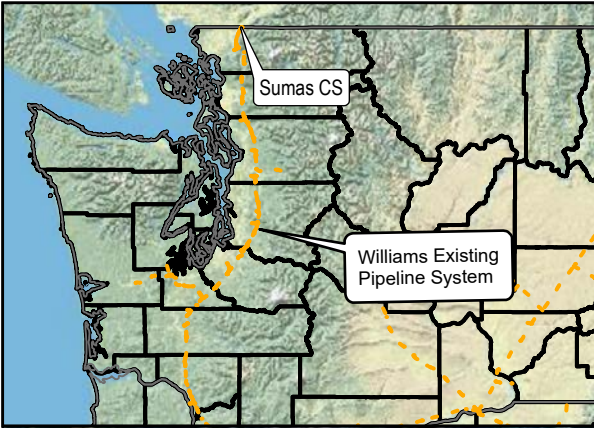
Whatcom County, Washington

Sec. 36, T.41N., R.4E.



Huntingdon Project Sumas Compressor Station Map 2 - Site Plan

Whatcom County, WA Sec. 36, T41N, R4E



Legend

- Modification Areas
- Wetland
- Wetland Buffer

ATTACHMENT B
Wetland Delineation Report

July 17, 2023

Clay Gustaves
 Williams Northwest Pipeline
 Clay.gustaves@williams.com
 c/o Dan Duce
 dduce@edgeenvironmental.com

Williams Sumas Compressor Station, Wetland Delineation Report

DCG/Watershed Reference Number: 230615

Summary

This report has been prepared to present the findings of a wetland delineation study located at the Williams Northwest Pipeline Sumas facility, located at 4738 Jones Road near the City of Sumas in unincorporated Whatcom County, Washington (parcels #4104364242920000, 4104363333040000, & 4104364973040000). In addition to the information and findings presented in this report, the following documents are enclosed:

- Site Photos
- Delineation Figure
- Wetland Determination Data Forms
- Wetland Rating Forms and Figures

Three wetlands (Wetland A-C) were identified and flagged within the study area. One potential wetland was noted off-site to the east. See the table below for required wetland buffers.

Table 1. Summary of wetlands, streams, and required buffers.

Feature Name	Category/Type	Habitat Score	Buffer (ft)
Wetland A	Category III	5	150
Wetland B	Category II	6	150
Wetland C	Category III	5	150
Potential Wetland D	Est. Category II	5	150

Study Area

The study area is defined as parcels 4104364242920000, 4104363333040000, & 4104364973040000 and is approximately 48.71 acres in size (Figure 1). Adjacent public or private property within 200 feet was screened from the edge of parcel or nearest publicly accessible land; no private property was accessed without permission. It is situated within Section 36 of Township 41 North, Range 04 East.

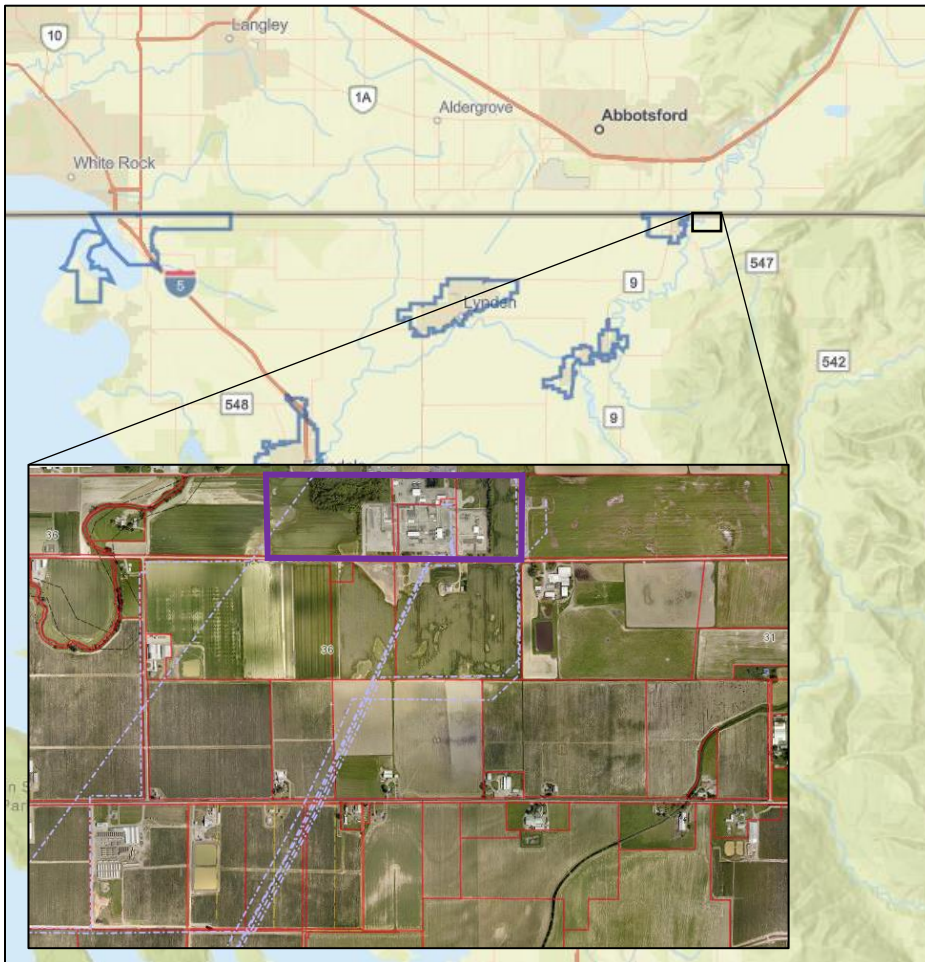


Figure 1. Study area map.

Methods

Field investigations for the delineation study were conducted on June 22 and 23, 2023, by ecologists Grace Brennan and Roen Hohlfeld. Senior Ecologists, Ryan Kahlo, PWS, and Nell Lund, PWS, supervised the study.

The study area was evaluated for wetlands using methodology from the *Corps of Engineers Wetland Delineation Manual* (Environmental Laboratory 1987) and the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region Version 2.0* (U.S. Army Corps of Engineers 2010). The presence or absence of wetlands was determined based on an examination of vegetation, soils, and hydrology. These parameters were sampled at several locations along the wetland boundaries to determine the approximate wetland edge. Wetlands were classified using the Washington State Department of Ecology's *Wetland Rating System for Western Washington*: (Hruby 2014).

Characterization of weather conditions for precipitation in the Wetland Determination Data Forms were determined using the WETS table methodology (USDA, NRCS 2015). The "Bellingham Intl AP" station from 1991-2020 was used as a source for precipitation data (<http://agacis.rcc-acis.org/>). The WETS table methodology uses climate data from the three months prior to the site visit month to determine if normal conditions are present in the study area region.

The study area was evaluated for streams based on the presence or absence of an ordinary high water mark (OHWM) as defined by Section 404 of the Clean Water Act, the Washington Administrative Code (WAC) 220-660-030, and the Revised Code of Washington (RCW) 90.58.030 and guidance documents including *Determining the Ordinary High Water Mark for Shoreline Management Act Compliance in Washington State* (Anderson 2016) and *A Guide to Ordinary High Water Mark (OHWM) Delineation for Non-Perennial Streams in the Western Mountains, Valleys, and Coast Region of the United States* (Mersel and Lichvar 2014).

Public-domain information on the subject properties was reviewed for this delineation study. Resources and review findings are presented in Table 2 of the "Environmental Setting" section of this letter.

Environmental Setting

The study area is in the Headwaters Sumas Creek sub-basin of the Nooksack watershed (WRIA 1). It is located east of the City of Sumas and is surrounded by agricultural land use. The property borders Canada directly to the north. Site topography is generally flat, with small depressions and berms located in certain areas of the site (Photo 1).

The subject property is approximately 48.71 acres in size and is developed with a natural gas compressor station and associated buildings and infrastructure (Photo 2). Portions of the property on the east and western edges of the site are agricultural areas that produce hay

(Photo 3). On the northern boundary of the site, one wetland mitigation area is present (Photo 4). This area is now densely vegetated.

Public-domain information reviewed for the site is summarized below (Table 2).

Table 2. Summary of online mapping and inventory resources.

Resource	Summary
USDA NRCS: Web Soil Survey	<i>Briscot silt loam, drained, 0 to 2 percent slopes in the southwest corner of the site. This is rated as hydric soil with a poorly drained drainage class. Puget silt loam, drained, 0 to 2 percent slopes throughout the remainder of the study area. This is not rated as a hydric soil and has a poorly drained drainage class.</i>
USFWS: NWI Wetland Mapper	<i>None within or adjacent to the subject parcel.</i>
WDFW: PHS on the Web	<i>None mapped within or adjacent to the subject parcel. Sumas River approximately 1,900 feet west to the west mapped as a fish-bearing stream that contains sockeye, chum, residential coastal cutthroat, coho, steelhead, Dolley Varden/bull trout and fall Chinook presence; along with coho breeding areas.</i>
WDFW & NWIFC: Statewide Washington Integrated Fish Distribution	<i>None mapped within or adjacent to the subject parcel. Sumas River mapped with chum, fall Chinook, sockeye, and steelhead presence; coho rearing.</i>
WA-DNR: Forest Practices Application Mapping Tool	<i>No features mapped within or adjacent to the subject parcel. Sumas River mapped as a shoreline of the state.</i>
WETS Climatic Condition	<i>Drier than normal; data from Bellingham International Airport.</i>

Findings

Wetlands

Three wetlands (Wetlands A-C) were delineated and flagged in the study area. Another possible wetland (Wetland D) was visible off-site to the east. Wetlands A - D are summarized in Tables 3 – 6, respectively.

Table 3. Wetland A assessment summary.

WETLAND A – Assessment Summary										
Location:	Southwest corner of site.									
WRIA / Sub-basin:	Nooksack Watershed (WRIA 1) / Headwaters Sumas Creek									
	2014 Western WA Ecology Rating:	Category III								
	Buffer Width and Buffer Setback:	150-foot buffer, 10-foot setback								
	Wetland Size:	Approx. 0.58 acres								
	Cowardin Classification(s):	Emergent								
	HGM Classification(s):	Depressional								
	Wetland Data Sheet(s):	DP-1								
	Upland Data Sheet (s):	DP-2								
	Flag Color:	Pink and black striped								
	Flag Numbers:	A-1 to A-24								
Vegetation	Tree stratum:	N/A								
	Shrub stratum:	Purple willow (<i>Salix purpurea</i>)								
	Herb stratum:	Perennial ryegrass (<i>Lolium perenne</i>), Redtop (<i>Agrostis gigantea</i>), reed canarygrass (<i>Phalaris arundinacea</i>)								
Soils	Soil survey:	Briscot silt loam, drained, 0 to 2 percent slopes								
	Field data:	Redox dark surface (F6)								
Hydrology	Source:	High groundwater table, precipitation, stormwater runoff								
	Field data:	Geomorphic position (D2), FAC-neutral test (D5)								
Wetland Functions										
	Improving Water Quality			Hydrologic			Habitat			
Site Potential	H	M	<u>L</u>	H	M	<u>L</u>	H	M	<u>L</u>	
Landscape Potential	<u>H</u>	M	L	H	<u>M</u>	L	H	<u>M</u>	L	
Value	<u>H</u>	M	L	<u>H</u>	M	L	H	<u>M</u>	L	TOTAL
Score Based on Ratings	7			6			5			18
Description and Comments										
Wetland A is a depressional wetland that is in the southwest corner of the subject parcel. It continues in a roadside ditch that extends to the west along Jones Road, ending at a culvert. It is bounded on two sides by roads.										

Table 4. Wetland B assessment summary.



 WETLAND B – Assessment Summary										
Location:	Forested area just north of proposed western staging area.									
WRIA / Sub-basin:	Nooksack Watershed (WRIA 1) / Headwaters Sumas Creek									
	2014 Western WA Ecology Rating:	Category II								
	Buffer Width and Buffer Setback:	150-foot buffer, 10-foot setback								
	Wetland Size:	Approx. 3.35 acres								
	Cowardin Classification(s):	Palustrine forested, Palustrine scrub-shrub								
	HGM Classification(s):	Depressional								
	Wetland Data Sheet(s):	DP-3								
	Upland Data Sheet (s):	DP-4								
	Flag Color:	Pink and black striped								
	Flag Numbers:	B-1 to B-13								
	Vegetation	Tree stratum:	Black cottonwood (<i>Populus balsamifera</i>), red alder (<i>Alnus rubra</i>)							
Shrub stratum:		Red-osier dogwood (<i>Cornus sericea</i>), salmonberry (<i>Rubus spectabilis</i>), Himalayan blackberry (<i>Rubus bifrons</i>)								
Herb stratum:		Lady fern (<i>Athyrium filix-femina</i>), reed canarygrass								
Soils	Soil survey:	Puget silt loam, drained, 0 to 2 percent slopes								
	Field data:	Redox dark surface (F6)								
Hydrology	Source:	High groundwater table, precipitation								
	Field data:	Sparsely vegetated concave surface (B8), FAC-neutral test (D5), geomorphic position (D2)								
Wetland Functions										
	Improving Water Quality			Hydrologic			Habitat			
Site Potential	<u>H</u>	M	L	<u>H</u>	M	L	H	<u>M</u>	L	
Landscape Potential	H	<u>M</u>	L	H	<u>M</u>	L	H	<u>M</u>	L	
Value	<u>H</u>	M	L	<u>H</u>	M	L	H	<u>M</u>	L	TOTAL
Score Based on Ratings	8			8			6			22
Description and Comments										
Wetland B was constructed as a mitigation area for impacts from the compressor station facility.										

Table 5. Wetland C assessment summary.

WETLAND C – Assessment Summary				
Location:	Northeast corner of the site, just west of the eastern proposed staging area.			
WRIA / Sub-basin:	Nooksack Watershed (WRIA 1) / Headwaters Sumas Creek			
	2014 Western WA Ecology Rating:	Category III		
	Buffer Width and Buffer Setback:	150-foot buffer, 10-foot setback		
	Wetland Size:	Approx. 1.32 acres		
	Cowardin Classification(s):	Palustrine emergent		
	HGM Classification(s):	Slope		
	Wetland Data Sheet(s):	DP-6		
	Upland Data Sheet (s):	DP-7		
	Flag Color:	Pink and black striped		
	Flag Numbers:	C-1 to C-12		
Vegetation	Tree stratum:	N/A		
	Shrub stratum:	N/A		
	Herb stratum:	Reed canarygrass		
Soils	Soil survey:	Puget silt loam, drained, 0 to 2 percent slopes		
	Field data:	Depleted matrix (F3)		
Hydrology	Source:	High groundwater table, stormwater runoff, precipitation		
	Field data:	Geomorphic position (D2), FAC-neutral test (D5)		
Wetland Functions				
	Improving Water Quality	Hydrologic	Habitat	
Site Potential	H <u>M</u> L	H <u>M</u> L	H M <u>L</u>	
Landscape Potential	H <u>M</u> L	H <u>M</u> L	H <u>M</u> L	
Value	<u>H</u> M L	<u>H</u> M L	H <u>M</u> L	TOTAL
Score Based on Ratings	7	7	5	19
Description and Comments				
Wetland C is a slope wetland that sits in the northeastern portion of the site. This wetland is surrounded by a gravel berm related to the pipeline facility.				

Table 6. Wetland D assessment summary.

WETLAND D – Assessment Summary				
Location:	East of eastern proposed staging area.			
WRIA / Sub-basin:	Nooksack Watershed (WRIA 1) / Headwaters Sumas Creek			
	2014 Western WA Ecology Rating:	Estimated Category II		
	Buffer Width and Buffer Setback:	150-foot buffer, 10-foot setback		
	Wetland Size:	Approx. 1,700 square feet		
	Cowardin Classification(s):	Palustrine emergent		
	HGM Classification(s):	Depressional		
	Wetland Data Sheet(s):	N/A		
	Upland Data Sheet (s):	N/A		
	Flag Color:	No flags hung		
	Flag Numbers:	N/A		
Vegetation	Tree stratum:	Black cottonwood		
	Shrub stratum:	Nootka rose (<i>Rosa nutkana</i>)		
	Herb stratum:	Reed canarygrass		
Soils	Soil survey:	Puget silt loam, drained, 0 to 2 percent slopes		
	Field data:	N/A – pits not dug		
Hydrology	Source:	High groundwater table, stormwater runoff, precipitation		
	Field data:	FAC-neutral test (D5), geomorphic position (D2)		
Wetland Functions				
	Improving Water Quality	Hydrologic	Habitat	
Site Potential	H <u>M</u> L	H <u>M</u> L	H M <u>L</u>	
Landscape Potential	<u>H</u> M L	<u>H</u> M L	H <u>M</u> L	
Value	<u>H</u> M L	<u>H</u> M L	H <u>M</u> L	TOTAL
Score Based on Ratings	8	8	5	21
Description and Comments				
<p>Wetland D is located outside of the study area and separated from the project area by a road and pipeline facility. Due to this, wetland data points were not collected in this area, and the wetland rating and data provided is an estimate. The presence and size of the wetland was not confirmed.</p>				

Streams

No streams were identified within the study area. No bed and bank characteristics, scour, sorted sediments, drainage patterns or other OHWM indicators were observed.

Local Regulations

Critical areas in unincorporated Whatcom County are regulated by the County's Critical Areas Regulations [Whatcom County Code (WCC) Chapter 16.16].

According to the code, wetlands are rated as one of four categories based on the Rating System. Under the Rating System, Wetlands A and C are Category III wetlands with 5 habitat points, Wetland B is a Category II wetland with 6 habitat points, and Wetland D is an estimated Category II wetland with 5 habitat points. Wetland buffer widths in Whatcom County are based on a combination of the wetland category, the habitat score, and the intensity of the site's land use. Industrial uses are considered high-intensity. Category II and III wetlands with habitat scores from 5-7 require 150-foot buffers (Table 1).

Whatcom County requires a 10-foot building setback from the edges of all critical area buffers. Building setbacks may contain landscaping, uncovered decks, building overhangs (if no more than 18 inches into the setback area), impervious ground surfaces with specified drainage provisions, and utility service connections (WCC 16.16.265).

WCC 16.16.275 allows for lawful use of any nonconforming building, structure, land, or premises existing on September 30, 2005, to be continued provided that the use is not expanded, enlarged, or otherwise increases the nonconformity. Therefore, the functional buffer of the delineated wetlands effectively ends at the edge of the developed areas of the site (See the Wetland Delineation Figure). While an above described use may be allowed, all buffer alterations would still be subject to the avoidance, minimization and mitigation requirements of WCC 16.16.260.

Critical Area Buffer Reduction

Within wetland buffers WCC 16.16.640 allows for buffers of Category II and III wetlands to be reduced to 75 percent of the required buffer or 50 feet, whichever is greater. In this case, buffers onsite could be reduced to 112.5 feet. Mitigation measures include directing lights away from the wetland; placing noise generating activities away from the wetland; routing new untreated runoff away from the wetland; installing fencing or landscaping to delineate the buffer edge and restrict access into the buffer; and restoring degraded portions of the buffer to a natural condition.

On the other hand, wetland buffers may also be modified through buffer averaging. Buffer averaging may be allowed if buffer averaging does not reduce the functions or values of the wetland, the increase in buffer dimension is generally parallel to the wetland boundary, the total buffer area is equivalent to the area before averaging, the minimum buffer width is not less than 75 percent of the standard buffer, and the buffer has not been reduced.

Under WCC 16.16.30.A: *“Buffers shall not include areas that are functionally and effectively disconnected from the wetland by an existing, legally established road or other substantial developed surface.”* Therefore, the existing developed facilities are not subject to buffer restrictions, and associated with any off-site wetland area separated from the subject property by a legally established road do not encumber the subject property.

Habitat Conservation Areas

Habitat Conservation Areas are defined under WCC 16.16.710.A as: *“those areas identified as being of critical importance to the maintenance of certain fish, wildlife, and/or plant species. These areas are typically identified either by known point locations of specific species (such as a nest or den) or by habitat areas or both.* Individual qualifying habitat conservation areas are enumerated under WCC 16.16.710.C.

No habitat conservation areas are present in the study area, with the exception of “frequently flooded areas that are subject to the Federal Emergency Management Agency’s National Flood Insurance Program Biological Opinion;” the entire property is located within the regulated 100-year floodplain. No streams, naturally occurring or manmade ponds, marine waters, state waters, or natural resource conservation areas defined by Washington Department of Natural Resources are present.

The study area does not have a primary association with or provide suitable habitat for any federally listed, state-listed, or state-priority species or habitats. According to USFWS IPaC database, the species summarized in Table 7 may occur in or near the study area.

Species Name	Listing Status	Habitat Requirement ¹	Potential Occurrence Determination
Taylor’s Checkerspot (<i>Euphydryas Editha taylori</i>)	Endangered	The Taylor’s checkerspot is found in open grasslands and grass/oak woodland sites where food plants for larvae and nectar sources are available.	The project site is an industrial facility surrounded by agricultural land and fragmented stands of trees. No oak trees or open native grasslands are present. Grassy areas on the Northwest property are actively harvested and/or are areas of

		In Washington, these sites only occurred around Puget Sound on open island prairies, shorelines, and mounded prairies.	pipeline ROW that are highly disturbed.
Marbled Murrelet (<i>Brachyramphus marmoratus</i>)	Threatened	Marbled murrelets are coastal birds that occur mainly near saltwater within 1.2 miles of shore. They regularly visit coastal lakes. Nesting habitats consist of mature or old-growth coniferous forest stands near the coastline. These forests are generally characterized by large trees (>32 inches [80 cm] dbh.), a multistoried canopy, moderate to high canopy closure or an open crown canopy, large snags, and numerous downed snags in all stages of decay.	The proposed Project is more than 10 miles from the nearest inlet to Puget Sound and there is no significant forest stand in the vicinity of the project site. Available habitat may not be considered suitable for this species.
Streaked horned lark (<i>Eremophila alpestris strigata</i>)	Threatened	Preferred habitat for the streaked horned lark consists of bare ground, including open country with very short or no vegetation, and agricultural fields. They breed in short grassland, short-stature sage shrubland, desert, and even alpine and arctic tundra.	The proposed Project does contain flat, bare ground within the facility itself and the surrounding agricultural fields. No grasslands, sagebrush, or desert/ tundra is present. The project site is an active industrial facility and is not considered suitable habitat for the species.
Yellow-billed Cuckoo (<i>Coccyzus americanus</i>)	Threatened	Yellow-billed Cuckoos use wooded habitat with dense cover and water nearby, including woodlands with low, scrubby, vegetation, overgrown orchards, abandoned farmland, and dense thickets along streams and marshes. In the West, nests are often placed in willows along streams and rivers, with nearby cottonwoods serving as foraging sites.	The project area does not feature significant woodlands or water and lacks areas dominated by low scrubby vegetation. The project area does not contain a large population of willow or cottonwood species and may not be considered suitable habitat for the species.
Northern spotted owl (<i>Strix</i>)	Threatened	Habitat for the Northern spotted owl is covered with evergreen	There are no significant stands of evergreen trees in the vicinity of the

<i>occidentalis caurina</i>)		trees in cool, northern climates also known as taiga.	project site. The project site is a disturbed industrial site with adjacent cultivated agricultural fields and is not considered suitable habitat for the species.
Bull trout (<i>Salvelinus confluentus</i>)	Threatened	Bull trout need cold water and are seldom found in waters where temperatures exceed 59 to 64 degrees (F). They also require stable stream channels, clean spawning and rearing gravel, complex and diverse cover, and unblocked migratory corridors.	The nearest waterway to the project location is the Sumas River, approximately 0.25 mile northwest of the project boundary.
Oregon spotted frog (<i>Rana pretiosa</i>)	Threatened	This species is highly aquatic and rarely found away from water. Extant populations occur in large shallow wetland systems associated with a stream or stream network. Breeding habitat is in seasonally flooded margins of wetlands and areas of extensive shallows (approximately 6 to 8 inches deep). (from WDFW Species and Habitats site)	The project site and surrounding area does not feature waterbodies or wetlands with a stream or stream network. Mapped critical habitat for the species overlies the subject property (and a large surrounding area), but the closest suitable habitat is the Sumas River and its adjacent wetlands, approximately 0.25 mile northwest of the project site boundary.
Canada lynx (<i>Lynx canadensis</i>)	Threatened	Lynx populations are closely tied to boreal spruce-fir ecosystems known as the taiga. They require large tracts of forest with dense growths of trees and underbrush.	The project area does not feature boreal spruce-fir trees or large, dense stands of trees and underbrush habitat suitable for this species.
Golden paintbrush (<i>Castilleja levisecta</i>)	Threatened	The species requires a low-statured vegetation community dominated by native grass and forb species.	The project area does not feature low-statured vegetation communities dominated by native grass and forb species in the vicinity of the project site. Areas that will feature construction activities and temporary equipment staging are either paved/gravelled or in cultivation (i.e., sod farming). As a result, suitable habitat is not present for the Golden paintbrush.

Whitebark pine (<i>Pinus albicaulis</i>)	Proposed Threatened	The whitebark pine is native to subalpine and treeline environments.	The project site is not in a subalpine zone or near a treeline. The subject site is an industrial site with adjacent cultivated agricultural land and is not considered suitable habitat for the species.
---	------------------------	--	---

No wildlife corridors identified under WCC16.16.710.C.12 are present in the study area.

State and Federal Regulations

Federal Agencies

Most wetlands and streams are regulated by the U.S. Army Corps of Engineers (Corps) under Section 404 of the Clean Water Act. Any proposed filling or other direct impacts to Waters of the U.S., including wetlands (except isolated wetlands), would require preconstruction notification and permit authorization from the Corps. Wetlands A-D appear to be isolated in our opinion; a Jurisdictional Determination from the Corps would be required to confirm the wetland’s jurisdictional status. Unavoidable impacts to jurisdictional wetlands are typically required to be compensated through implementation of an approved mitigation plan. If activities requiring a Corps permit are proposed, a Joint Aquatic Resource Permit Application (JARPA) could be submitted to obtain authorization.

Federally permitted actions that could affect endangered species may also require a biological assessment study and consultation with the U.S. Fish and Wildlife Service and/or the National Marine Fisheries Service. Compliance with the Endangered Species Act must be demonstrated for activities within jurisdictional wetlands and the 100-year floodplain. Application for Corps permits may also require an individual 401 Water Quality Certification and Coastal Zone Management Consistency determination from Ecology and a cultural resource study in accordance with Section 106 of the National Historic Preservation Act.

Washington Department of Ecology (Ecology)

Like the Corps, Ecology is charged with reviewing, conditioning, and approving or denying certain federally permitted actions that result in discharges to state waters under Section 401 of the Clean Water Act. However, Ecology review under the Clean Water Act would only become necessary if a Section 404 permit from the Corps was issued. Ecology also regulates wetlands, including isolated wetlands, under the Washington Water Pollution Control Act, but only if

direct wetland impacts are proposed. Therefore, authorization from Ecology would not be needed if filling activities are avoided.

A JARPA may also be submitted to Ecology to obtain a Section 401 Water Quality Certification and Coastal Zone Management Consistency Determination if filling is proposed. Ecology approvals are either issued concurrently with the Corps approval or within 90 days following the Corps approval.

In general, neither the Corps nor Ecology regulates wetland and stream buffers, unless direct impacts are proposed. When direct impacts are proposed, buffers are applied based on Corps and Ecology joint regulatory guidance.

Disclaimer

The information contained in this letter is based on the application of technical guidelines currently accepted as the best available science and in conjunction with the manuals and criteria referenced above. All discussions, conclusions and recommendations reflect the best professional judgment of the author(s) and are based upon information available at the time the study was conducted. All work was completed within the constraints of budget, scope, and timing. The findings of this report are subject to verification and agreement by the appropriate local, state, and federal regulatory authorities. No other warranty, expressed or implied, is made.

Please call if you have any questions or if we can provide you with any additional information.

Sincerely,



Grace Brennan
Ecologist



Nell Lund, PWS
Senior Ecologist

References

- Anderson, P.S. et al. 2016. Determining the Ordinary High Water Mark for Shoreline Management Act Compliance in Washington State. (Publication #16-06-029). Olympia, WA: Shorelands and Environmental Assistance Program, Washington Department of Ecology.
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<https://fortress.wa.gov/ecy/publications/parts/1606001part1.pdf>.
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- U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS). 2015. National Engineering Handbook, Part 650 Engineering Field Handbook, Chapter 19 Hydrology Tools for Wetland Identification and Analysis. ed. R. A. Weber. 210-VI-NEH, Amend. 75. Washington, DC.

Site Photos



Photo 1. The site is generally flat. From the eastern side of site, facing west.



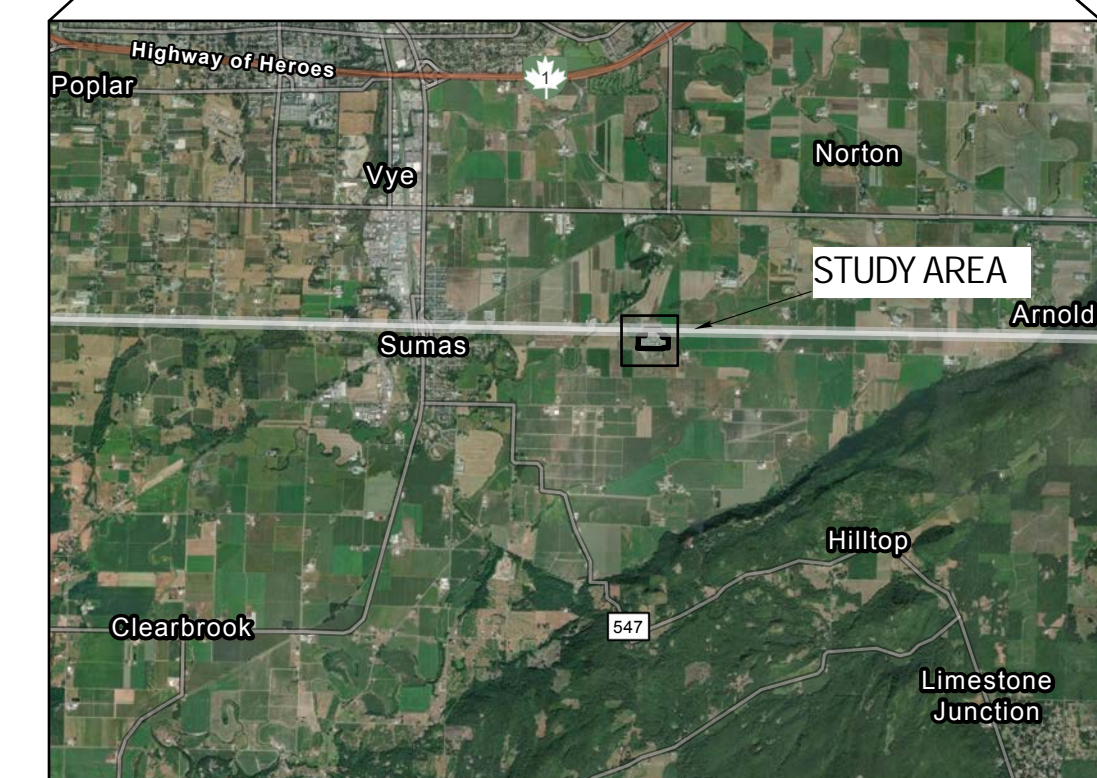
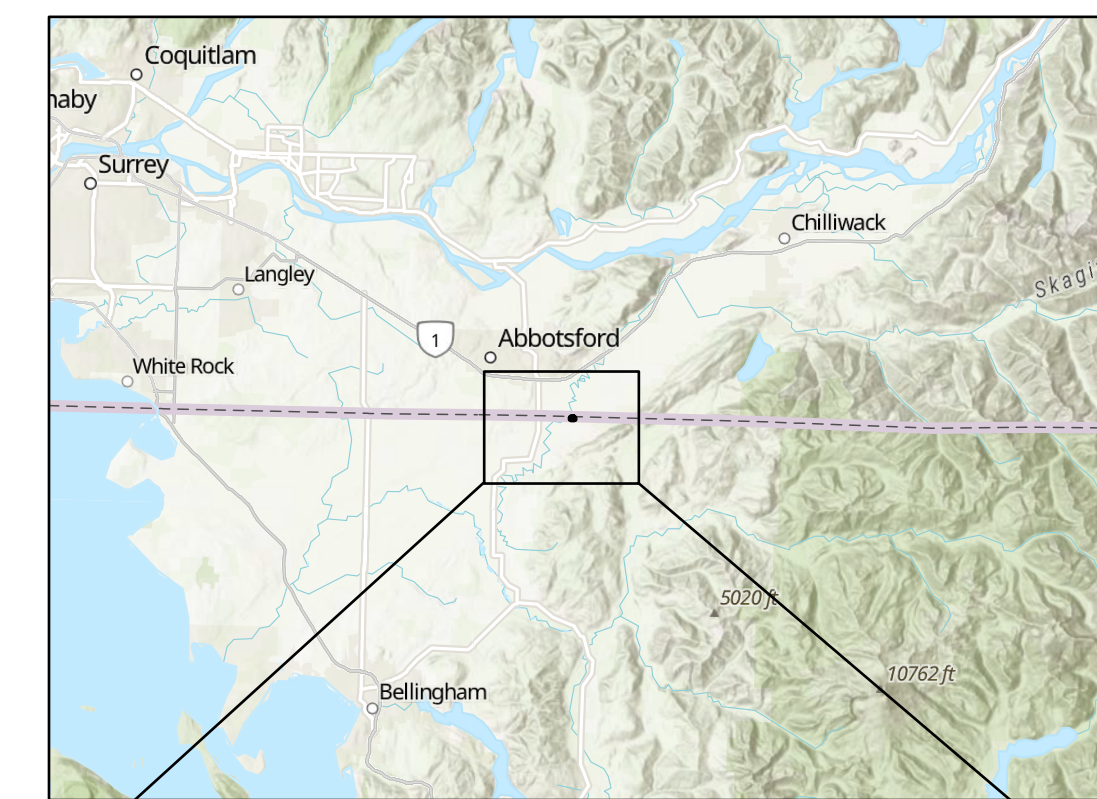
Photo 2. Compressor station infrastructure.



Photo 3. Grass field on site, likely used for hay production.



Photo 4. Dense vegetation of Wetland B.



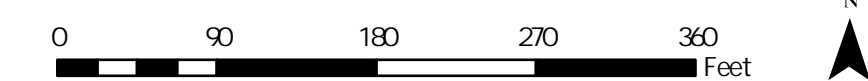
VICINITY MAPS

LEGEND

- DATA POINT
- WETLAND BUFFER (150FT)
- EFFECTIVE BUFFER
- DELINEATED WETLAND BOUNDARY
- APPROXIMATE WETLAND AREA
- POTENTIAL OFF-PROPERTY WETLAND
- PROPOSED TEMPORARY LAYDOWN AREAS
- SUMAS COMPRESSOR STATION BOUNDARY

NOTES

1. CRITICAL AREAS DELINEATED BY DCG /WATERSHED ON JUNE 22 AND 23 2023.
2. GPS/GNSS DATA DISPLAYED ON THIS MAP WERE COLLECTED IN THE FIELD USING A TRIMBLE DA2 RECEIVER WITH TRIMBLE CATALYST GNSS POSITIONING SERVICE. GPS/GNSS DATA IS BELIEVED RELIABLE FOR GENERAL PLANNING AND MOST REGULATORY PURPOSES. HOWEVER, ACCURACY IS VARIABLE AND SHOULD NOT BE CONSIDERED EQUIVALENT TO A PROFESSIONAL LAND SURVEY. NO WARRANTY IS EXPRESSED OR IMPLIED.
3. EFFECTIVE BUFFER GENERATED PURSUANT TO WHATCOM COUNTY CODE 16.16.275 WHICH STATES THAT LEGALLY ESTABLISHED NONCONFORMING USE MAY CONTINUE PROVIDED THE FOOTPRINT DOES NOT INCREASE.



**WILLIAMS SUMAS COMPRESSOR STATION
WETLAND DELINEATION**
4788 JONES ROAD
SUMAS, WA 98266

PROJECT:

PRINCIPLE: HM
PM_RK
FIELDWORK: GB, RH
DRAFTED BY: GB
JOB NO.: 230915
DATE: 7/5/2023

NO.	DESCRIPTION	DATE
1	DRAFT	7/5/2023

NOT FOR CONSTRUCTION

WETLAND DELINEATION

7/5/2023

WETLAND
DELINEATION MAP

Project/Site: Williams Sumas Compressor Station City/County: Whatcom Sampling date: 6/22/2023
 Applicant/Owner: Williams Pipeline State: WA Sampling Point: DP-1
 Investigator(s): G. Brennan, R. Hohlfeld Section, Township, Range: S36 T41N R04E
 Landform (hillslope, terrace, etc): Depression Local relief (concave, convex, none): Concave Slope (%): 2
 Subregion (LRR): A Lat: - Long: - Datum: -
 Soil Map Unit Name: Briscot silt loam, drained 0-2% slopes NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes No (If no, explain in remarks.)
 Are Vegetation , Soil , or Hydrology significantly disturbed? Are "Normal Circumstances" present on the site? Yes No
 Are Vegetation , Soil , or Hydrology naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	Is the Sampled Area within a Wetland?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>
Hydric Soils Present?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>			
Wetland Hydrology Present?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>			
Remarks: Wetland A in-pit Drier than normal according to the WETS Table methodology, with data from the Bellingham International Airport					

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status	
Tree Stratum (Plot size: 5-m diameter)				Dominance Test worksheet: Number of Dominant Species that are OBL, FACW, or FAC: <u>1</u> (A) Total Number of Dominant Species Across all Strata: <u>1</u> (B) Percent of Dominant Species that are OBL, FACW, or FAC: <u>100</u> (A/B)
1.				
2.				
3.				
4.				
	<u>0</u>	= Total Cover		
Sapling/Shrub Stratum (Plot size: 3-m diameter)				Prevalence Index worksheet: Total % Cover of: <u> </u> Multiply by: OBL species <u> </u> x 1 = <u> </u> FACW species <u> </u> x 2 = <u> </u> FAC species <u> </u> x 3 = <u> </u> FACU species <u> </u> x 4 = <u> </u> UPL species <u> </u> x 5 = <u> </u> Column Totals: (A) <u> </u> (B) <u> </u> Prevalence Index = B/A = <u> </u>
1.	<u>2</u>	<u>N</u>	<u>OBL</u>	
2.				
3.				
4.				
5.				
	<u>2</u>	= Total Cover		
Herb Stratum (Plot size: 1-m diameter)				Hydrophytic Vegetation Indicators: <input type="checkbox"/> 1 – Rapid Test for Hydrophytic Vegetation <input checked="" type="checkbox"/> 2 – Dominance Test is > 50% <input type="checkbox"/> 3 – Prevalence Index is ≤ 3.0 ¹ <input type="checkbox"/> 4 – Morphological Adaptations ¹ (Provide supporting data in Remarks or on a separate sheet) <input type="checkbox"/> 5 – Wetland Non-Vascular Plants ¹ <input type="checkbox"/> Problematic Hydrophytic Vegetation ¹ (Explain) <small>¹Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.</small>
1.	<u>98</u>	<u>Y</u>	<u>FACW</u>	
2.	<u>10</u>	<u>N</u>	<u>FAC</u>	
3.	<u>3</u>	<u>N</u>	<u>UPL</u>	
4.	<u>2</u>	<u>N</u>	<u>FAC</u>	
5.	<u>5</u>	<u>N</u>	<u>FAC</u>	
6.	<u>Trace</u>	<u>N</u>	<u>FACW</u>	
7.				
8.				
9.				
10.				
11.				
	<u>118</u>	= Total Cover		
Woody Vine Stratum (Plot size: 3-m diameter)				Hydrophytic Vegetation Present? Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
1.				
2.				
	<u>0</u>	= Total Cover		
% Bare Ground in Herb Stratum: <u>0</u>				
Remarks:				

SOIL

Sampling Point: DP-1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)								
Depth (inches)	Matrix		Redox Features		Type ¹	Loc ²	Texture	Remarks
	Color (moist)	%	Color (moist)	%				
0-8	2.5Y 3/2	95	10YR 3/4	5	C	M	Clay loam	
8-16	2.5Y 3/2	90	10YR 3/4	10	C	M	Clay loam	
¹ Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. ² Loc: PL=Pore Lining, M=Matrix.								
Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.) <input type="checkbox"/> Histosol (A1) <input type="checkbox"/> Histic Epipedon (A2) <input type="checkbox"/> Black Histic (A3) <input type="checkbox"/> Hydrogen Sulfide (A4) <input type="checkbox"/> Depleted Below Dark Surface (A11) <input type="checkbox"/> Thick Dark Surface (A12) <input type="checkbox"/> Sandy Mucky Mineral (S1) <input type="checkbox"/> Sandy Gleyed Matrix (S4)			<input type="checkbox"/> Sandy Redox (S5) <input type="checkbox"/> Stripped Matrix (S6) <input type="checkbox"/> Loamy Mucky Mineral (F1) (except MLRA 1) <input type="checkbox"/> Loamy Gleyed Matrix (F2) <input type="checkbox"/> Depleted Matrix (F3) <input checked="" type="checkbox"/> Redox Dark Surface (F6) <input type="checkbox"/> Depleted Dark Surface (F7) <input type="checkbox"/> Redox Depressions (F8)			Indicators for Problematic Hydric Soils³: <input type="checkbox"/> 2cm Muck (A10) <input type="checkbox"/> Red Parent Material (TF2) <input type="checkbox"/> Very Shallow Dark Surface (TF12) <input type="checkbox"/> Other (Explain in Remarks)		
Restrictive Layer (if present): Type: _____ Depth (inches): _____						Hydric soil present? Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>		
Remarks: _____								

HYDROLOGY

Wetland Hydrology Indicators:			
Primary Indicators (minimum of one required: check all that apply)		Secondary Indicators (2 or more required)	
<input type="checkbox"/> Surface water (A1)	<input type="checkbox"/> Water-Stained Leaves (except MLRA 1, 2, 4A & 4B) (B9)	<input type="checkbox"/> Water-Stained Leaves (B9) (MLRA 1, 2, 4A & 4B)	<input type="checkbox"/> Drainage Patterns (B10)
<input type="checkbox"/> High Water Table (A2)	<input type="checkbox"/> Salt Crust (B11)	<input type="checkbox"/> Aquatic Invertebrates (B13)	<input type="checkbox"/> Dry-Season Water Table (C2)
<input type="checkbox"/> Saturation (A3)	<input type="checkbox"/> Hydrogen Sulfide Odor (C1)	<input type="checkbox"/> Oxidized Rhizospheres along Living Roots (C3)	<input checked="" type="checkbox"/> Saturation Visible on Aerial Imagery (C9)
<input type="checkbox"/> Water Marks (B1)	<input type="checkbox"/> Presence of Reduced Iron (C4)	<input type="checkbox"/> FAC-Neutral Test (D5)	<input checked="" type="checkbox"/> Geomorphic Position (D2)
<input type="checkbox"/> Sediment Deposits (B2)	<input type="checkbox"/> Recent Iron Reduction in Tilled Soils (C6)	<input type="checkbox"/> Raised Ant Mounds (D6) (LRR A)	<input type="checkbox"/> Shallow Aquitard (D3)
<input type="checkbox"/> Drift Deposits (B3)	<input type="checkbox"/> Stunted or Stressed Plants (D1) (LRR A)	<input type="checkbox"/> Frost-Heave Hummocks	<input type="checkbox"/> Other (explain in remarks)
<input type="checkbox"/> Algal Mat or Crust (B4)			
<input type="checkbox"/> Iron Deposits (B5)			
<input type="checkbox"/> Surface Soil Cracks (B6)			
<input type="checkbox"/> Inundation Visible on Aerial Imagery (B7)			
<input type="checkbox"/> Sparsely Vegetated Concave Surface (B8)			
Field Observations: Surface Water Present? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Depth (in): _____ Water Table Present? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Depth (in): _____ Saturation Present? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Depth (in): _____ (includes capillary fringe)			
Wetland Hydrology Present? Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>			
Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:			
Remarks: Dry throughout, surface cracks and algae nearby			

Project/Site: Williams Sumas Compressor Station City/County: Whatcom Sampling date: 6/22/2023
 Applicant/Owner: Williams Pipeline State: WA Sampling Point: DP-2
 Investigator(s): G. Brennan, R. Hohlfeld Section, Township, Range: S36 T41N R04E
 Landform (hillslope, terrace, etc): Slight hillslope Local relief (concave, convex, none): None Slope (%): 5%
 Subregion (LRR): A Lat: - Long: - Datum: -
 Soil Map Unit Name: Briscot silt loam, drained 0-2% slopes NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes No (If no, explain in remarks.)
 Are Vegetation , Soil , or Hydrology significantly disturbed? Are "Normal Circumstances" present on the site? Yes No
 Are Vegetation , Soil , or Hydrology naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	Is the Sampled Area within a Wetland?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>
Hydic Soils Present?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>			
Wetland Hydrology Present?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>			
Remarks: Wetland A Out-pit Drier than normal according to the WETS Table methodology, with data from the Bellingham International Airport					

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status		
Tree Stratum (Plot size: 5-m diameter)					
1. <u>Pinus contorta</u>	5	Y	FAC	Dominance Test worksheet: Number of Dominant Species that are OBL, FACW, or FAC: <u>2</u> (A) Total Number of Dominant Species Across all Strata: <u>2</u> (B) Percent of Dominant Species that are OBL, FACW, or FAC: <u>100</u> (A/B)	
2. _____					
3. _____					
4. _____					
<u>5</u> = Total Cover				Prevalence Index worksheet: Total % Cover of: Multiply by: OBL species _____ x 1 = _____ FACW species _____ x 2 = _____ FAC species _____ x 3 = _____ FACU species _____ x 4 = _____ UPL species _____ x 5 = _____ Column Totals: (A) _____ (B) _____ Prevalence Index = B/A = _____	
Sapling/Shrub Stratum (Plot size: 3-m diameter)					
1. _____					
2. _____					
3. _____					
4. _____					
5. _____					
<u>0</u> = Total Cover					
Herb Stratum (Plot size: 1-m diameter)					
1. <u>Taraxacum officinale</u>	2	N	FACU	Hydrophytic Vegetation Indicators: <input type="checkbox"/> 1 – Rapid Test for Hydrophytic Vegetation <input checked="" type="checkbox"/> 2 – Dominance Test is > 50% <input type="checkbox"/> 3 – Prevalence Index is ≤ 3.0 ¹ <input type="checkbox"/> 4 – Morphological Adaptations ¹ (Provide supporting data in Remarks or on a separate sheet) <input type="checkbox"/> 5 – Wetland Non-Vascular Plants ¹ <input type="checkbox"/> Problematic Hydrophytic Vegetation ¹ (Explain) <small>¹Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.</small>	
2. <u>Trifolium repens</u>	10	N	FAC		
3. <u>Poaceae sp.</u>	88	Y	FAC		
4. _____					
5. _____					
6. _____					
7. _____					
8. _____					
9. _____					
10. _____					
11. _____					
<u>100</u> = Total Cover					
Woody Vine Stratum (Plot size: 3-m diameter)					
1. _____				Hydrophytic Vegetation Present? Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	
2. _____					
<u>0</u> = Total Cover					
% Bare Ground in Herb Stratum: <u>0</u>					
Remarks:					

SOIL

Sampling Point: DP-2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)									
Depth (inches)	Matrix		Redox Features			Type ¹	Loc ²	Texture	Remarks
	Color (moist)	%	Color (moist)	%					
0-6	10YR 3/2	100						Silt loam	
6-16	10YR 3/2	99	10YR 4/6	1		C	M	Silt loam	
¹ Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. ² Loc: PL=Pore Lining, M=Matrix.									
Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.) <input type="checkbox"/> Histosol (A1) <input type="checkbox"/> Sandy Redox (S5) <input type="checkbox"/> Histic Epipedon (A2) <input type="checkbox"/> Stripped Matrix (S6) <input type="checkbox"/> Black Histic (A3) <input type="checkbox"/> Loamy Mucky Mineral (F1) (except MLRA 1) <input type="checkbox"/> Hydrogen Sulfide (A4) <input type="checkbox"/> Loamy Gleyed Matrix (F2) <input type="checkbox"/> Depleted Below Dark Surface (A11) <input type="checkbox"/> Depleted Matrix (F3) <input type="checkbox"/> Thick Dark Surface (A12) <input type="checkbox"/> Redox Dark Surface (F6) <input type="checkbox"/> Sandy Mucky Mineral (S1) <input type="checkbox"/> Depleted Dark Surface (F7) <input type="checkbox"/> Sandy Gleyed Matrix (S4) <input type="checkbox"/> Redox Depressions (F8)						Indicators for Problematic Hydric Soils³: <input type="checkbox"/> 2cm Muck (A10) <input type="checkbox"/> Red Parent Material (TF2) <input type="checkbox"/> Very Shallow Dark Surface (TF12) <input type="checkbox"/> Other (Explain in Remarks)			
Restrictive Layer (if present): Type: _____ Depth (inches): _____						Hydric soil present? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
Remarks: Not enough redox in matrix to qualify as redox dark surface									

HYDROLOGY

Wetland Hydrology Indicators:			
Primary Indicators (minimum of one required: check all that apply)		Secondary Indicators (2 or more required)	
<input type="checkbox"/> Surface water (A1)	<input type="checkbox"/> Water-Stained Leaves (except MLRA 1, 2, 4A & 4B) (B9)	<input type="checkbox"/> Water-Stained Leaves (B9) (MLRA 1, 2, 4A & 4B)	<input type="checkbox"/> Drainage Patterns (B10)
<input type="checkbox"/> High Water Table (A2)	<input type="checkbox"/> Salt Crust (B11)	<input type="checkbox"/> Aquatic Invertebrates (B13)	<input type="checkbox"/> Dry-Season Water Table (C2)
<input type="checkbox"/> Saturation (A3)	<input type="checkbox"/> Hydrogen Sulfide Odor (C1)	<input type="checkbox"/> Oxidized Rhizospheres along Living Roots (C3)	<input type="checkbox"/> Saturation Visible on Aerial Imagery (C9)
<input type="checkbox"/> Water Marks (B1)	<input type="checkbox"/> Presence of Reduced Iron (C4)	<input type="checkbox"/> Recent Iron Reduction in Tilled Soils (C6)	<input type="checkbox"/> Geomorphic Position (D2)
<input type="checkbox"/> Sediment Deposits (B2)	<input type="checkbox"/> Stunted or Stressed Plants (D1) (LRR A)	<input type="checkbox"/> Other (explain in remarks)	<input type="checkbox"/> Shallow Aquitard (D3)
<input type="checkbox"/> Drift Deposits (B3)			<input type="checkbox"/> FAC-Neutral Test (D5)
<input type="checkbox"/> Algal Mat or Crust (B4)			<input type="checkbox"/> Raised Ant Mounds (D6) (LRR A)
<input type="checkbox"/> Iron Deposits (B5)			<input type="checkbox"/> Frost-Heave Hummocks
<input type="checkbox"/> Surface Soil Cracks (B6)			
<input type="checkbox"/> Inundation Visible on Aerial Imagery (B7)			
<input type="checkbox"/> Sparsely Vegetated Concave Surface (B8)			
Field Observations: Surface Water Present? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Depth (in): _____ Water Table Present? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Depth (in): _____ Saturation Present? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Depth (in): _____ (includes capillary fringe)		Wetland Hydrology Present? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	
Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:			
Remarks: Very dry throughout			

Project/Site: Williams Sumas Compressor Station City/County: Whatcom Sampling date: 6/22/2023
 Applicant/Owner: Williams Pipeline State: WA Sampling Point: DP-3
 Investigator(s): G. Brennan, R. Hohlfeld Section, Township, Range: S36 T41N R04E
 Landform (hillslope, terrace, etc): Hillslope Local relief (concave, convex, none): Concave Slope (%): 5
 Subregion (LRR): A Lat: - Long: - Datum: -
 Soil Map Unit Name: Puget silt loam, drained, 0-2% slopes NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes No (If no, explain in remarks.)
 Are Vegetation , Soil , or Hydrology significantly disturbed? Are "Normal Circumstances" present on the site? Yes No
 Are Vegetation , Soil , or Hydrology naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	Is the Sampled Area within a Wetland?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>
Hydic Soils Present?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>			
Wetland Hydrology Present?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>			
Remarks: Wetland B in-pit Drier than normal according to the WETS Table methodology, with data from the Bellingham International Airport					

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status		
Tree Stratum (Plot size: 5-m diameter)					
1. <u>Populus balsamifera</u>	10	Y	FACW	Dominance Test worksheet: Number of Dominant Species that are OBL, FACW, or FAC: <u>3</u> (A) Total Number of Dominant Species Across all Strata: <u>3</u> (B) Percent of Dominant Species that are OBL, FACW, or FAC: <u>100</u> (A/B)	
2. <u>Alnus rubra</u>	20	Y	FAC		
3. _____					
4. _____					
	<u>30</u>	= Total Cover		Prevalence Index worksheet: Total % Cover of: <u> </u> Multiply by: OBL species <u> </u> x 1 = <u> </u> FACW species <u> </u> x 2 = <u> </u> FAC species <u> </u> x 3 = <u> </u> FACU species <u> </u> x 4 = <u> </u> UPL species <u> </u> x 5 = <u> </u> Column Totals: (A) <u> </u> (B) <u> </u> Prevalence Index = B/A = <u> </u>	
Sapling/Shrub Stratum (Plot size: 3-m diameter)					
1. <u>Cornus sericea</u>	5	Y	FACW		
2. _____					
3. _____					
4. _____					
5. _____					
	<u>5</u>	= Total Cover			
Herb Stratum (Plot size: 1-m diameter)					
1. _____				Hydrophytic Vegetation Indicators: <input type="checkbox"/> 1 – Rapid Test for Hydrophytic Vegetation <input checked="" type="checkbox"/> 2 – Dominance Test is > 50% <input type="checkbox"/> 3 – Prevalence Index is ≤ 3.0 ¹ <input type="checkbox"/> 4 – Morphological Adaptations ¹ (Provide supporting data in Remarks or on a separate sheet) <input type="checkbox"/> 5 – Wetland Non-Vascular Plants ¹ <input type="checkbox"/> Problematic Hydrophytic Vegetation ¹ (Explain) ¹ Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.	
2. _____					
3. _____					
4. _____					
5. _____					
6. _____					
7. _____					
8. _____					
9. _____					
10. _____					
11. _____					
	<u>0</u>	= Total Cover			
Woody Vine Stratum (Plot size: 3-m diameter)					
1. _____				Hydrophytic Vegetation Present? Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	
2. _____					
	<u>0</u>	= Total Cover			
% Bare Ground in Herb Stratum: <u>0</u>					
Remarks:					

SOIL

Sampling Point: DP-3

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)								
Depth (inches)	Matrix		Redox Features		Type ¹	Loc ²	Texture	Remarks
	Color (moist)	%	Color (moist)	%				
0-5	10YR 2/2	100					Loam	
5-13	10YR 3/2	80	10YR 4/6	20	C	M	Silt loam	
13-16	10YR 4/1	70	10YR 3/6	30	C	M	Silt loam	
¹ Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. ² Loc: PL=Pore Lining, M=Matrix.								
Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.) <input type="checkbox"/> Histosol (A1) <input type="checkbox"/> Histic Epipedon (A2) <input type="checkbox"/> Black Histic (A3) <input type="checkbox"/> Hydrogen Sulfide (A4) <input type="checkbox"/> Depleted Below Dark Surface (A11) <input type="checkbox"/> Thick Dark Surface (A12) <input type="checkbox"/> Sandy Mucky Mineral (S1) <input type="checkbox"/> Sandy Gleyed Matrix (S4)			<input type="checkbox"/> Sandy Redox (S5) <input type="checkbox"/> Stripped Matrix (S6) <input type="checkbox"/> Loamy Mucky Mineral (F1) (except MLRA 1) <input type="checkbox"/> Loamy Gleyed Matrix (F2) <input type="checkbox"/> Depleted Matrix (F3) <input checked="" type="checkbox"/> Redox Dark Surface (F6) <input type="checkbox"/> Depleted Dark Surface (F7) <input type="checkbox"/> Redox Depressions (F8)			Indicators for Problematic Hydric Soils³: <input type="checkbox"/> 2cm Muck (A10) <input type="checkbox"/> Red Parent Material (TF2) <input type="checkbox"/> Very Shallow Dark Surface (TF12) <input type="checkbox"/> Other (Explain in Remarks)		
Restrictive Layer (if present): Type: _____ Depth (inches): _____						Hydric soil present? Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>		
Remarks:								

HYDROLOGY

Wetland Hydrology Indicators:			
Primary Indicators (minimum of one required: check all that apply)		Secondary Indicators (2 or more required)	
<input type="checkbox"/> Surface water (A1)	<input type="checkbox"/> Water-Stained Leaves (except MLRA 1, 2, 4A & 4B) (B9)	<input type="checkbox"/> Water-Stained Leaves (B9) (MLRA 1, 2, 4A & 4B)	<input type="checkbox"/> Drainage Patterns (B10)
<input type="checkbox"/> High Water Table (A2)	<input type="checkbox"/> Salt Crust (B11)	<input type="checkbox"/> Aquatic Invertebrates (B13)	<input type="checkbox"/> Dry-Season Water Table (C2)
<input type="checkbox"/> Saturation (A3)	<input type="checkbox"/> Hydrogen Sulfide Odor (C1)	<input type="checkbox"/> Oxidized Rhizospheres along Living Roots (C3)	<input checked="" type="checkbox"/> Saturation Visible on Aerial Imagery (C9)
<input type="checkbox"/> Water Marks (B1)	<input type="checkbox"/> Presence of Reduced Iron (C4)	<input type="checkbox"/> Recent Iron Reduction in Tilled Soils (C6)	<input checked="" type="checkbox"/> Geomorphic Position (D2)
<input type="checkbox"/> Sediment Deposits (B2)	<input type="checkbox"/> Stunted or Stressed Plants (D1) (LRR A)	<input type="checkbox"/> Other (explain in remarks)	<input type="checkbox"/> Shallow Aquitard (D3)
<input type="checkbox"/> Drift Deposits (B3)			<input checked="" type="checkbox"/> FAC-Neutral Test (D5)
<input type="checkbox"/> Algal Mat or Crust (B4)			<input type="checkbox"/> Raised Ant Mounds (D6) (LRR A)
<input type="checkbox"/> Iron Deposits (B5)			<input type="checkbox"/> Frost-Heave Hummocks
<input type="checkbox"/> Surface Soil Cracks (B6)			
<input type="checkbox"/> Inundation Visible on Aerial Imagery (B7)			
<input checked="" type="checkbox"/> Sparsely Vegetated Concave Surface (B8)			
Field Observations: Surface Water Present? Yes <input type="checkbox"/> No <input type="checkbox"/> Depth (in): _____ Water Table Present? Yes <input type="checkbox"/> No <input type="checkbox"/> Depth (in): _____ Saturation Present? Yes <input type="checkbox"/> No <input type="checkbox"/> Depth (in): _____ (includes capillary fringe)		Wetland Hydrology Present? Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	
Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:			
Remarks:			

Project/Site: Williams Sumas Compressor Station City/County: Whatcom Sampling date: 6/22/2023
 Applicant/Owner: Williams Pipeline State: WA Sampling Point: DP-4
 Investigator(s): G. Brennan, R. Hohlfeld Section, Township, Range: S36 T41N R04E
 Landform (hillslope, terrace, etc): Terrace Local relief (concave, convex, none): None Slope (%): -
 Subregion (LRR): A Lat: - Long: - Datum: -
 Soil Map Unit Name: Puget silt loam, drained, 0-2% slopes NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes No (If no, explain in remarks.)
 Are Vegetation , Soil , or Hydrology significantly disturbed? Are "Normal Circumstances" present on the site? Yes No
 Are Vegetation , Soil , or Hydrology naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	Is the Sampled Area within a Wetland?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>
Hydric Soils Present?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>			
Wetland Hydrology Present?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>			
Remarks: Wetland B out-pit Drier than normal according to the WETS Table methodology, with data from the Bellingham International Airport					

VEGETATION – Use scientific names of plants.

Stratum	Absolute % Cover	Dominant Species?	Indicator Status	Notes	
Tree Stratum (Plot size: 5-m diameter)					
1. <u>Populus balsamifera</u>	15	Y	FACW	Dominance Test worksheet: Number of Dominant Species that are OBL, FACW, or FAC: <u>2</u> (A) Total Number of Dominant Species Across all Strata: <u>2</u> (B) Percent of Dominant Species that are OBL, FACW, or FAC: <u>100</u> (A/B)	
2. <u>Alnus rubra</u>	5	N	FAC		
3. _____					
4. _____					
<u>20</u> = Total Cover				Prevalence Index worksheet: Total % Cover of: <u> </u> Multiply by: OBL species <u> </u> x 1 = <u> </u> FACW species <u> </u> x 2 = <u> </u> FAC species <u> </u> x 3 = <u> </u> FACU species <u> </u> x 4 = <u> </u> UPL species <u> </u> x 5 = <u> </u> Column Totals: (A) <u> </u> (B) <u> </u> Prevalence Index = B/A = <u> </u>	
Sapling/Shrub Stratum (Plot size: 3-m diameter)					
1. _____					
2. _____					
3. _____					
4. _____					
5. _____					
<u>0</u> = Total Cover					
Herb Stratum (Plot size: 1-m diameter)					
1. <u>Lolium perenne</u>	100	Y	FAC		
2. _____					
3. _____					
4. _____					
5. _____					
6. _____					
7. _____					
8. _____					
9. _____					
10. _____					
11. _____					
<u>100</u> = Total Cover					
Woody Vine Stratum (Plot size: 3-m diameter)					
1. _____					
2. _____					
<u>0</u> = Total Cover					
% Bare Ground in Herb Stratum: <u>0</u>				Hydrophytic Vegetation Indicators: <input type="checkbox"/> 1 – Rapid Test for Hydrophytic Vegetation <input checked="" type="checkbox"/> 2 – Dominance Test is > 50% <input type="checkbox"/> 3 – Prevalence Index is ≤ 3.0 ¹ <input type="checkbox"/> 4 – Morphological Adaptations ¹ (Provide supporting data in Remarks or on a separate sheet) <input type="checkbox"/> 5 – Wetland Non-Vascular Plants ¹ <input type="checkbox"/> Problematic Hydrophytic Vegetation ¹ (Explain) <small>¹Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.</small>	
Remarks:					
				Hydrophytic Vegetation Present? Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	

SOIL

Sampling Point: DP-4

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)								
Depth (inches)	Matrix		Redox Features		Type ¹	Loc ²	Texture	Remarks
	Color (moist)	%	Color (moist)	%				
0-16	10YR 4/2	100					Loam	
¹ Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. ² Loc: PL=Pore Lining, M=Matrix.								
Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)					Indicators for Problematic Hydric Soils³:			
<input type="checkbox"/> Histosol (A1)	<input type="checkbox"/> Sandy Redox (S5)			<input type="checkbox"/> 2cm Muck (A10)				
<input type="checkbox"/> Histic Epipedon (A2)	<input type="checkbox"/> Stripped Matrix (S6)			<input type="checkbox"/> Red Parent Material (TF2)				
<input type="checkbox"/> Black Histic (A3)	<input type="checkbox"/> Loamy Mucky Mineral (F1) (except MLRA 1)			<input type="checkbox"/> Very Shallow Dark Surface (TF12)				
<input type="checkbox"/> Hydrogen Sulfide (A4)	<input type="checkbox"/> Loamy Gleyed Matrix (F2)			<input type="checkbox"/> Other (Explain in Remarks)				
<input type="checkbox"/> Depleted Below Dark Surface (A11)	<input type="checkbox"/> Depleted Matrix (F3)			³ Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.				
<input type="checkbox"/> Thick Dark Surface (A12)	<input type="checkbox"/> Redox Dark Surface (F6)							
<input type="checkbox"/> Sandy Mucky Mineral (S1)	<input type="checkbox"/> Depleted Dark Surface (F7)							
<input type="checkbox"/> Sandy Gleyed Matrix (S4)	<input type="checkbox"/> Redox Depressions (F8)							
Restrictive Layer (if present):					Hydric soil present? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
Type: _____								
Depth (inches): _____								
Remarks:								

HYDROLOGY

Wetland Hydrology Indicators:				Secondary Indicators (2 or more required)			
Primary Indicators (minimum of one required: check all that apply)							
<input type="checkbox"/> Surface water (A1)	<input type="checkbox"/> Water-Stained Leaves (except MLRA 1, 2, 4A & 4B) (B9)			<input type="checkbox"/> Water-Stained Leaves (B9) (MLRA 1, 2, 4A & 4B)			
<input type="checkbox"/> High Water Table (A2)	<input type="checkbox"/> Salt Crust (B11)			<input type="checkbox"/> Drainage Patterns (B10)			
<input type="checkbox"/> Saturation (A3)	<input type="checkbox"/> Aquatic Invertebrates (B13)			<input type="checkbox"/> Dry-Season Water Table (C2)			
<input type="checkbox"/> Water Marks (B1)	<input type="checkbox"/> Hydrogen Sulfide Odor (C1)			<input type="checkbox"/> Saturation Visible on Aerial Imagery (C9)			
<input type="checkbox"/> Sediment Deposits (B2)	<input type="checkbox"/> Oxidized Rhizospheres along Living Roots (C3)			<input type="checkbox"/> Geomorphic Position (D2)			
<input type="checkbox"/> Drift Deposits (B3)	<input type="checkbox"/> Presence of Reduced Iron (C4)			<input type="checkbox"/> Shallow Aquitard (D3)			
<input type="checkbox"/> Algal Mat or Crust (B4)	<input type="checkbox"/> Recent Iron Reduction in Tilled Soils (C6)			<input type="checkbox"/> FAC-Neutral Test (D5)			
<input type="checkbox"/> Iron Deposits (B5)	<input type="checkbox"/> Stunted or Stressed Plants (D1) (LRR A)			<input type="checkbox"/> Raised Ant Mounds (D6) (LRR A)			
<input type="checkbox"/> Surface Soil Cracks (B6)	<input type="checkbox"/> Other (explain in remarks)			<input type="checkbox"/> Frost-Heave Hummocks			
<input type="checkbox"/> Inundation Visible on Aerial Imagery (B7)							
<input type="checkbox"/> Sparsely Vegetated Concave Surface (B8)							
Field Observations:				Wetland Hydrology Present? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
Surface Water Present?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	Depth (in): _____				
Water Table Present?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	Depth (in): _____				
Saturation Present? (includes capillary fringe)	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	Depth (in): _____				
Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:							
Remarks: Dry throughout							

Project/Site: Williams Sumas Compressor Station City/County: Whatcom Sampling date: 6/23/2023
 Applicant/Owner: Williams Pipeline State: WA Sampling Point: DP-5
 Investigator(s): G. Brennan, R. Hohlfeld Section, Township, Range: S36 T41N R04E
 Landform (hillslope, terrace, etc): Terrace Local relief (concave, convex, none): None Slope (%): 1%
 Subregion (LRR): A Lat: - Long: - Datum: -
 Soil Map Unit Name: Puget silt loam, drained, 0-2% slopes NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes No (If no, explain in remarks.)
 Are Vegetation , Soil , or Hydrology significantly disturbed? Are "Normal Circumstances" present on the site? Yes No
 Are Vegetation , Soil , or Hydrology naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	Is the Sampled Area within a Wetland?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>
Hydric Soils Present?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>			
Wetland Hydrology Present?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>			
Remarks: Drier than normal according to the WETS Table methodology, with data from the Bellingham International Airport					

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status	
Tree Stratum (Plot size: 5-m diameter)				Dominance Test worksheet: Number of Dominant Species that are OBL, FACW, or FAC: <u>0</u> (A) Total Number of Dominant Species Across all Strata: <u>1</u> (B) Percent of Dominant Species that are OBL, FACW, or FAC: <u>-</u> (A/B)
1. _____				
2. _____				
3. _____				
4. _____				
<u>0</u> = Total Cover				
Sapling/Shrub Stratum (Plot size: 3-m diameter)				Prevalence Index worksheet: Total % Cover of: _____ Multiply by: OBL species _____ x 1 = _____ FACW species _____ x 2 = _____ FAC species _____ x 3 = _____ FACU species _____ x 4 = _____ UPL species _____ x 5 = _____ Column Totals: (A) _____ (B) _____ Prevalence Index = B/A = _____
1. _____				
2. _____				
3. _____				
4. _____				
<u>0</u> = Total Cover				
Herb Stratum (Plot size: 1-m diameter)				Hydrophytic Vegetation Indicators: <input type="checkbox"/> 1 – Rapid Test for Hydrophytic Vegetation <input type="checkbox"/> 2 – Dominance Test is > 50% <input type="checkbox"/> 3 – Prevalence Index is ≤ 3.0 ¹ <input type="checkbox"/> 4 – Morphological Adaptations ¹ (Provide supporting data in Remarks or on a separate sheet) <input type="checkbox"/> 5 – Wetland Non-Vascular Plants ¹ <input type="checkbox"/> Problematic Hydrophytic Vegetation ¹ (Explain) <small>¹Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.</small>
1. <u>Amaranthus retroflexus</u>	65	Y	FACU	
2. <u>Atriplex prostrata</u>	10	N	FAC	
3. <u>Gnaphalium uliginosum</u>	10	N	FAC	
4. <u>Rorippa sylvestris</u>	3	N	OBL	
5. _____				
6. _____				
7. _____				
8. _____				
9. _____				
10. _____				
<u>88</u> = Total Cover				
Woody Vine Stratum (Plot size: 3-m diameter)				Hydrophytic Vegetation Present? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
1. _____				
2. _____				
<u>0</u> = Total Cover				
% Bare Ground in Herb Stratum: <u>0</u>				
Remarks:				

Project/Site: Williams Sumas Compressor Station City/County: Whatcom Sampling date: 6/23/2023
 Applicant/Owner: Williams Pipeline State: WA Sampling Point: DP-6
 Investigator(s): G. Brennan, R. Hohlfeld Section, Township, Range: S36 T41N R04E
 Landform (hillslope, terrace, etc): Terrace Local relief (concave, convex, none): None Slope (%): -
 Subregion (LRR): A Lat: - Long: - Datum: -
 Soil Map Unit Name: Puget silt loam, drained, 0-2% slopes NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes No (If no, explain in remarks.)
 Are Vegetation , Soil , or Hydrology significantly disturbed? Are "Normal Circumstances" present on the site? Yes No
 Are Vegetation , Soil , or Hydrology naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	Is the Sampled Area within a Wetland?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>
Hydic Soils Present?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>			
Wetland Hydrology Present?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>			
Remarks: Wetland C in-pit Drier than normal according to the WETS Table methodology, with data from the Bellingham International Airport					

VEGETATION – Use scientific names of plants.

Stratum	Absolute % Cover	Dominant Species?	Indicator Status	Worksheet
<u>Tree Stratum</u> (Plot size: 5-m diameter)				Dominance Test worksheet:
1. _____				Number of Dominant Species that are OBL, FACW, or FAC: <u>1</u> (A)
2. _____				Total Number of Dominant Species Across all Strata: <u>1</u> (B)
3. _____				Percent of Dominant Species that are OBL, FACW, or FAC: <u>100</u> (A/B)
4. _____				
<u>0</u> = Total Cover				
<u>Sapling/Shrub Stratum</u> (Plot size: 3-m diameter)				Prevalence Index worksheet:
1. _____				<u>Total % Cover of:</u> _____ <u>Multiply by:</u> _____
2. _____				OBL species _____ x 1 = _____
3. _____				FACW species _____ x 2 = _____
4. _____				FAC species _____ x 3 = _____
5. _____				FACU species _____ x 4 = _____
<u>0</u> = Total Cover				UPL species _____ x 5 = _____
<u>Herb Stratum</u> (Plot size: 1-m diameter)				Column Totals: (A) _____ (B) _____
1. <u>Phalaris arundinacea</u>	100	Y	FACW	Prevalence Index = B/A = _____
2. _____				
3. _____				
4. _____				
5. _____				
6. _____				
7. _____				
8. _____				
9. _____				
10. _____				
11. _____				
<u>100</u> = Total Cover				
<u>Woody Vine Stratum</u> (Plot size: 3-m diameter)				
1. _____				
2. _____				
<u>0</u> = Total Cover				
% Bare Ground in Herb Stratum: <u>0</u>				
Remarks:				Hydrophytic Vegetation Indicators: <input type="checkbox"/> 1 – Rapid Test for Hydrophytic Vegetation <input checked="" type="checkbox"/> 2 – Dominance Test is > 50% <input type="checkbox"/> 3 – Prevalence Index is ≤ 3.0 ¹ <input type="checkbox"/> 4 – Morphological Adaptations ¹ (Provide supporting data in Remarks or on a separate sheet) <input type="checkbox"/> 5 – Wetland Non-Vascular Plants ¹ <input type="checkbox"/> Problematic Hydrophytic Vegetation ¹ (Explain) ¹ Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.
				Hydrophytic Vegetation Present? Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>

SOIL

Sampling Point: DP-6

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)								
Depth (inches)	Matrix		Redox Features		Type ¹	Loc ²	Texture	Remarks
	Color (moist)	%	Color (moist)	%				
0-9	10YR 4/2						Silt loam	
9-16	10YR 5/1	60	10YR 5/6 10YR 3/6	10 30	C	M	Silt loam	
¹ Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains.						² Loc: PL=Pore Lining, M=Matrix.		
Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)					Indicators for Problematic Hydric Soils³:			
<input type="checkbox"/> Histosol (A1)	<input type="checkbox"/> Sandy Redox (S5)	<input type="checkbox"/> 2cm Muck (A10)						
<input type="checkbox"/> Histic Epipedon (A2)	<input type="checkbox"/> Stripped Matrix (S6)	<input type="checkbox"/> Red Parent Material (TF2)						
<input type="checkbox"/> Black Histic (A3)	<input type="checkbox"/> Loamy Mucky Mineral (F1) (except MLRA 1)	<input type="checkbox"/> Very Shallow Dark Surface (TF12)						
<input type="checkbox"/> Hydrogen Sulfide (A4)	<input type="checkbox"/> Loamy Gleyed Matrix (F2)	<input type="checkbox"/> Other (Explain in Remarks)						
<input type="checkbox"/> Depleted Below Dark Surface (A11)	<input checked="" type="checkbox"/> Depleted Matrix (F3)	³ Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.						
<input type="checkbox"/> Thick Dark Surface (A12)	<input type="checkbox"/> Redox Dark Surface (F6)							
<input type="checkbox"/> Sandy Mucky Mineral (S1)	<input type="checkbox"/> Depleted Dark Surface (F7)							
<input type="checkbox"/> Sandy Gleyed Matrix (S4)	<input type="checkbox"/> Redox Depressions (F8)							
Restrictive Layer (if present):					Hydric soil present? Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>			
Type: _____								
Depth (inches): _____								
Remarks:								

HYDROLOGY

Wetland Hydrology Indicators:			
Primary Indicators (minimum of one required: check all that apply)		Secondary Indicators (2 or more required)	
<input type="checkbox"/> Surface water (A1)	<input type="checkbox"/> Water-Stained Leaves (except MLRA 1, 2, 4A & 4B) (B9)	<input type="checkbox"/> Water-Stained Leaves (B9) (MLRA 1, 2, 4A & 4B)	
<input type="checkbox"/> High Water Table (A2)	<input type="checkbox"/> Salt Crust (B11)	<input type="checkbox"/> Drainage Patterns (B10)	
<input type="checkbox"/> Saturation (A3)	<input type="checkbox"/> Aquatic Invertebrates (B13)	<input type="checkbox"/> Dry-Season Water Table (C2)	
<input type="checkbox"/> Water Marks (B1)	<input type="checkbox"/> Hydrogen Sulfide Odor (C1)	<input type="checkbox"/> Saturation Visible on Aerial Imagery (C9)	
<input type="checkbox"/> Sediment Deposits (B2)	<input type="checkbox"/> Oxidized Rhizospheres along Living Roots (C3)	<input checked="" type="checkbox"/> Geomorphic Position (D2)	
<input type="checkbox"/> Drift Deposits (B3)	<input type="checkbox"/> Presence of Reduced Iron (C4)	<input type="checkbox"/> Shallow Aquitard (D3)	
<input type="checkbox"/> Algal Mat or Crust (B4)	<input type="checkbox"/> Recent Iron Reduction in Tilled Soils (C6)	<input checked="" type="checkbox"/> FAC-Neutral Test (D5)	
<input type="checkbox"/> Iron Deposits (B5)	<input type="checkbox"/> Stunted or Stressed Plants (D1) (LRR A)	<input type="checkbox"/> Raised Ant Mounds (D6) (LRR A)	
<input type="checkbox"/> Surface Soil Cracks (B6)	<input type="checkbox"/> Other (explain in remarks)	<input type="checkbox"/> Frost-Heave Hummocks	
<input type="checkbox"/> Inundation Visible on Aerial Imagery (B7)			
<input type="checkbox"/> Sparsely Vegetated Concave Surface (B8)			
Field Observations:			
Surface Water Present?	Yes <input type="checkbox"/> No <input type="checkbox"/>	Wetland Hydrology Present? Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	Depth (in): _____
Water Table Present?	Yes <input type="checkbox"/> No <input type="checkbox"/>		Depth (in): _____
Saturation Present?	Yes <input type="checkbox"/> No <input type="checkbox"/>		Depth (in): _____
(includes capillary fringe)			
Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:			
Remarks:			

Project/Site: Williams Sumas Compressor Station City/County: Whatcom Sampling date: 6/23/2023
 Applicant/Owner: Williams Pipeline State: WA Sampling Point: DP-7
 Investigator(s): G. Brennan, R. Hohlfeld Section, Township, Range: S36 T41N R04E
 Landform (hillslope, terrace, etc): Slope Local relief (concave, convex, none): Convex Slope (%): 2
 Subregion (LRR): A Lat: - Long: - Datum: -
 Soil Map Unit Name: Puget silt loam, drained, 0-2% slopes NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes No (If no, explain in remarks.)
 Are Vegetation , Soil , or Hydrology significantly disturbed? Are "Normal Circumstances" present on the site? Yes No
 Are Vegetation , Soil , or Hydrology naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	Is the Sampled Area within a Wetland?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>
Hydric Soils Present?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>			
Wetland Hydrology Present?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>			
Remarks: Wetland C out-pit Drier than normal according to the WETS Table methodology, with data from the Bellingham International Airport					

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status	
Tree Stratum (Plot size: 5-m diameter)				Dominance Test worksheet: Number of Dominant Species that are OBL, FACW, or FAC: <u>1</u> (A) Total Number of Dominant Species Across all Strata: <u>1</u> (B) Percent of Dominant Species that are OBL, FACW, or FAC: <u>100</u> (A/B)
1. _____				
2. _____				
3. _____				
4. _____				
<u>0</u> = Total Cover				Prevalence Index worksheet: Total % Cover of: <u> </u> Multiply by: OBL species <u> </u> x 1 = <u> </u> FACW species <u> </u> x 2 = <u> </u> FAC species <u> </u> x 3 = <u> </u> FACU species <u> </u> x 4 = <u> </u> UPL species <u> </u> x 5 = <u> </u> Column Totals: (A) <u> </u> (B) <u> </u> Prevalence Index = B/A = <u> </u>
Sapling/Shrub Stratum (Plot size: 3-m diameter)				
1. _____				
2. _____				
3. _____				
4. _____				
5. _____				
<u>0</u> = Total Cover				
Herb Stratum (Plot size: 1-m diameter)				Hydrophytic Vegetation Indicators: <input type="checkbox"/> 1 – Rapid Test for Hydrophytic Vegetation <input checked="" type="checkbox"/> 2 – Dominance Test is > 50% <input type="checkbox"/> 3 – Prevalence Index is ≤ 3.0 ¹ <input type="checkbox"/> 4 – Morphological Adaptations ¹ (Provide supporting data in Remarks or on a separate sheet) <input type="checkbox"/> 5 – Wetland Non-Vascular Plants ¹ <input type="checkbox"/> Problematic Hydrophytic Vegetation ¹ (Explain) ¹ Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.
1. <i>Phalaris arundinacea</i>	100	Y	FACW	
2. _____				
3. _____				
4. _____				
5. _____				
6. _____				
7. _____				
8. _____				
9. _____				
10. _____				
11. _____				
<u>100</u> = Total Cover				
Woody Vine Stratum (Plot size: 3-m diameter)				Hydrophytic Vegetation Present? Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
1. _____				
2. _____				
<u>0</u> = Total Cover				
% Bare Ground in Herb Stratum: <u>0</u>				
Remarks:				

SOIL

Sampling Point: DP-7

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)								
Depth (inches)	Matrix		Redox Features		Type ¹	Loc ²	Texture	Remarks
	Color (moist)	%	Color (moist)	%				
0-16	2.5Y 2/3	100					Silt loam	
¹ Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. ² Loc: PL=Pore Lining, M=Matrix.								
Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.) <input type="checkbox"/> Histosol (A1) <input type="checkbox"/> Sandy Redox (S5) <input type="checkbox"/> Histic Epipedon (A2) <input type="checkbox"/> Stripped Matrix (S6) <input type="checkbox"/> Black Histic (A3) <input type="checkbox"/> Loamy Mucky Mineral (F1) (except MLRA 1) <input type="checkbox"/> Hydrogen Sulfide (A4) <input type="checkbox"/> Loamy Gleyed Matrix (F2) <input type="checkbox"/> Depleted Below Dark Surface (A11) <input type="checkbox"/> Depleted Matrix (F3) <input type="checkbox"/> Thick Dark Surface (A12) <input type="checkbox"/> Redox Dark Surface (F6) <input type="checkbox"/> Sandy Mucky Mineral (S1) <input type="checkbox"/> Depleted Dark Surface (F7) <input type="checkbox"/> Sandy Gleyed Matrix (S4) <input type="checkbox"/> Redox Depressions (F8)					Indicators for Problematic Hydric Soils³: <input type="checkbox"/> 2cm Muck (A10) <input type="checkbox"/> Red Parent Material (TF2) <input type="checkbox"/> Very Shallow Dark Surface (TF12) <input type="checkbox"/> Other (Explain in Remarks)			
Restrictive Layer (if present): Type: _____ Depth (inches): _____					Hydric soil present? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
Remarks: _____								

HYDROLOGY

Wetland Hydrology Indicators:			
Primary Indicators (minimum of one required: check all that apply)		Secondary Indicators (2 or more required)	
<input type="checkbox"/> Surface water (A1)	<input type="checkbox"/> Water-Stained Leaves (except MLRA 1, 2, 4A & 4B) (B9)	<input type="checkbox"/> Water-Stained Leaves (B9) (MLRA 1, 2, 4A & 4B)	<input type="checkbox"/> High Water Table (A2)
<input type="checkbox"/> Saturation (A3)	<input type="checkbox"/> Salt Crust (B11)	<input type="checkbox"/> Drainage Patterns (B10)	<input type="checkbox"/> Water Marks (B1)
<input type="checkbox"/> Sediment Deposits (B2)	<input type="checkbox"/> Aquatic Invertebrates (B13)	<input type="checkbox"/> Dry-Season Water Table (C2)	<input type="checkbox"/> Iron Deposits (B5)
<input type="checkbox"/> Drift Deposits (B3)	<input type="checkbox"/> Hydrogen Sulfide Odor (C1)	<input type="checkbox"/> Saturation Visible on Aerial Imagery (C9)	<input type="checkbox"/> Surface Soil Cracks (B6)
<input type="checkbox"/> Algal Mat or Crust (B4)	<input type="checkbox"/> Oxidized Rhizospheres along Living Roots (C3)	<input checked="" type="checkbox"/> Geomorphic Position (D2)	<input type="checkbox"/> Inundation Visible on Aerial Imagery (B7)
<input type="checkbox"/> Iron Deposits (B5)	<input type="checkbox"/> Presence of Reduced Iron (C4)	<input type="checkbox"/> Shallow Aquitard (D3)	<input type="checkbox"/> Sparsely Vegetated Concave Surface (B8)
<input type="checkbox"/> Surface Soil Cracks (B6)	<input type="checkbox"/> Recent Iron Reduction in Tilled Soils (C6)	<input type="checkbox"/> FAC-Neutral Test (D5)	
<input type="checkbox"/> Inundation Visible on Aerial Imagery (B7)	<input type="checkbox"/> Stunted or Stressed Plants (D1) (LRR A)	<input type="checkbox"/> Raised Ant Mounds (D6) (LRR A)	
<input type="checkbox"/> Sparsely Vegetated Concave Surface (B8)	<input type="checkbox"/> Other (explain in remarks)	<input type="checkbox"/> Frost-Heave Hummocks	
Field Observations: Surface Water Present? Yes <input type="checkbox"/> No <input type="checkbox"/> Depth (in): _____ Water Table Present? Yes <input type="checkbox"/> No <input type="checkbox"/> Depth (in): _____ Saturation Present? Yes <input type="checkbox"/> No <input type="checkbox"/> Depth (in): _____ (includes capillary fringe)		Wetland Hydrology Present? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	
Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:			
Remarks: Powder dry. Geomorphic position within the floodplain.			

Project/Site: Williams Sumas Compressor Station City/County: Whatcom Sampling date: 6/23/2023
 Applicant/Owner: Williams Pipeline State: WA Sampling Point: DP-8
 Investigator(s): G. Brennan, R. Hohlfeld Section, Township, Range: S36 T41N R04E
 Landform (hillslope, terrace, etc): Terrace Local relief (concave, convex, none): None Slope (%): -
 Subregion (LRR): A Lat: - Long: - Datum: -
 Soil Map Unit Name: Puget silt loam, drained, 0-2% slopes NWI classification: None

Are climatic / hydrologic conditions on the site typical for this time of year? Yes No (If no, explain in remarks.)
 Are Vegetation , Soil , or Hydrology significantly disturbed? Are "Normal Circumstances" present on the site? Yes No
 Are Vegetation , Soil , or Hydrology naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	Is the Sampled Area within a Wetland?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>
Hydric Soils Present?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>			
Wetland Hydrology Present?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>			
Remarks: Drier than normal according to the WETS Table methodology, with data from the Bellingham International Airport					

VEGETATION – Use scientific names of plants.

Stratum	Absolute % Cover	Dominant Species?	Indicator Status	Worksheet
<u>Tree Stratum</u> (Plot size: 5-m diameter)				Dominance Test worksheet:
1. _____				Number of Dominant Species that are OBL, FACW, or FAC: <u>1</u> (A)
2. _____				Total Number of Dominant Species Across all Strata: <u>1</u> (B)
3. _____				Percent of Dominant Species that are OBL, FACW, or FAC: <u>100</u> (A/B)
4. _____				
<u>0</u> = Total Cover				
<u>Sapling/Shrub Stratum</u> (Plot size: 3-m diameter)				Prevalence Index worksheet:
1. _____				<u>Total % Cover of:</u> <u> </u> <u>Multiply by:</u>
2. _____				OBL species <u> </u> x 1 = <u> </u>
3. _____				FACW species <u> </u> x 2 = <u> </u>
4. _____				FAC species <u> </u> x 3 = <u> </u>
5. _____				FACU species <u> </u> x 4 = <u> </u>
<u>0</u> = Total Cover				UPL species <u> </u> x 5 = <u> </u>
<u>Herb Stratum</u> (Plot size: 1-m diameter)				Column Totals: (A) <u> </u> (B) <u> </u>
1. <u>Lolium perenne</u>	100	Y	FAC	Prevalence Index = B/A = <u> </u>
2. _____				
3. _____				
4. _____				
5. _____				
6. _____				
7. _____				
8. _____				
9. _____				
10. _____				
11. _____				
<u>100</u> = Total Cover				
<u>Woody Vine Stratum</u> (Plot size: 3-m diameter)				Hydrophytic Vegetation Indicators:
1. _____				<input type="checkbox"/> 1 – Rapid Test for Hydrophytic Vegetation
2. _____				<input checked="" type="checkbox"/> 2 – Dominance Test is > 50%
<u>0</u> = Total Cover				<input type="checkbox"/> 3 – Prevalence Index is ≤ 3.0 ¹
% Bare Ground in Herb Stratum: <u>0</u>				<input type="checkbox"/> 4 – Morphological Adaptations ¹ (Provide supporting data in Remarks or on a separate sheet)
				<input type="checkbox"/> 5 – Wetland Non-Vascular Plants ¹
				<input type="checkbox"/> Problematic Hydrophytic Vegetation ¹ (Explain)
				¹ Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.
Remarks:				Hydrophytic Vegetation Present? Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>

SOIL

Sampling Point: DP-8

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)									
Depth (inches)	Matrix		Redox Features			Type ¹	Loc ²	Texture	Remarks
	Color (moist)	%	Color (moist)	%					
0-7	2.5Y 3/3	100						Clay loam	
7-16	2.5Y 3/3	99	10YR 4/6	1		C	M	Clay loam	
¹ Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. ² Loc: PL=Pore Lining, M=Matrix.									
Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.) <input type="checkbox"/> Histosol (A1) <input type="checkbox"/> Histic Epipedon (A2) <input type="checkbox"/> Black Histic (A3) <input type="checkbox"/> Hydrogen Sulfide (A4) <input type="checkbox"/> Depleted Below Dark Surface (A11) <input type="checkbox"/> Thick Dark Surface (A12) <input type="checkbox"/> Sandy Mucky Mineral (S1) <input type="checkbox"/> Sandy Gleyed Matrix (S4)			<input type="checkbox"/> Sandy Redox (S5) <input type="checkbox"/> Stripped Matrix (S6) <input type="checkbox"/> Loamy Mucky Mineral (F1) (except MLRA 1) <input type="checkbox"/> Loamy Gleyed Matrix (F2) <input type="checkbox"/> Depleted Matrix (F3) <input type="checkbox"/> Redox Dark Surface (F6) <input type="checkbox"/> Depleted Dark Surface (F7) <input type="checkbox"/> Redox Depressions (F8)			Indicators for Problematic Hydric Soils³: <input type="checkbox"/> 2cm Muck (A10) <input type="checkbox"/> Red Parent Material (TF2) <input type="checkbox"/> Very Shallow Dark Surface (TF12) <input type="checkbox"/> Other (Explain in Remarks)			
Restrictive Layer (if present): Type: _____ Depth (inches): _____						Hydric soil present? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>			
Remarks: Matrix too bright to qualify as hydric and redox too limited									

HYDROLOGY

Wetland Hydrology Indicators:			
Primary Indicators (minimum of one required: check all that apply)		Secondary Indicators (2 or more required)	
<input type="checkbox"/> Surface water (A1)	<input type="checkbox"/> Water-Stained Leaves (except MLRA 1, 2, 4A & 4B) (B9)	<input type="checkbox"/> Water-Stained Leaves (B9) (MLRA 1, 2, 4A & 4B)	
<input type="checkbox"/> High Water Table (A2)	<input type="checkbox"/> Salt Crust (B11)	<input type="checkbox"/> Drainage Patterns (B10)	
<input type="checkbox"/> Saturation (A3)	<input type="checkbox"/> Aquatic Invertebrates (B13)	<input type="checkbox"/> Dry-Season Water Table (C2)	
<input type="checkbox"/> Water Marks (B1)	<input type="checkbox"/> Hydrogen Sulfide Odor (C1)	<input type="checkbox"/> Saturation Visible on Aerial Imagery (C9)	
<input type="checkbox"/> Sediment Deposits (B2)	<input type="checkbox"/> Oxidized Rhizospheres along Living Roots (C3)	<input type="checkbox"/> Geomorphic Position (D2)	
<input type="checkbox"/> Drift Deposits (B3)	<input type="checkbox"/> Presence of Reduced Iron (C4)	<input type="checkbox"/> Shallow Aquitard (D3)	
<input type="checkbox"/> Algal Mat or Crust (B4)	<input type="checkbox"/> Recent Iron Reduction in Tilled Soils (C6)	<input type="checkbox"/> FAC-Neutral Test (D5)	
<input type="checkbox"/> Iron Deposits (B5)	<input type="checkbox"/> Stunted or Stressed Plants (D1) (LRR A)	<input type="checkbox"/> Raised Ant Mounds (D6) (LRR A)	
<input type="checkbox"/> Surface Soil Cracks (B6)	<input type="checkbox"/> Other (explain in remarks)	<input type="checkbox"/> Frost-Heave Hummocks	
<input type="checkbox"/> Inundation Visible on Aerial Imagery (B7)			
<input type="checkbox"/> Sparsely Vegetated Concave Surface (B8)			
Field Observations: Surface Water Present? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Depth (in): _____ Water Table Present? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Depth (in): _____ Saturation Present? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Depth (in): _____ (includes capillary fringe)		Wetland Hydrology Present? Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	
Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:			
Remarks: Powder dry throughout			

Wetland name or number: Wetland A

RATING SUMMARY – Western Washington

Name of wetland (or ID #): Wetland A Date of site visit: 6/22/2023

Rated by: G. Brennan, R. Hohlfeld Trained by Ecology? Y N Date of training: 10/2019, 9/2017

HGM Class used for rating: Depressional Wetland has multiple HGM classes? Y N

NOTE: Form is not complete without the figures requested (figures can be combined).

Source of base aerial photo/map: Google Earth, DOE Water Quality Atlas

OVERALL WETLAND CATEGORY: III (based on functions or special characteristics)

1. Category of wetland based on FUNCTIONS

- Category I** – Total score = 23 - 27
- Category II** – Total score = 20 - 22
- Category III** – Total score = 16 - 19
- Category IV** – Total score = 9 - 15

FUNCTION	Improving Water Quality	Hydrologic	Habitat	
<i>Circle the appropriate ratings</i>				
Site Potential	H M <u>L</u>	H M <u>L</u>	H M <u>L</u>	
Landscape Potential	<u>H</u> M L	H <u>M</u> L	H <u>M</u> L	
Value	<u>H</u> M L	<u>H</u> M L	H <u>M</u> L	TOTAL
Score Based on Ratings	7	6	5	18

Score for each function based on three ratings (order of ratings is not important)

- 9 = H,H,H
- 8 = H,H,M
- 7 = H,H,L
- 7 = H,M,M
- 6 = H,M,L
- 6 = M,M,M
- 5 = H,L,L
- 5 = M,M,L
- 4 = M,L,L
- 3 = L,L,L

2. Category based on SPECIAL CHARACTERISTICS of wetland

CHARACTERISTIC	CATEGORY
Estuarine	I II
Wetland of High Conservation Value	I
Bog	I
Mature Forest	I
Old Growth Forest	I
Coastal Lagoon	I II
Interdunal	I II III IV
None of the above	<input checked="" type="checkbox"/>

Wetland name or number: Wetland A

Maps and figures required to answer questions correctly for Western Washington

Depressional Wetlands

Map of:	To answer questions:	Figure #
Cowardin plant classes	D 1.3, H 1.1, H 1.4	1
Hydroperiods	D 1.4, H 1.2	2
Location of outlet (<i>can be added to map of hydroperiods</i>)	D 1.1, D 4.1	2
Boundary of area within 150 ft of the wetland (<i>can be added to another figure</i>)	D 2.2, D 5.2	2
Map of the contributing basin	D 4.3, D 5.3	3
1 km Polygon: Area that extends 1 km from entire wetland edge - including polygons for accessible habitat and undisturbed habitat	H 2.1, H 2.2, H 2.3	5
Screen capture of map of 303(d) listed waters in basin (from Ecology website)	D 3.1, D 3.2	6
Screen capture of list of TMDLs for WRIA in which unit is found (from web)	D 3.3	7

HGM Classification of Wetlands in Western Washington

For questions 1-7, the criteria described must apply to the entire unit being rated.

If the hydrologic criteria listed in each question do not apply to the entire unit being rated, you probably have a unit with multiple HGM classes. In this case, identify which hydrologic criteria in questions 1-7 apply, and go to Question 8.

1. Are the water levels in the entire unit usually controlled by tides except during floods?

NO – go to 2

YES – the wetland class is **Tidal Fringe** – go to 1.1

1.1 Is the salinity of the water during periods of annual low flow below 0.5 ppt (parts per thousand)?

NO – Saltwater Tidal Fringe (Estuarine)

YES – Freshwater Tidal Fringe

*If your wetland can be classified as a Freshwater Tidal Fringe use the forms for **Riverine** wetlands. If it is Saltwater Tidal Fringe it is an **Estuarine** wetland and is not scored. This method **cannot** be used to score functions for estuarine wetlands.*

2. The entire wetland unit is flat and precipitation is the only source (>90%) of water to it. Groundwater and surface water runoff are NOT sources of water to the unit.

NO – go to 3

YES – The wetland class is **Flats**

*If your wetland can be classified as a Flats wetland, use the form for **Depressional** wetlands.*

3. Does the entire wetland unit **meet all** of the following criteria?

The vegetated part of the wetland is on the shores of a body of permanent open water (without any plants on the surface at any time of the year) at least 20 ac (8 ha) in size;

At least 30% of the open water area is deeper than 6.6 ft (2 m).

NO – go to 4

YES – The wetland class is **Lake Fringe** (Lacustrine Fringe)

4. Does the entire wetland unit **meet all** of the following criteria?

The wetland is on a slope (*slope can be very gradual*),

The water flows through the wetland in one direction (unidirectional) and usually comes from seeps. It may flow subsurface, as sheetflow, or in a swale without distinct banks,

The water leaves the wetland **without being impounded**.

NO – go to 5

YES – The wetland class is **Slope**

NOTE: Surface water does not pond in these type of wetlands except occasionally in very small and shallow depressions or behind hummocks (depressions are usually <3 ft diameter and less than 1 ft deep).

5. Does the entire wetland unit **meet all** of the following criteria?

The unit is in a valley, or stream channel, where it gets inundated by overbank flooding from that stream or river,

The overbank flooding occurs at least once every 2 years.

Wetland name or number: Wetland A

NO – go to 6

YES – The wetland class is **Riverine**

NOTE: The Riverine unit can contain depressions that are filled with water when the river is not flooding

6. Is the entire wetland unit in a topographic depression in which water ponds, or is saturated to the surface, at some time during the year? *This means that any outlet, if present, is higher than the interior of the wetland.*

NO – go to 7

YES – The wetland class is **Depressional**

7. Is the entire wetland unit located in a very flat area with no obvious depression and no overbank flooding? The unit does not pond surface water more than a few inches. The unit seems to be maintained by high groundwater in the area. The wetland may be ditched, but has no obvious natural outlet.

NO – go to 8

YES – The wetland class is **Depressional**

8. Your wetland unit seems to be difficult to classify and probably contains several different HGM classes. For example, seeps at the base of a slope may grade into a riverine floodplain, or a small stream within a Depressional wetland has a zone of flooding along its sides. **GO BACK AND IDENTIFY WHICH OF THE HYDROLOGIC REGIMES DESCRIBED IN QUESTIONS 1-7 APPLY TO DIFFERENT AREAS IN THE UNIT** (make a rough sketch to help you decide). Use the following table to identify the appropriate class to use for the rating system if you have several HGM classes present within the wetland unit being scored.

NOTE: Use this table only if the class that is recommended in the second column represents 10% or more of the total area of the wetland unit being rated. If the area of the HGM class listed in column 2 is less than 10% of the unit; classify the wetland using the class that represents more than 90% of the total area.

HGM classes within the wetland unit being rated	HGM class to use in rating
Slope + Riverine	Riverine
Slope + Depressional	Depressional
Slope + Lake Fringe	Lake Fringe
Depressional + Riverine along stream within boundary of depression	Depressional
Depressional + Lake Fringe	Depressional
Riverine + Lake Fringe	Riverine
Salt Water Tidal Fringe and any other class of freshwater wetland	Treat as ESTUARINE

*If you are still unable to determine which of the above criteria apply to your wetland, or if you have **more than 2 HGM classes** within a wetland boundary, classify the wetland as Depressional for the rating.*

DEPRESSIONAL AND FLATS WETLANDS		
Water Quality Functions - Indicators that the site functions to improve water quality		
D 1.0. Does the site have the potential to improve water quality?		
D 1.1. <u>Characteristics of surface water outflows from the wetland:</u> <input type="checkbox"/> Wetland is a depression or flat depression (QUESTION 7 on key) with no surface water leaving it (no outlet). points = 3 <input checked="" type="checkbox"/> Wetland has an intermittently flowing stream or ditch, OR highly constricted permanently flowing outlet. points = 2 <input type="checkbox"/> Wetland has an unconstricted, or slightly constricted, surface outlet that is permanently flowing. points = 1 <input type="checkbox"/> Wetland is a flat depression (QUESTION 7 on key), whose outlet is a permanently flowing ditch. points = 1	2	
D 1.2. <u>The soil 2 in below the surface (or duff layer) is true clay or true organic (use NRCS definitions).</u> <input type="checkbox"/> Yes = 4 <input checked="" type="checkbox"/> No = 0		0
D 1.3. <u>Characteristics and distribution of persistent plants</u> (Emergent, Scrub-shrub, and/or Forested Cowardin classes): <input type="checkbox"/> Wetland has persistent, ungrazed, plants > 95% of area points = 5 <input type="checkbox"/> Wetland has persistent, ungrazed, plants > 1/2 of area points = 3 <input checked="" type="checkbox"/> Wetland has persistent, ungrazed plants > 1/10 of area points = 1 <input type="checkbox"/> Wetland has persistent, ungrazed plants < 1/10 of area points = 0	1	
D 1.4. <u>Characteristics of seasonal ponding or inundation:</u> <i>This is the area that is ponded for at least 2 months. See description in manual.</i> <input type="checkbox"/> Area seasonally ponded is > ½ total area of wetland points = 4 <input type="checkbox"/> Area seasonally ponded is > ¼ total area of wetland points = 2 <input checked="" type="checkbox"/> Area seasonally ponded is < ¼ total area of wetland points = 0	0	
Total for D 1	Add the points in the boxes above	3

Rating of Site Potential If score is: 12-16 = H 6-11 = M 0-5 = L *Record the rating on the first page*

D 2.0. Does the landscape have the potential to support the water quality function of the site?		
D 2.1. Does the wetland unit receive stormwater discharges?	<input checked="" type="checkbox"/> Yes = 1 <input type="checkbox"/> No = 0	1
D 2.2. Is > 10% of the area within 150 ft of the wetland in land uses that generate pollutants?	<input checked="" type="checkbox"/> Yes = 1 <input type="checkbox"/> No = 0	1
D 2.3. Are there septic systems within 250 ft of the wetland?	<input checked="" type="checkbox"/> Yes = 1 <input type="checkbox"/> No = 0	1
D 2.4. Are there other sources of pollutants coming into the wetland that are not listed in questions D 2.1-D 2.3? Source: Click here to enter text.	<input type="checkbox"/> Yes = 1 <input checked="" type="checkbox"/> No = 0	0
Total for D 2	Add the points in the boxes above	3

Rating of Landscape Potential If score is: 3 or 4 = H 1 or 2 = M 0 = L *Record the rating on the first page*

D 3.0. Is the water quality improvement provided by the site valuable to society?		
D 3.1. Does the wetland discharge directly (i.e., within 1 mi) to a stream, river, lake, or marine water that is on the 303(d) list?	<input type="checkbox"/> Yes = 1 <input checked="" type="checkbox"/> No = 0	0
D 3.2. Is the wetland in a basin or sub-basin where an aquatic resource is on the 303(d) list?	<input checked="" type="checkbox"/> Yes = 1 <input type="checkbox"/> No = 0	1
D 3.3. Has the site been identified in a watershed or local plan as important for maintaining water quality (answer YES if there is a TMDL for the basin in which the unit is found)?	<input checked="" type="checkbox"/> Yes = 2 <input type="checkbox"/> No = 0	2
Total for D 3	Add the points in the boxes above	3

Rating of Value If score is: 2-4 = H 1 = M 0 = L *Record the rating on the first page*

DEPRESSIONAL AND FLATS WETLANDS

Hydrologic Functions - Indicators that the site functions to reduce flooding and stream degradation

D 4.0. Does the site have the potential to reduce flooding and erosion?		
D 4.1. <u>Characteristics of surface water outflows from the wetland:</u>		
<input type="checkbox"/> Wetland is a depression or flat depression with no surface water leaving it (no outlet). points = 4		2
<input checked="" type="checkbox"/> Wetland has an intermittently flowing stream or ditch, OR highly constricted permanently flowing outlet. points = 2		
<input type="checkbox"/> Wetland is a flat depression (QUESTION 7 on key), whose outlet is a permanently flowing ditch. points = 1		
<input type="checkbox"/> Wetland has an unconstricted, or slightly constricted, surface outlet that is permanently flowing. points = 0		
D 4.2. <u>Depth of storage during wet periods:</u> <i>Estimate the height of ponding above the bottom of the outlet. For wetlands with no outlet, measure from the surface of permanent water or if dry, the deepest part.</i>		
<input type="checkbox"/> Marks of ponding are 3 ft or more above the surface or bottom of outlet. points = 7		0
<input type="checkbox"/> Marks of ponding between 2 ft to < 3 ft from surface or bottom of outlet. points = 5		
<input type="checkbox"/> Marks are at least 0.5 ft to < 2 ft from surface or bottom of outlet. points = 3		
<input type="checkbox"/> The wetland is a "headwater" wetland. points = 3		
<input type="checkbox"/> Wetland is flat but has small depressions on the surface that trap water. points = 1		
<input checked="" type="checkbox"/> Marks of ponding less than 0.5 ft (6 in). points = 0		
D 4.3. <u>Contribution of the wetland to storage in the watershed:</u> <i>Estimate the ratio of the area of upstream basin contributing surface water to the wetland to the area of the wetland unit itself.</i>		
<input type="checkbox"/> The area of the basin is less than 10 times the area of the unit. points = 5		3
<input checked="" type="checkbox"/> The area of the basin is 10 to 100 times the area of the unit. points = 3		
<input type="checkbox"/> The area of the basin is more than 100 times the area of the unit. points = 0		
<input type="checkbox"/> Entire wetland is in the Flats class. points = 5		
Total for D 4	Add the points in the boxes above	5

Rating of Site Potential If score is: 12-16 = H 6-11 = M 0-5 = L *Record the rating on the first page*

D 5.0. Does the landscape have the potential to support hydrologic functions of the site?		
D 5.1. Does the wetland receive stormwater discharges?	<input checked="" type="checkbox"/> Yes = 1 <input type="checkbox"/> No = 0	1
D 5.2. Is >10% of the area within 150 ft of the wetland in land uses that generate excess runoff?	<input checked="" type="checkbox"/> Yes = 1 <input type="checkbox"/> No = 0	1
D 5.3. Is more than 25% of the contributing basin of the wetland covered with intensive human land uses (residential at >1 residence/ac, urban, commercial, agriculture, etc.)?	<input type="checkbox"/> Yes = 1 <input checked="" type="checkbox"/> No = 0	0
Total for D 5	Add the points in the boxes above	2

Rating of Landscape Potential If score is: 3 = H 1 or 2 = M 0 = L *Record the rating on the first page*

D 6.0. Are the hydrologic functions provided by the site valuable to society?		
D 6.1. <u>The unit is in a landscape that has flooding problems.</u> <i>Choose the description that best matches conditions around the wetland unit being rated. Do not add points. Choose the highest score if more than one condition is met.</i> The wetland captures surface water that would otherwise flow down-gradient into areas where flooding has damaged human or natural resources (e.g., houses or salmon redds):		
• <input checked="" type="checkbox"/> Flooding occurs in a sub-basin that is immediately down-gradient of unit. points = 2		2
• <input type="checkbox"/> Surface flooding problems are in a sub-basin farther down-gradient. points = 1		
<input type="checkbox"/> Flooding from groundwater is an issue in the sub-basin. points = 1		
<input type="checkbox"/> The existing or potential outflow from the wetland is so constrained by human or natural conditions that the water stored by the wetland cannot reach areas that flood.		
<i>Explain why:</i> ___ points = 0		
<input type="checkbox"/> There are no problems with flooding downstream of the wetland. points = 0		
D 6.2. Has the site been identified as important for flood storage or flood conveyance in a regional flood control plan?	<input type="checkbox"/> Yes = 2 <input checked="" type="checkbox"/> No = 0	0
Total for D 6	Add the points in the boxes above	2

Rating of Value If score is: 2-4 = H 1 = M 0 = L *Record the rating on the first page*

These questions apply to wetlands of all HGM classes.

HABITAT FUNCTIONS - Indicators that site functions to provide important habitat

H 1.0. Does the site have the potential to provide habitat?

H 1.1. Structure of plant community: *Indicators are Cowardin classes and strata within the Forested class.* Check the Cowardin plant classes in the wetland. *Up to 10 patches may be combined for each class to meet the threshold of ¼ ac or more than 10% of the unit if it is smaller than 2.5 ac. Add the number of structures checked.*

- Aquatic bed 4 structures or more: points = 4
 - Emergent 3 structures: points = 2
 - Scrub-shrub (areas where shrubs have > 30% cover) 2 structures: points = 1
 - Forested (areas where trees have > 30% cover) 1 structure: points = 0
- If the unit has a Forested class, check if:*
- The Forested class has 3 out of 5 strata (canopy, sub-canopy, shrubs, herbaceous, moss/ground-cover) that each cover 20% within the Forested polygon

0

H 1.2. Hydroperiods

Check the types of water regimes (hydroperiods) present within the wetland. The water regime has to cover more than 10% of the wetland or ¼ ac to count (*see text for descriptions of hydroperiods*).

- Permanently flooded or inundated 4 or more types present: points = 3
- Seasonally flooded or inundated 3 types present: points = 2
- Occasionally flooded or inundated 2 types present: points = 1
- Saturated only 1 type present: points = 0
- Permanently flowing stream or river in, or adjacent to, the wetland
- Seasonally flowing stream in, or adjacent to, the wetland
- Lake Fringe wetland** **2 points**
- Freshwater tidal wetland** **2 points**

1

H 1.3. Richness of plant species

Count the number of plant species in the wetland that cover at least 10 ft².

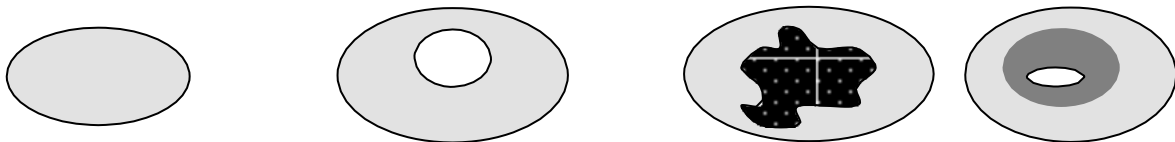
Different patches of the same species can be combined to meet the size threshold and you do not have to name the species. Do not include Eurasian milfoil, reed canarygrass, purple loosestrife, Canadian thistle

- If you counted:
- > 19 species points = 2
 - 5 - 19 species points = 1
 - < 5 species points = 0

1

H 1.4. Interspersion of habitats

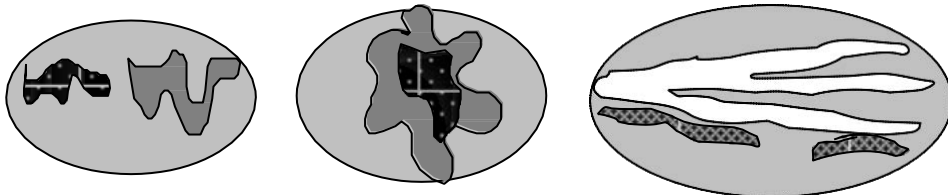
Decide from the diagrams below whether interspersions among Cowardin plants classes (described in H 1.1), or the classes and unvegetated areas (can include open water or mudflats) is high, moderate, low, or none. *If you have four or more plant classes or three classes and open water, the rating is always high.*



None = 0 points

Low = 1 point

Moderate = 2 points



All three diagrams in this row are

HIGH = 3 points

0

Wetland name or number: Wetland A

<p>H 1.5. Special habitat features:</p> <p>Check the habitat features that are present in the wetland. <i>The number of checks is the number of points.</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> Large, downed, woody debris within the wetland (> 4 in diameter and 6 ft long). <input type="checkbox"/> Standing snags (dbh > 4 in) within the wetland. <input type="checkbox"/> Undercut banks are present for at least 6.6 ft (2 m) AND/OR overhanging plants extends at least 3.3 ft (1 m) over a stream (or ditch) in, or contiguous with the wetland, for at least 33 ft (10 m). <input type="checkbox"/> Stable steep banks of fine material that might be used by beaver or muskrat for denning (> 30 degree slope) OR signs of recent beaver activity are present (<i>cut shrubs or trees that have not yet weathered where wood is exposed</i>). <input type="checkbox"/> At least ¼ ac of thin-stemmed persistent plants or woody branches are present in areas that are permanently or seasonally inundated (<i>structures for egg-laying by amphibians</i>). <input type="checkbox"/> Invasive plants cover less than 25% of the wetland area in every stratum of plants (<i>see H 1.1 for list of strata</i>). 		0
Total for H 1	Add the points in the boxes above	2

Rating of Site Potential If score is: 15-18 = H 7-14 = M 0-6 = L *Record the rating on the first page*

H 2.0. Does the landscape have the potential to support the habitat functions of the site?			
<p>H 2.1. Accessible habitat (include <i>only habitat that directly abuts wetland unit</i>).</p> <p><i>Calculate:</i> % undisturbed habitat + [(%moderate and low intensity land uses)/2] = 1% + [32.9%/2] = 17.4%</p> <p>If total accessible habitat is:</p> <ul style="list-style-type: none"> <input type="checkbox"/> > 1/3 (33.3%) of 1 km Polygon points = 3 <input type="checkbox"/> 20-33% of 1 km Polygon points = 2 <input checked="" type="checkbox"/> 10-19% of 1 km Polygon points = 1 <input type="checkbox"/> < 10% of 1 km Polygon points = 0 			1
<p>H 2.2. Undisturbed habitat in 1 km Polygon around the wetland.</p> <p><i>Calculate:</i> % undisturbed habitat + [(%moderate and low intensity land uses)/2] = 4.4% + (89.7%/2) = 49.2%</p> <ul style="list-style-type: none"> <input type="checkbox"/> Undisturbed habitat > 50% of Polygon points = 3 <input checked="" type="checkbox"/> Undisturbed habitat 10-50% and in 1-3 patches points = 2 <input type="checkbox"/> Undisturbed habitat 10-50% and > 3 patches points = 1 <input type="checkbox"/> Undisturbed habitat < 10% of 1 km Polygon points = 0 			2
<p>H 2.3. Land use intensity in 1 km Polygon: If</p> <ul style="list-style-type: none"> <input type="checkbox"/> > 50% of 1 km Polygon is high intensity land use points = (- 2) <input checked="" type="checkbox"/> ≤ 50% of 1 km Polygon is high intensity points = 0 			0
Total for H 2	Add the points in the boxes above	3	

Rating of Landscape Potential If score is: 4-6 = H 1-3 = M < 1 = L *Record the rating on the first page*

H 3.0. Is the habitat provided by the site valuable to society?			
<p>H 3.1. Does the site provide habitat for species valued in laws, regulations, or policies? <i>Choose only the highest score that applies to the wetland being rated.</i></p> <p>Site meets ANY of the following criteria: points = 2</p> <ul style="list-style-type: none"> <input type="checkbox"/> It has 3 or more priority habitats within 100 m (see next page) <input type="checkbox"/> It provides habitat for Threatened or Endangered species (any plant or animal on the state or federal lists) <input type="checkbox"/> It is mapped as a location for an individual WDFW priority species <input type="checkbox"/> It is a Wetland of High Conservation Value as determined by the Department of Natural Resources <input type="checkbox"/> It has been categorized as an important habitat site in a local or regional comprehensive plan, in a Shoreline Master Plan, or in a watershed plan <input checked="" type="checkbox"/> Site has 1 or 2 priority habitats (listed on next page) within 100 m points = 1 <input type="checkbox"/> Site does not meet any of the criteria above points = 0 			1

Rating of Value If score is: 2 = H 1 = M 0 = L *Record the rating on the first page*

Wetland name or number: Wetland A

WDFW Priority Habitats

Priority habitats listed by WDFW (see complete descriptions of WDFW priority habitats, and the counties in which they can be found, in: Washington Department of Fish and Wildlife. 2008. Priority Habitat and Species List. Olympia, Washington. 177 pp. <http://wdfw.wa.gov/publications/00165/wdfw00165.pdf> or access the list from here: <http://wdfw.wa.gov/conservation/phs/list/>)

Count how many of the following priority habitats are within 330 ft (100 m) of the wetland unit: **NOTE:** *This question is independent of the land use between the wetland unit and the priority habitat.*

- Aspen Stands:** Pure or mixed stands of aspen greater than 1 ac (0.4 ha).
- Biodiversity Areas and Corridors:** Areas of habitat that are relatively important to various species of native fish and wildlife (*full descriptions in WDFW PHS report*).
- Herbaceous Balds:** Variable size patches of grass and forbs on shallow soils over bedrock.
- Old-growth/Mature forests:** Old-growth west of Cascade crest – Stands of at least 2 tree species, forming a multi-layered canopy with occasional small openings; with at least 8 trees/ac (20 trees/ha) > 32 in (81 cm) dbh or > 200 years of age. Mature forests – Stands with average diameters exceeding 21 in (53 cm) dbh; crown cover may be less than 100%; decay, decadence, numbers of snags, and quantity of large downed material is generally less than that found in old-growth; 80-200 years old west of the Cascade crest.
- Oregon White Oak:** Woodland stands of pure oak or oak/conifer associations where canopy coverage of the oak component is important (*full descriptions in WDFW PHS report p. 158 – see web link above*).
- Riparian:** The area adjacent to aquatic systems with flowing water that contains elements of both aquatic and terrestrial ecosystems which mutually influence each other.
- Westside Prairies:** Herbaceous, non-forested plant communities that can either take the form of a dry prairie or a wet prairie (*full descriptions in WDFW PHS report p. 161 – see web link above*).
- Instream:** The combination of physical, biological, and chemical processes and conditions that interact to provide functional life history requirements for instream fish and wildlife resources.
- Nearshore:** Relatively undisturbed nearshore habitats. These include Coastal Nearshore, Open Coast Nearshore, and Puget Sound Nearshore. (*full descriptions of habitats and the definition of relatively undisturbed are in WDFW report – see web link on previous page*).
- Caves:** A naturally occurring cavity, recess, void, or system of interconnected passages under the earth in soils, rock, ice, or other geological formations and is large enough to contain a human.
- Cliffs:** Greater than 25 ft (7.6 m) high and occurring below 5000 ft elevation.
- Talus:** Homogenous areas of rock rubble ranging in average size 0.5 - 6.5 ft (0.15 - 2.0 m), composed of basalt, andesite, and/or sedimentary rock, including riprap slides and mine tailings. May be associated with cliffs.
- Snags and Logs:** Trees are considered snags if they are dead or dying and exhibit sufficient decay characteristics to enable cavity excavation/use by wildlife. Priority snags have a diameter at breast height of > 20 in (51 cm) in western Washington and are > 6.5 ft (2 m) in height. Priority logs are > 12 in (30 cm) in diameter at the largest end, and > 20 ft (6 m) long.

Note: All vegetated wetlands are by definition a priority habitat but are not included in this list because they are addressed elsewhere.

CATEGORIZATION BASED ON SPECIAL CHARACTERISTICS

Wetland Type	Category
<i>Check off any criteria that apply to the wetland. Circle the category when the appropriate criteria are met.</i>	
<p>SC 1.0. Estuarine wetlands Does the wetland meet the following criteria for Estuarine wetlands? <input type="checkbox"/> The dominant water regime is tidal, <input type="checkbox"/> Vegetated, and <input type="checkbox"/> With a salinity greater than 0.5 ppt <input type="checkbox"/> Yes – Go to SC 1.1 <input checked="" type="checkbox"/> No = Not an estuarine wetland</p>	
<p>SC 1.1. Is the wetland within a National Wildlife Refuge, National Park, National Estuary Reserve, Natural Area Preserve, State Park or Educational, Environmental, or Scientific Reserve designated under WAC 332-30-151? <input type="checkbox"/> Yes = Category I <input checked="" type="checkbox"/> No - Go to SC 1.2</p>	Cat. I
<p>SC 1.2. Is the wetland unit at least 1 ac in size and meets at least two of the following three conditions? <input type="checkbox"/> The wetland is relatively undisturbed (has no diking, ditching, filling, cultivation, grazing, and has less than 10% cover of non-native plant species. (If non-native species are <i>Spartina</i>, see page 25) <input type="checkbox"/> At least ¾ of the landward edge of the wetland has a 100 ft buffer of shrub, forest, or un-grazed or un-mowed grassland. <input type="checkbox"/> The wetland has at least two of the following features: tidal channels, depressions with open water, or contiguous freshwater wetlands. <input type="checkbox"/> Yes = Category I <input checked="" type="checkbox"/> No = Category II</p>	Cat. I Cat. II
<p>SC 2.0. Wetlands of High Conservation Value (WHCV) SC 2.1. Has the WA Department of Natural Resources updated their website to include the list of Wetlands of High Conservation Value? <input checked="" type="checkbox"/> Yes – Go to SC 2.2 <input type="checkbox"/> No – Go to SC 2.3 SC 2.2. Is the wetland listed on the WDNR database as a Wetland of High Conservation Value? http://www.dnr.wa.gov/NHPwetlandviewer <input type="checkbox"/> Yes = Category I <input checked="" type="checkbox"/> No = Not a WHCV SC 2.3. Is the wetland in a Section/Township/Range that contains a Natural Heritage wetland? http://file.dnr.wa.gov/publications/amp_nh_wetlands_trs.pdf <input type="checkbox"/> Yes – Contact WNHP/WDNR and go to SC 2.4 <input checked="" type="checkbox"/> No = Not a WHCV SC 2.4. Has WDNR identified the wetland within the S/T/R as a Wetland of High Conservation Value and listed it on their website? <input type="checkbox"/> Yes = Category I <input checked="" type="checkbox"/> No = Not a WHCV</p>	Cat. I
<p>SC 3.0. Bogs Does the wetland (or any part of the unit) meet both the criteria for soils and vegetation in bogs? <i>Use the key below. If you answer YES you will still need to rate the wetland based on its functions.</i> SC 3.1. Does an area within the wetland unit have organic soil horizons, either peats or mucks, that compose 16 in or more of the first 32 in of the soil profile? <input type="checkbox"/> Yes – Go to SC 3.3 <input checked="" type="checkbox"/> No – Go to SC 3.2 SC 3.2. Does an area within the wetland unit have organic soils, either peats or mucks, that are less than 16 in deep over bedrock, or an impermeable hardpan such as clay or volcanic ash, or that are floating on top of a lake or pond? <input type="checkbox"/> Yes – Go to SC 3.3 <input checked="" type="checkbox"/> No = Is not a bog SC 3.3. Does an area with peats or mucks have more than 70% cover of mosses at ground level, AND at least a 30% cover of plant species listed in Table 4? <input type="checkbox"/> Yes = Is a Category I bog <input checked="" type="checkbox"/> No – Go to SC 3.4 NOTE: If you are uncertain about the extent of mosses in the understory, you may substitute that criterion by measuring the pH of the water that seeps into a hole dug at least 16 in deep. If the pH is less than 5.0 and the plant species in Table 4 are present, the wetland is a bog. SC 3.4. Is an area with peats or mucks forested (> 30% cover) with Sitka spruce, subalpine fir, western red cedar, western hemlock, lodgepole pine, quaking aspen, Engelmann spruce, or western white pine, AND any of the species (or combination of species) listed in Table 4 provide more than 30% of the cover under the canopy? <input type="checkbox"/> Yes = Is a Category I bog <input checked="" type="checkbox"/> No = Is not a</p>	Cat. I

Wetland name or number: Wetland A

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Wetland name or number: Wetland B

RATING SUMMARY – Western Washington

Name of wetland (or ID #): Wetland B Date of site visit: 6/22/2023

Rated by: G. Brennan, R. Hohlfeld Trained by Ecology? Y N Date of training: 10/2019, 9/2017

HGM Class used for rating: Depressional Wetland has multiple HGM classes? Y N

NOTE: Form is not complete without the figures requested (figures can be combined).

Source of base aerial photo/map: Google Earth, DOE Water Quality Atlas

OVERALL WETLAND CATEGORY: II (based on functions or special characteristics)

1. Category of wetland based on FUNCTIONS

- Category I** – Total score = 23 - 27
- Category II** – Total score = 20 - 22
- Category III** – Total score = 16 - 19
- Category IV** – Total score = 9 - 15

FUNCTION	Improving Water Quality	Hydrologic	Habitat	
<i>Circle the appropriate ratings</i>				
Site Potential	<u>H</u> M L	<u>H</u> M L	H <u>M</u> L	
Landscape Potential	H <u>M</u> L	H <u>M</u> L	H <u>M</u> L	
Value	<u>H</u> M L	<u>H</u> M L	H <u>M</u> L	TOTAL
Score Based on Ratings	8	8	6	22

Score for each function based on three ratings (order of ratings is not important)

- 9 = H,H,H
- 8 = H,H,M
- 7 = H,H,L
- 7 = H,M,M
- 6 = H,M,L
- 6 = M,M,M
- 5 = H,L,L
- 5 = M,M,L
- 4 = M,L,L
- 3 = L,L,L

2. Category based on SPECIAL CHARACTERISTICS of wetland

CHARACTERISTIC	CATEGORY
Estuarine	I II
Wetland of High Conservation Value	I
Bog	I
Mature Forest	I
Old Growth Forest	I
Coastal Lagoon	I II
Interdunal	I II III IV
None of the above	<input checked="" type="checkbox"/>

Wetland name or number: Wetland B

Maps and figures required to answer questions correctly for Western Washington

Depressional Wetlands

Map of:	To answer questions:	Figure #
Cowardin plant classes	D 1.3, H 1.1, H 1.4	1
Hydroperiods	D 1.4, H 1.2	2
Location of outlet (<i>can be added to map of hydroperiods</i>)	D 1.1, D 4.1	2
Boundary of area within 150 ft of the wetland (<i>can be added to another figure</i>)	D 2.2, D 5.2	2
Map of the contributing basin	D 4.3, D 5.3	3
1 km Polygon: Area that extends 1 km from entire wetland edge - including polygons for accessible habitat and undisturbed habitat	H 2.1, H 2.2, H 2.3	5
Screen capture of map of 303(d) listed waters in basin (from Ecology website)	D 3.1, D 3.2	6
Screen capture of list of TMDLs for WRIA in which unit is found (from web)	D 3.3	7

HGM Classification of Wetlands in Western Washington

For questions 1-7, the criteria described must apply to the entire unit being rated.

If the hydrologic criteria listed in each question do not apply to the entire unit being rated, you probably have a unit with multiple HGM classes. In this case, identify which hydrologic criteria in questions 1-7 apply, and go to Question 8.

1. Are the water levels in the entire unit usually controlled by tides except during floods?

NO – go to 2

YES – the wetland class is **Tidal Fringe** – go to 1.1

1.1 Is the salinity of the water during periods of annual low flow below 0.5 ppt (parts per thousand)?

NO – Saltwater Tidal Fringe (Estuarine)

YES – Freshwater Tidal Fringe

*If your wetland can be classified as a Freshwater Tidal Fringe use the forms for **Riverine** wetlands. If it is Saltwater Tidal Fringe it is an **Estuarine** wetland and is not scored. This method **cannot** be used to score functions for estuarine wetlands.*

2. The entire wetland unit is flat and precipitation is the only source (>90%) of water to it. Groundwater and surface water runoff are NOT sources of water to the unit.

NO – go to 3

YES – The wetland class is **Flats**

*If your wetland can be classified as a Flats wetland, use the form for **Depressional** wetlands.*

3. Does the entire wetland unit **meet all** of the following criteria?

The vegetated part of the wetland is on the shores of a body of permanent open water (without any plants on the surface at any time of the year) at least 20 ac (8 ha) in size;

At least 30% of the open water area is deeper than 6.6 ft (2 m).

NO – go to 4

YES – The wetland class is **Lake Fringe** (Lacustrine Fringe)

4. Does the entire wetland unit **meet all** of the following criteria?

The wetland is on a slope (*slope can be very gradual*),

The water flows through the wetland in one direction (unidirectional) and usually comes from seeps. It may flow subsurface, as sheetflow, or in a swale without distinct banks,

The water leaves the wetland **without being impounded**.

NO – go to 5

YES – The wetland class is **Slope**

NOTE: Surface water does not pond in these type of wetlands except occasionally in very small and shallow depressions or behind hummocks (depressions are usually <3 ft diameter and less than 1 ft deep).

5. Does the entire wetland unit **meet all** of the following criteria?

The unit is in a valley, or stream channel, where it gets inundated by overbank flooding from that stream or river,

The overbank flooding occurs at least once every 2 years.

Wetland name or number: Wetland B

NO – go to 6

YES – The wetland class is **Riverine**

NOTE: The Riverine unit can contain depressions that are filled with water when the river is not flooding

6. Is the entire wetland unit in a topographic depression in which water ponds, or is saturated to the surface, at some time during the year? *This means that any outlet, if present, is higher than the interior of the wetland.*

NO – go to 7

YES – The wetland class is **Depressional**

7. Is the entire wetland unit located in a very flat area with no obvious depression and no overbank flooding? The unit does not pond surface water more than a few inches. The unit seems to be maintained by high groundwater in the area. The wetland may be ditched, but has no obvious natural outlet.

NO – go to 8

YES – The wetland class is **Depressional**

8. Your wetland unit seems to be difficult to classify and probably contains several different HGM classes. For example, seeps at the base of a slope may grade into a riverine floodplain, or a small stream within a Depressional wetland has a zone of flooding along its sides. **GO BACK AND IDENTIFY WHICH OF THE HYDROLOGIC REGIMES DESCRIBED IN QUESTIONS 1-7 APPLY TO DIFFERENT AREAS IN THE UNIT** (make a rough sketch to help you decide). Use the following table to identify the appropriate class to use for the rating system if you have several HGM classes present within the wetland unit being scored.

NOTE: Use this table only if the class that is recommended in the second column represents 10% or more of the total area of the wetland unit being rated. If the area of the HGM class listed in column 2 is less than 10% of the unit; classify the wetland using the class that represents more than 90% of the total area.

HGM classes within the wetland unit being rated	HGM class to use in rating
Slope + Riverine	Riverine
Slope + Depressional	Depressional
Slope + Lake Fringe	Lake Fringe
Depressional + Riverine along stream within boundary of depression	Depressional
Depressional + Lake Fringe	Depressional
Riverine + Lake Fringe	Riverine
Salt Water Tidal Fringe and any other class of freshwater wetland	Treat as ESTUARINE

*If you are still unable to determine which of the above criteria apply to your wetland, or if you have **more than 2 HGM classes** within a wetland boundary, classify the wetland as Depressional for the rating.*

DEPRESSIONAL AND FLATS WETLANDS		
Water Quality Functions - Indicators that the site functions to improve water quality		
D 1.0. Does the site have the potential to improve water quality?		
D 1.1. <u>Characteristics of surface water outflows from the wetland:</u> <input checked="" type="checkbox"/> Wetland is a depression or flat depression (QUESTION 7 on key) with no surface water leaving it (no outlet). points = 3 <input type="checkbox"/> Wetland has an intermittently flowing stream or ditch, OR highly constricted permanently flowing outlet. points = 2 <input type="checkbox"/> Wetland has an unconstricted, or slightly constricted, surface outlet that is permanently flowing. points = 1 <input type="checkbox"/> Wetland is a flat depression (QUESTION 7 on key), whose outlet is a permanently flowing ditch. points = 1	3	
D 1.2. <u>The soil 2 in below the surface (or duff layer) is true clay or true organic (use NRCS definitions).</u> <input type="checkbox"/> Yes = 4 <input checked="" type="checkbox"/> No = 0	0	
D 1.3. <u>Characteristics and distribution of persistent plants</u> (Emergent, Scrub-shrub, and/or Forested Cowardin classes): <input checked="" type="checkbox"/> Wetland has persistent, ungrazed, plants > 95% of area points = 5 <input type="checkbox"/> Wetland has persistent, ungrazed, plants > 1/2 of area points = 3 <input type="checkbox"/> Wetland has persistent, ungrazed plants > 1/10 of area points = 1 <input type="checkbox"/> Wetland has persistent, ungrazed plants < 1/10 of area points = 0	5	
D 1.4. <u>Characteristics of seasonal ponding or inundation:</u> <i>This is the area that is ponded for at least 2 months. See description in manual.</i> <input checked="" type="checkbox"/> Area seasonally ponded is > ½ total area of wetland points = 4 <input type="checkbox"/> Area seasonally ponded is > ¼ total area of wetland points = 2 <input type="checkbox"/> Area seasonally ponded is < ¼ total area of wetland points = 0	4	
Total for D 1	Add the points in the boxes above	12
Rating of Site Potential If score is: <input checked="" type="checkbox"/> 12-16 = H <input type="checkbox"/> 6-11 = M <input type="checkbox"/> 0-5 = L <i>Record the rating on the first page</i>		
D 2.0. Does the landscape have the potential to support the water quality function of the site?		
D 2.1. Does the wetland unit receive stormwater discharges? <input checked="" type="checkbox"/> Yes = 1 <input type="checkbox"/> No = 0	1	
D 2.2. Is > 10% of the area within 150 ft of the wetland in land uses that generate pollutants? <input checked="" type="checkbox"/> Yes = 1 <input type="checkbox"/> No = 0	1	
D 2.3. Are there septic systems within 250 ft of the wetland? <input type="checkbox"/> Yes = 1 <input checked="" type="checkbox"/> No = 0	0	
D 2.4. Are there other sources of pollutants coming into the wetland that are not listed in questions D 2.1-D 2.3? Source: Click here to enter text. <input type="checkbox"/> Yes = 1 <input checked="" type="checkbox"/> No = 0	0	
Total for D 2	Add the points in the boxes above	2
Rating of Landscape Potential If score is: <input type="checkbox"/> 3 or 4 = H <input checked="" type="checkbox"/> 1 or 2 = M <input type="checkbox"/> 0 = L <i>Record the rating on the first page</i>		
D 3.0. Is the water quality improvement provided by the site valuable to society?		
D 3.1. Does the wetland discharge directly (i.e., within 1 mi) to a stream, river, lake, or marine water that is on the 303(d) list? <input type="checkbox"/> Yes = 1 <input checked="" type="checkbox"/> No = 0	0	
D 3.2. Is the wetland in a basin or sub-basin where an aquatic resource is on the 303(d) list? <input checked="" type="checkbox"/> Yes = 1 <input type="checkbox"/> No = 0	1	
D 3.3. Has the site been identified in a watershed or local plan as important for maintaining water quality (answer YES if there is a TMDL for the basin in which the unit is found)? <input checked="" type="checkbox"/> Yes = 2 <input type="checkbox"/> No = 0	2	
Total for D 3	Add the points in the boxes above	3
Rating of Value If score is: <input checked="" type="checkbox"/> 2-4 = H <input type="checkbox"/> 1 = M <input type="checkbox"/> 0 = L <i>Record the rating on the first page</i>		

DEPRESSIONAL AND FLATS WETLANDS

Hydrologic Functions - Indicators that the site functions to reduce flooding and stream degradation

D 4.0. Does the site have the potential to reduce flooding and erosion?		
D 4.1. <u>Characteristics of surface water outflows from the wetland:</u>		
<input checked="" type="checkbox"/> Wetland is a depression or flat depression with no surface water leaving it (no outlet). points = 4		4
<input type="checkbox"/> Wetland has an intermittently flowing stream or ditch, OR highly constricted permanently flowing outlet. points = 2		
<input type="checkbox"/> Wetland is a flat depression (QUESTION 7 on key), whose outlet is a permanently flowing ditch. points = 1		
<input type="checkbox"/> Wetland has an unconstricted, or slightly constricted, surface outlet that is permanently flowing. points = 0		
D 4.2. <u>Depth of storage during wet periods: Estimate the height of ponding above the bottom of the outlet. For wetlands with no outlet, measure from the surface of permanent water or if dry, the deepest part.</u>		
<input type="checkbox"/> Marks of ponding are 3 ft or more above the surface or bottom of outlet. points = 7		3
<input type="checkbox"/> Marks of ponding between 2 ft to < 3 ft from surface or bottom of outlet. points = 5		
<input checked="" type="checkbox"/> Marks are at least 0.5 ft to < 2 ft from surface or bottom of outlet. points = 3		
<input type="checkbox"/> The wetland is a "headwater" wetland. points = 3		
<input type="checkbox"/> Wetland is flat but has small depressions on the surface that trap water. points = 1		
<input type="checkbox"/> Marks of ponding less than 0.5 ft (6 in). points = 0		
D 4.3. <u>Contribution of the wetland to storage in the watershed: Estimate the ratio of the area of upstream basin contributing surface water to the wetland to the area of the wetland unit itself.</u>		
<input checked="" type="checkbox"/> The area of the basin is less than 10 times the area of the unit. points = 5		5
<input type="checkbox"/> The area of the basin is 10 to 100 times the area of the unit. points = 3		
<input type="checkbox"/> The area of the basin is more than 100 times the area of the unit. points = 0		
<input type="checkbox"/> Entire wetland is in the Flats class. points = 5		
Total for D 4	Add the points in the boxes above	12

Rating of Site Potential If score is: 12-16 = H 6-11 = M 0-5 = L Record the rating on the first page

D 5.0. Does the landscape have the potential to support hydrologic functions of the site?		
D 5.1. Does the wetland receive stormwater discharges?	<input checked="" type="checkbox"/> Yes = 1 <input type="checkbox"/> No = 0	1
D 5.2. Is >10% of the area within 150 ft of the wetland in land uses that generate excess runoff?	<input checked="" type="checkbox"/> Yes = 1 <input type="checkbox"/> No = 0	1
D 5.3. Is more than 25% of the contributing basin of the wetland covered with intensive human land uses (residential at >1 residence/ac, urban, commercial, agriculture, etc.)?	<input type="checkbox"/> Yes = 1 <input checked="" type="checkbox"/> No = 0	0
Total for D 5	Add the points in the boxes above	2

Rating of Landscape Potential If score is: 3 = H 1 or 2 = M 0 = L Record the rating on the first page

D 6.0. Are the hydrologic functions provided by the site valuable to society?		
D 6.1. <u>The unit is in a landscape that has flooding problems. Choose the description that best matches conditions around the wetland unit being rated. Do not add points. Choose the highest score if more than one condition is met.</u> The wetland captures surface water that would otherwise flow down-gradient into areas where flooding has damaged human or natural resources (e.g., houses or salmon redds):		
• <input checked="" type="checkbox"/> Flooding occurs in a sub-basin that is immediately down-gradient of unit. points = 2		2
• <input type="checkbox"/> Surface flooding problems are in a sub-basin farther down-gradient. points = 1		
<input type="checkbox"/> Flooding from groundwater is an issue in the sub-basin. points = 1		
<input type="checkbox"/> The existing or potential outflow from the wetland is so constrained by human or natural conditions that the water stored by the wetland cannot reach areas that flood.		
<i>Explain why:</i> ___ points = 0		
<input type="checkbox"/> There are no problems with flooding downstream of the wetland. points = 0		
D 6.2. Has the site been identified as important for flood storage or flood conveyance in a regional flood control plan?	<input type="checkbox"/> Yes = 2 <input checked="" type="checkbox"/> No = 0	0
Total for D 6	Add the points in the boxes above	2

Rating of Value If score is: 2-4 = H 1 = M 0 = L Record the rating on the first page

These questions apply to wetlands of all HGM classes.

HABITAT FUNCTIONS - Indicators that site functions to provide important habitat

H 1.0. Does the site have the potential to provide habitat?

H 1.1. Structure of plant community: *Indicators are Cowardin classes and strata within the Forested class. Check the Cowardin plant classes in the wetland. Up to 10 patches may be combined for each class to meet the threshold of ¼ ac or more than 10% of the unit if it is smaller than 2.5 ac. Add the number of structures checked.*

- Aquatic bed 4 structures or more: points = 4
 - Emergent 3 structures: points = 2
 - Scrub-shrub (areas where shrubs have > 30% cover) 2 structures: points = 1
 - Forested (areas where trees have > 30% cover) 1 structure: points = 0
- If the unit has a Forested class, check if:*
- The Forested class has 3 out of 5 strata (canopy, sub-canopy, shrubs, herbaceous, moss/ground-cover) that each cover 20% within the Forested polygon

2

H 1.2. Hydroperiods

Check the types of water regimes (hydroperiods) present within the wetland. The water regime has to cover more than 10% of the wetland or ¼ ac to count (*see text for descriptions of hydroperiods*).

- Permanently flooded or inundated 4 or more types present: points = 3
- Seasonally flooded or inundated 3 types present: points = 2
- Occasionally flooded or inundated 2 types present: points = 1
- Saturated only 1 type present: points = 0
- Permanently flowing stream or river in, or adjacent to, the wetland
- Seasonally flowing stream in, or adjacent to, the wetland
- Lake Fringe wetland** **2 points**
- Freshwater tidal wetland** **2 points**

2

H 1.3. Richness of plant species

Count the number of plant species in the wetland that cover at least 10 ft².

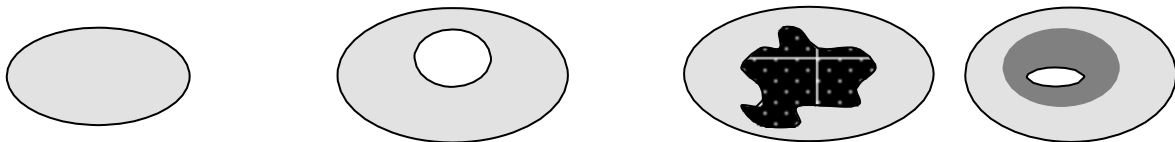
Different patches of the same species can be combined to meet the size threshold and you do not have to name the species. Do not include Eurasian milfoil, reed canarygrass, purple loosestrife, Canadian thistle

- If you counted:
- > 19 species points = 2
 - 5 - 19 species points = 1
 - < 5 species points = 0

1

H 1.4. Interspersion of habitats

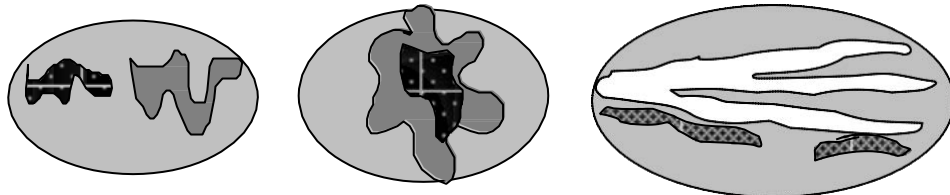
Decide from the diagrams below whether interspersion among Cowardin plants classes (described in H 1.1), or the classes and unvegetated areas (can include open water or mudflats) is high, moderate, low, or none. *If you have four or more plant classes or three classes and open water, the rating is always high.*



None = 0 points

Low = 1 point

Moderate = 2 points



All three diagrams in this row are

HIGH = 3points

1

Wetland name or number: Wetland B

<p>H 1.5. Special habitat features: Check the habitat features that are present in the wetland. <i>The number of checks is the number of points.</i></p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Large, downed, woody debris within the wetland (> 4 in diameter and 6 ft long). <input checked="" type="checkbox"/> Standing snags (dbh > 4 in) within the wetland. <input type="checkbox"/> Undercut banks are present for at least 6.6 ft (2 m) AND/OR overhanging plants extends at least 3.3 ft (1 m) over a stream (or ditch) in, or contiguous with the wetland, for at least 33 ft (10 m). <input type="checkbox"/> Stable steep banks of fine material that might be used by beaver or muskrat for denning (> 30 degree slope) OR signs of recent beaver activity are present (<i>cut shrubs or trees that have not yet weathered where wood is exposed</i>). <input type="checkbox"/> At least ¼ ac of thin-stemmed persistent plants or woody branches are present in areas that are permanently or seasonally inundated (<i>structures for egg-laying by amphibians</i>). <input type="checkbox"/> Invasive plants cover less than 25% of the wetland area in every stratum of plants (<i>see H 1.1 for list of strata</i>). 		2
Total for H 1	Add the points in the boxes above	8

Rating of Site Potential If score is: 15-18 = H 7-14 = M 0-6 = L *Record the rating on the first page*

H 2.0. Does the landscape have the potential to support the habitat functions of the site?

<p>H 2.1. Accessible habitat (include <i>only habitat that directly abuts wetland unit</i>). <i>Calculate: % undisturbed habitat + [(%moderate and low intensity land uses)/2] = 1% + [32.9%/2] = 17.4%</i> If total accessible habitat is:</p> <ul style="list-style-type: none"> <input type="checkbox"/> > 1/3 (33.3%) of 1 km Polygon points = 3 <input type="checkbox"/> 20-33% of 1 km Polygon points = 2 <input checked="" type="checkbox"/> 10-19% of 1 km Polygon points = 1 <input type="checkbox"/> < 10% of 1 km Polygon points = 0 		1
<p>H 2.2. Undisturbed habitat in 1 km Polygon around the wetland. <i>Calculate: % undisturbed habitat + [(%moderate and low intensity land uses)/2] = 4.4% + (89.7%/2) = 49.2%</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> Undisturbed habitat > 50% of Polygon points = 3 <input checked="" type="checkbox"/> Undisturbed habitat 10-50% and in 1-3 patches points = 2 <input type="checkbox"/> Undisturbed habitat 10-50% and > 3 patches points = 1 <input type="checkbox"/> Undisturbed habitat < 10% of 1 km Polygon points = 0 		2
<p>H 2.3. Land use intensity in 1 km Polygon: If</p> <ul style="list-style-type: none"> <input type="checkbox"/> > 50% of 1 km Polygon is high intensity land use points = (- 2) <input type="checkbox"/> ≤ 50% of 1 km Polygon is high intensity points = 0 		0
Total for H 2	Add the points in the boxes above	3

Rating of Landscape Potential If score is: 4-6 = H 1-3 = M < 1 = L *Record the rating on the first page*

H 3.0. Is the habitat provided by the site valuable to society?

<p>H 3.1. Does the site provide habitat for species valued in laws, regulations, or policies? <i>Choose only the highest score that applies to the wetland being rated.</i></p> <p>Site meets ANY of the following criteria: points = 2</p> <ul style="list-style-type: none"> <input type="checkbox"/> It has 3 or more priority habitats within 100 m (see next page) <input type="checkbox"/> It provides habitat for Threatened or Endangered species (any plant or animal on the state or federal lists) <input type="checkbox"/> It is mapped as a location for an individual WDFW priority species <input type="checkbox"/> It is a Wetland of High Conservation Value as determined by the Department of Natural Resources <input type="checkbox"/> It has been categorized as an important habitat site in a local or regional comprehensive plan, in a Shoreline Master Plan, or in a watershed plan <input checked="" type="checkbox"/> Site has 1 or 2 priority habitats (listed on next page) within 100 m points = 1 <input type="checkbox"/> Site does not meet any of the criteria above points = 0 		1
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Rating of Value If score is: 2 = H 1 = M 0 = L *Record the rating on the first page*

WDFW Priority Habitats

Priority habitats listed by WDFW (see complete descriptions of WDFW priority habitats, and the counties in which they can be found, in: Washington Department of Fish and Wildlife. 2008. Priority Habitat and Species List. Olympia, Washington. 177 pp. <http://wdfw.wa.gov/publications/00165/wdfw00165.pdf> or access the list from here: <http://wdfw.wa.gov/conservation/phs/list/>)

Count how many of the following priority habitats are within 330 ft (100 m) of the wetland unit: **NOTE:** *This question is independent of the land use between the wetland unit and the priority habitat.*

- Aspen Stands:** Pure or mixed stands of aspen greater than 1 ac (0.4 ha).
- Biodiversity Areas and Corridors:** Areas of habitat that are relatively important to various species of native fish and wildlife (*full descriptions in WDFW PHS report*).
- Herbaceous Balds:** Variable size patches of grass and forbs on shallow soils over bedrock.
- Old-growth/Mature forests:** Old-growth west of Cascade crest – Stands of at least 2 tree species, forming a multi-layered canopy with occasional small openings; with at least 8 trees/ac (20 trees/ha) > 32 in (81 cm) dbh or > 200 years of age. Mature forests – Stands with average diameters exceeding 21 in (53 cm) dbh; crown cover may be less than 100%; decay, decadence, numbers of snags, and quantity of large downed material is generally less than that found in old-growth; 80-200 years old west of the Cascade crest.
- Oregon White Oak:** Woodland stands of pure oak or oak/conifer associations where canopy coverage of the oak component is important (*full descriptions in WDFW PHS report p. 158 – see web link above*).
- Riparian:** The area adjacent to aquatic systems with flowing water that contains elements of both aquatic and terrestrial ecosystems which mutually influence each other.
- Westside Prairies:** Herbaceous, non-forested plant communities that can either take the form of a dry prairie or a wet prairie (*full descriptions in WDFW PHS report p. 161 – see web link above*).
- Instream:** The combination of physical, biological, and chemical processes and conditions that interact to provide functional life history requirements for instream fish and wildlife resources.
- Nearshore:** Relatively undisturbed nearshore habitats. These include Coastal Nearshore, Open Coast Nearshore, and Puget Sound Nearshore. (*full descriptions of habitats and the definition of relatively undisturbed are in WDFW report – see web link on previous page*).
- Caves:** A naturally occurring cavity, recess, void, or system of interconnected passages under the earth in soils, rock, ice, or other geological formations and is large enough to contain a human.
- Cliffs:** Greater than 25 ft (7.6 m) high and occurring below 5000 ft elevation.
- Talus:** Homogenous areas of rock rubble ranging in average size 0.5 - 6.5 ft (0.15 - 2.0 m), composed of basalt, andesite, and/or sedimentary rock, including riprap slides and mine tailings. May be associated with cliffs.
- Snags and Logs:** Trees are considered snags if they are dead or dying and exhibit sufficient decay characteristics to enable cavity excavation/use by wildlife. Priority snags have a diameter at breast height of > 20 in (51 cm) in western Washington and are > 6.5 ft (2 m) in height. Priority logs are > 12 in (30 cm) in diameter at the largest end, and > 20 ft (6 m) long.

Note: All vegetated wetlands are by definition a priority habitat but are not included in this list because they are addressed elsewhere.

CATEGORIZATION BASED ON SPECIAL CHARACTERISTICS

Wetland Type	Category
<i>Check off any criteria that apply to the wetland. Circle the category when the appropriate criteria are met.</i>	
<p>SC 1.0. Estuarine wetlands Does the wetland meet the following criteria for Estuarine wetlands? <input type="checkbox"/> The dominant water regime is tidal, <input type="checkbox"/> Vegetated, and <input type="checkbox"/> With a salinity greater than 0.5 ppt <input type="checkbox"/> Yes – Go to SC 1.1 <input checked="" type="checkbox"/> No = Not an estuarine wetland</p>	
<p>SC 1.1. Is the wetland within a National Wildlife Refuge, National Park, National Estuary Reserve, Natural Area Preserve, State Park or Educational, Environmental, or Scientific Reserve designated under WAC 332-30-151? <input type="checkbox"/> Yes = Category I <input checked="" type="checkbox"/> No - Go to SC 1.2</p>	Cat. I
<p>SC 1.2. Is the wetland unit at least 1 ac in size and meets at least two of the following three conditions? <input type="checkbox"/> The wetland is relatively undisturbed (has no diking, ditching, filling, cultivation, grazing, and has less than 10% cover of non-native plant species. (If non-native species are <i>Spartina</i>, see page 25) <input type="checkbox"/> At least ¾ of the landward edge of the wetland has a 100 ft buffer of shrub, forest, or un-grazed or un-mowed grassland. <input type="checkbox"/> The wetland has at least two of the following features: tidal channels, depressions with open water, or contiguous freshwater wetlands. <input type="checkbox"/> Yes = Category I <input checked="" type="checkbox"/> No = Category II</p>	Cat. I Cat. II
<p>SC 2.0. Wetlands of High Conservation Value (WHCV) SC 2.1. Has the WA Department of Natural Resources updated their website to include the list of Wetlands of High Conservation Value? <input checked="" type="checkbox"/> Yes – Go to SC 2.2 <input type="checkbox"/> No – Go to SC 2.3 SC 2.2. Is the wetland listed on the WDNR database as a Wetland of High Conservation Value? http://www.dnr.wa.gov/NHPwetlandviewer <input type="checkbox"/> Yes = Category I <input checked="" type="checkbox"/> No = Not a WHCV SC 2.3. Is the wetland in a Section/Township/Range that contains a Natural Heritage wetland? http://file.dnr.wa.gov/publications/amp_nh_wetlands_trs.pdf <input type="checkbox"/> Yes – Contact WNHP/WDNR and go to SC 2.4 <input checked="" type="checkbox"/> No = Not a WHCV SC 2.4. Has WDNR identified the wetland within the S/T/R as a Wetland of High Conservation Value and listed it on their website? <input type="checkbox"/> Yes = Category I <input checked="" type="checkbox"/> No = Not a WHCV</p>	Cat. I
<p>SC 3.0. Bogs Does the wetland (or any part of the unit) meet both the criteria for soils and vegetation in bogs? <i>Use the key below. If you answer YES you will still need to rate the wetland based on its functions.</i> SC 3.1. Does an area within the wetland unit have organic soil horizons, either peats or mucks, that compose 16 in or more of the first 32 in of the soil profile? <input type="checkbox"/> Yes – Go to SC 3.3 <input checked="" type="checkbox"/> No – Go to SC 3.2 SC 3.2. Does an area within the wetland unit have organic soils, either peats or mucks, that are less than 16 in deep over bedrock, or an impermeable hardpan such as clay or volcanic ash, or that are floating on top of a lake or pond? <input type="checkbox"/> Yes – Go to SC 3.3 <input checked="" type="checkbox"/> No = Is not a bog SC 3.3. Does an area with peats or mucks have more than 70% cover of mosses at ground level, AND at least a 30% cover of plant species listed in Table 4? <input type="checkbox"/> Yes = Is a Category I bog <input checked="" type="checkbox"/> No – Go to SC 3.4 NOTE: If you are uncertain about the extent of mosses in the understory, you may substitute that criterion by measuring the pH of the water that seeps into a hole dug at least 16 in deep. If the pH is less than 5.0 and the plant species in Table 4 are present, the wetland is a bog. SC 3.4. Is an area with peats or mucks forested (> 30% cover) with Sitka spruce, subalpine fir, western red cedar, western hemlock, lodgepole pine, quaking aspen, Engelmann spruce, or western white pine, AND any of the species (or combination of species) listed in Table 4 provide more than 30% of the cover under the canopy? <input type="checkbox"/> Yes = Is a Category I bog <input checked="" type="checkbox"/> No = Is not a</p>	Cat. I

<p>SC 4.0. Forested Wetlands</p> <p>Does the wetland have at least <u>1 contiguous acre</u> of forest that meets one of these criteria for the WA Department of Fish and Wildlife's forests as priority habitats? <i>If you answer YES you will still need to rate the wetland based on its functions.</i></p> <p><input type="checkbox"/> Old-growth forests (west of Cascade crest): Stands of at least two tree species, forming a multi-layered canopy with occasional small openings; with at least 8 trees/ac (20 trees/ha) that are at least 200 years of age OR have a diameter at breast height (dbh) of 32 in (81 cm) or more.</p> <p><input type="checkbox"/> Mature forests (west of the Cascade Crest): Stands where the largest trees are 80- 200 years old OR the species that make up the canopy have an average diameter (dbh) exceeding 21 in (53 cm).</p> <p><input type="checkbox"/> Yes = Category I <input checked="" type="checkbox"/> No = Not a forested wetland for this section</p>	<p>Cat. I</p>
<p>SC 5.0. Wetlands in Coastal Lagoons</p> <p>Does the wetland meet all of the following criteria of a wetland in a coastal lagoon?</p> <p><input type="checkbox"/> The wetland lies in a depression adjacent to marine waters that is wholly or partially separated from marine waters by sandbanks, gravel banks, shingle, or, less frequently, rocks</p> <p><input type="checkbox"/> The lagoon in which the wetland is located contains ponded water that is saline or brackish (> 0.5 ppt) during most of the year in at least a portion of the lagoon (<i>needs to be measured near the bottom</i>)</p> <p><input type="checkbox"/> Yes – Go to SC 5.1 <input checked="" type="checkbox"/> No = Not a wetland in a coastal lagoon</p> <p>SC 5.1. Does the wetland meet all of the following three conditions?</p> <p><input type="checkbox"/> The wetland is relatively undisturbed (has no diking, ditching, filling, cultivation, grazing), and has less than 20% cover of aggressive, opportunistic plant species (see list of species on p. 100).</p> <p><input type="checkbox"/> At least ¾ of the landward edge of the wetland has a 100 ft buffer of shrub, forest, or un-grazed or un-mowed grassland.</p> <p><input type="checkbox"/> The wetland is larger than 1/10 ac (4350 ft²)</p> <p><input type="checkbox"/> Yes = Category I <input type="checkbox"/> No = Category II</p>	<p>Cat. I</p> <p>Cat. II</p>
<p>SC 6.0. Interdunal Wetlands</p> <p>Is the wetland west of the 1889 line (also called the Western Boundary of Upland Ownership or WBUO)? <i>If you answer yes you will still need to rate the wetland based on its habitat functions.</i></p> <p>In practical terms that means the following geographic areas:</p> <p><input type="checkbox"/> Long Beach Peninsula: Lands west of SR 103</p> <p><input type="checkbox"/> Grayland-Westport: Lands west of SR 105</p> <p><input type="checkbox"/> Ocean Shores-Copalis: Lands west of SR 115 and SR 109</p> <p><input type="checkbox"/> Yes – Go to SC 6.1 <input checked="" type="checkbox"/> No = not an interdunal wetland for rating</p> <p>SC 6.1. Is the wetland 1 ac or larger and scores an 8 or 9 for the habitat functions on the form (rates H,H,H or H,H,M for the three aspects of function)?</p> <p><input type="checkbox"/> Yes = Category I <input type="checkbox"/> No – Go to SC 6.2</p> <p>SC 6.2. Is the wetland 1 ac or larger, or is it in a mosaic of wetlands that is 1 ac or larger?</p> <p><input type="checkbox"/> Yes = Category II <input type="checkbox"/> No – Go to SC 6.3</p> <p>SC 6.3. Is the unit between 0.1 and 1 ac, or is it in a mosaic of wetlands that is between 0.1 and 1 ac?</p> <p><input type="checkbox"/> Yes = Category III <input type="checkbox"/> No = Category IV</p>	<p>Cat I</p> <p>Cat. II</p> <p>Cat. III</p> <p>Cat. IV</p>
<p>Category of wetland based on Special Characteristics</p> <p>If you answered No for all types, enter "Not Applicable" on Summary Form</p>	<p>NA</p>

Wetland name or number: Wetland A

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Wetland name or number: Wetland C

RATING SUMMARY – Western Washington

Name of wetland (or ID #): Wetland C Date of site visit: 6/23/2023

Rated by: G. Brennan, R. Hohlfeld Trained by Ecology? Y N Date of training: 10/2019, 9/2017

HGM Class used for rating: Slope

Wetland has multiple HGM classes? Y N

NOTE: Form is not complete without the figures requested (figures can be combined).

Source of base aerial photo/map: Google Earth, DOE Water Quality Atlas

OVERALL WETLAND CATEGORY: III (based on functions or special characteristics)

1. Category of wetland based on FUNCTIONS

- Category I** – Total score = 23 - 27
- Category II** – Total score = 20 - 22
- Category III** – Total score = 16 - 19
- Category IV** – Total score = 9 - 15

FUNCTION	Improving Water Quality	Hydrologic	Habitat	
<i>Circle the appropriate ratings</i>				
Site Potential	H <u>M</u> L	H <u>M</u> L	H M <u>L</u>	
Landscape Potential	H <u>M</u> L	H <u>M</u> L	H <u>M</u> L	
Value	<u>H</u> M L	<u>H</u> M L	H <u>M</u> L	TOTAL
Score Based on Ratings	7	7	5	19

Score for each function based on three ratings (order of ratings is not important)

9 = H,H,H
 8 = H,H,M
 7 = H,H,L
 7 = H,M,M
 6 = H,M,L
 6 = M,M,M
 5 = H,L,L
 5 = M,M,L
 4 = M,L,L
 3 = L,L,L

2. Category based on SPECIAL CHARACTERISTICS of wetland

CHARACTERISTIC	CATEGORY
Estuarine	I II
Wetland of High Conservation Value	I
Bog	I
Mature Forest	I
Old Growth Forest	I
Coastal Lagoon	I II
Interdunal	I II III IV
None of the above	<input checked="" type="checkbox"/>

Wetland name or number: Wetland C

Maps and figures required to answer questions correctly for Western Washington

Slope Wetlands

Map of:	To answer questions:	Figure #
Cowardin plant classes	H 1.1, H 1.4	
Hydroperiods	H 1.2	
Plant cover of dense trees, shrubs, and herbaceous plants	S 1.3	
Plant cover of dense, rigid trees, shrubs, and herbaceous plants (<i>can be added to figure above</i>)	S 4.1	
Boundary of 150 ft buffer (<i>can be added to another figure</i>)	S 2.1, S 5.1	
1 km Polygon: Area that extends 1 km from entire wetland edge - including polygons for accessible habitat and undisturbed habitat	H 2.1, H 2.2, H 2.3	
Screen capture of map of 303(d) listed waters in basin (from Ecology website)	S 3.1, S 3.2	
Screen capture of list of TMDLs for WRIA in which unit is found (from web)	S 3.3	

Wetland name or number:

HGM Classification of Wetlands in Western Washington

For questions 1-7, the criteria described must apply to the entire unit being rated.

If the hydrologic criteria listed in each question do not apply to the entire unit being rated, you probably have a unit with multiple HGM classes. In this case, identify which hydrologic criteria in questions 1-7 apply, and go to Question 8.

1. Are the water levels in the entire unit usually controlled by tides except during floods?

NO – go to 2

YES – the wetland class is **Tidal Fringe** – go to 1.1

1.1 Is the salinity of the water during periods of annual low flow below 0.5 ppt (parts per thousand)?

NO – Saltwater Tidal Fringe (Estuarine)

YES – Freshwater Tidal Fringe

*If your wetland can be classified as a Freshwater Tidal Fringe use the forms for **Riverine** wetlands. If it is Saltwater Tidal Fringe it is an **Estuarine** wetland and is not scored. This method **cannot** be used to score functions for estuarine wetlands.*

2. The entire wetland unit is flat and precipitation is the only source (>90%) of water to it. Groundwater and surface water runoff are NOT sources of water to the unit.

NO – go to 3

YES – The wetland class is **Flats**

*If your wetland can be classified as a Flats wetland, use the form for **Depressional** wetlands.*

3. Does the entire wetland unit **meet all** of the following criteria?

The vegetated part of the wetland is on the shores of a body of permanent open water (without any plants on the surface at any time of the year) at least 20 ac (8 ha) in size;

At least 30% of the open water area is deeper than 6.6 ft (2 m).

NO – go to 4

YES – The wetland class is **Lake Fringe** (Lacustrine Fringe)

4. Does the entire wetland unit **meet all** of the following criteria?

The wetland is on a slope (*slope can be very gradual*),

The water flows through the wetland in one direction (unidirectional) and usually comes from seeps. It may flow subsurface, as sheetflow, or in a swale without distinct banks,

The water leaves the wetland **without being impounded**.

NO – go to 5

YES – The wetland class is **Slope**

NOTE: Surface water does not pond in these type of wetlands except occasionally in very small and shallow depressions or behind hummocks (depressions are usually <3 ft diameter and less than 1 ft deep).

5. Does the entire wetland unit **meet all** of the following criteria?

The unit is in a valley, or stream channel, where it gets inundated by overbank flooding from that stream or river,

The overbank flooding occurs at least once every 2 years.

Wetland name or number:

NO – go to 6

YES – The wetland class is **Riverine**

NOTE: The Riverine unit can contain depressions that are filled with water when the river is not flooding

6. Is the entire wetland unit in a topographic depression in which water ponds, or is saturated to the surface, at some time during the year? *This means that any outlet, if present, is higher than the interior of the wetland.*

NO – go to 7

YES – The wetland class is **Depressional**

7. Is the entire wetland unit located in a very flat area with no obvious depression and no overbank flooding? The unit does not pond surface water more than a few inches. The unit seems to be maintained by high groundwater in the area. The wetland may be ditched, but has no obvious natural outlet.

NO – go to 8

YES – The wetland class is **Depressional**

8. Your wetland unit seems to be difficult to classify and probably contains several different HGM classes. For example, seeps at the base of a slope may grade into a riverine floodplain, or a small stream within a Depressional wetland has a zone of flooding along its sides. **GO BACK AND IDENTIFY WHICH OF THE HYDROLOGIC REGIMES DESCRIBED IN QUESTIONS 1-7 APPLY TO DIFFERENT AREAS IN THE UNIT** (make a rough sketch to help you decide). Use the following table to identify the appropriate class to use for the rating system if you have several HGM classes present within the wetland unit being scored.

NOTE: Use this table only if the class that is recommended in the second column represents 10% or more of the total area of the wetland unit being rated. If the area of the HGM class listed in column 2 is less than 10% of the unit; classify the wetland using the class that represents more than 90% of the total area.

HGM classes within the wetland unit being rated	HGM class to use in rating
Slope + Riverine	Riverine
Slope + Depressional	Depressional
Slope + Lake Fringe	Lake Fringe
Depressional + Riverine along stream within boundary of depression	Depressional
Depressional + Lake Fringe	Depressional
Riverine + Lake Fringe	Riverine
Salt Water Tidal Fringe and any other class of freshwater wetland	Treat as ESTUARINE

*If you are still unable to determine which of the above criteria apply to your wetland, or if you have **more than 2 HGM classes** within a wetland boundary, classify the wetland as Depressional for the rating.*

Wetland name or number:

SLOPE WETLANDS

Water Quality Functions - Indicators that the site functions to improve water quality

S 1.0. Does the site have the potential to improve water quality?		
S 1.1. Characteristics of the average slope of the wetland: <i>(a 1% slope has a 1 ft vertical drop in elevation for every 100 ft of horizontal distance)</i>		
<input type="checkbox"/> Slope is 1% or less	points = 3	1
<input type="checkbox"/> Slope is > 1%-2%	points = 2	
<input checked="" type="checkbox"/> Slope is > 2%-5%	points = 1	
<input type="checkbox"/> Slope is greater than 5%	points = 0	
S 1.2. <u>The soil 2 in below the surface (or duff layer) is true clay or true organic (use NRCS definitions):</u> Yes = 3 <input type="checkbox"/> No = 0 <input checked="" type="checkbox"/>		0
S 1.3. Characteristics of the plants in the wetland that trap sediments and pollutants: Choose the points appropriate for the description that best fits the plants in the wetland. <i>Dense means you have trouble seeing the soil surface (>75% cover), and uncut means not grazed or mowed and plants are higher than 6 in.</i>		
<input checked="" type="checkbox"/> Dense, uncut, herbaceous plants > 90% of the wetland area	points = 6	6
<input type="checkbox"/> Dense, uncut, herbaceous plants > ½ of area	points = 3	
<input type="checkbox"/> Dense, woody, plants > ½ of area	points = 2	
<input type="checkbox"/> Dense, uncut, herbaceous plants > ¼ of area	points = 1	
<input type="checkbox"/> Does not meet any of the criteria above for plants	points = 0	
Total for S 1	Add the points in the boxes above	7

Rating of Site Potential If score is: 12 = H 6-11 = M 0-5 = L

Record the rating on the first page

S 2.0. Does the landscape have the potential to support the water quality function of the site?		
S 2.1. Is > 10% of the area within 150 ft on the uphill side of the wetland in land uses that generate pollutants?	<input checked="" type="checkbox"/> Yes = 1 <input type="checkbox"/> No = 0	1
S 2.2. Are there other sources of pollutants coming into the wetland that are not listed in question S 2.1? Other sources _____	<input type="checkbox"/> Yes = 1 <input checked="" type="checkbox"/> No = 0	0
Total for S 2	Add the points in the boxes above	1

Rating of Landscape Potential If score is: 1-2 = M 0 = L

Record the rating on the first page

S 3.0. Is the water quality improvement provided by the site valuable to society?		
S 3.1. Does the wetland discharge directly (i.e., within 1 mi) to a stream, river, lake, or marine water that is on the 303(d) list?	<input type="checkbox"/> Yes = 1 <input checked="" type="checkbox"/> No = 0	0
S 3.2. Is the wetland in a basin or sub-basin where water quality is an issue? <i>At least one aquatic resource in the basin is on the 303(d) list.</i>	<input checked="" type="checkbox"/> Yes = 1 <input type="checkbox"/> No = 0	1
S 3.3. Has the site been identified in a watershed or local plan as important for maintaining water quality? <i>Answer YES if there is a TMDL for the basin in which unit is found.</i>	<input checked="" type="checkbox"/> Yes = 2 <input type="checkbox"/> No = 0	2
Total for S 3	Add the points in the boxes above	3

Rating of Value If score is: 2-4 = H 1 = M 0 = L

Record the rating on the first page

Wetland name or number:

SLOPE WETLANDS

Hydrologic Functions - Indicators that the site functions to reduce flooding and stream erosion

S 4.0. Does the site have the potential to reduce flooding and stream erosion?	
S 4.1. Characteristics of plants that reduce the velocity of surface flows during storms: Choose the points appropriate for the description that best fits conditions in the wetland. <i>Stems of plants should be thick enough (usually >1/8₈ in), or dense enough, to remain erect during surface flows.</i> <input checked="" type="checkbox"/> Dense, uncut, rigid plants cover > 90% of the area of the wetland points = 1 <input type="checkbox"/> All other conditions points = 0	1

Rating of Site Potential If score is: **1 = M** **0 = L**

Record the rating on the first page

S 5.0. Does the landscape have the potential to support the hydrologic functions of the site?	
S 5.1. Is more than 25% of the area within 150 ft upslope of wetland in land uses or cover that generate excess surface runoff? <input checked="" type="checkbox"/> Yes = 1 <input type="checkbox"/> No = 0	1

Rating of Landscape Potential If score is: **1 = M** **0 = L**

Record the rating on the first page

S 6.0. Are the hydrologic functions provided by the site valuable to society?	
S 6.1. Distance to the nearest areas downstream that have flooding problems: <input checked="" type="checkbox"/> The sub-basin immediately down-gradient of site has flooding problems that result in damage to human or natural resources (e.g., houses or salmon redds) points = 2 <input type="checkbox"/> Surface flooding problems are in a sub-basin farther down-gradient points = 1 <input type="checkbox"/> No flooding problems anywhere downstream points = 0	2
S 6.2. Has the site been identified as important for flood storage or flood conveyance in a regional flood control plan? <input type="checkbox"/> Yes = 2 <input checked="" type="checkbox"/> No = 0	0
Total for S 6	Add the points in the boxes above 2

Rating of Value If score is: **2-4 = H** **1 = M** **0 = L**

Record the rating on the first page

NOTES and FIELD OBSERVATIONS:

Wetland name or number:

These questions apply to wetlands of all HGM classes.

HABITAT FUNCTIONS - Indicators that site functions to provide important habitat

H 1.0. Does the site have the potential to provide habitat?

H 1.1. Structure of plant community: *Indicators are Cowardin classes and strata within the Forested class. Check the Cowardin plant classes in the wetland. Up to 10 patches may be combined for each class to meet the threshold of ¼ ac or more than 10% of the unit if it is smaller than 2.5 ac. Add the number of structures checked.*

- Aquatic bed 4 structures or more: points = 4
 - Emergent 3 structures: points = 2
 - Scrub-shrub (areas where shrubs have > 30% cover) 2 structures: points = 1
 - Forested (areas where trees have > 30% cover) 1 structure: points = 0
- If the unit has a Forested class, check if:*
- The Forested class has 3 out of 5 strata (canopy, sub-canopy, shrubs, herbaceous, moss/ground-cover) that each cover 20% within the Forested polygon

0

H 1.2. Hydroperiods

Check the types of water regimes (hydroperiods) present within the wetland. The water regime has to cover more than 10% of the wetland or ¼ ac to count (*see text for descriptions of hydroperiods*).

- Permanently flooded or inundated 4 or more types present: points = 3
- Seasonally flooded or inundated 3 types present: points = 2
- Occasionally flooded or inundated 2 types present: points = 1
- Saturated only 1 type present: points = 0
- Permanently flowing stream or river in, or adjacent to, the wetland
- Seasonally flowing stream in, or adjacent to, the wetland
- Lake Fringe wetland** **2 points**
- Freshwater tidal wetland** **2 points**

1

H 1.3. Richness of plant species

Count the number of plant species in the wetland that cover at least 10 ft².

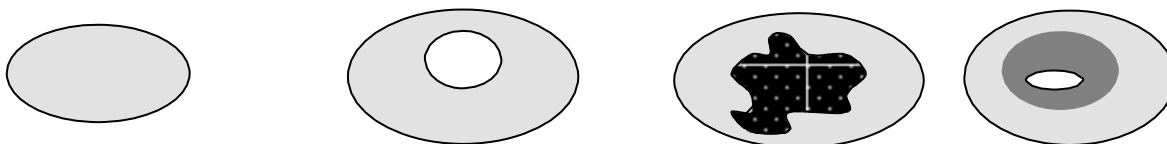
Different patches of the same species can be combined to meet the size threshold and you do not have to name the species. Do not include Eurasian milfoil, reed canarygrass, purple loosestrife, Canadian thistle

- If you counted:
- > 19 species points = 2
 - 5 - 19 species points = 1
 - < 5 species points = 0

1

H 1.4. Interspersion of habitats

Decide from the diagrams below whether interspersion among Cowardin plants classes (described in H 1.1), or the classes and unvegetated areas (can include open water or mudflats) is high, moderate, low, or none. *If you have four or more plant classes or three classes and open water, the rating is always high.*



None = 0 points

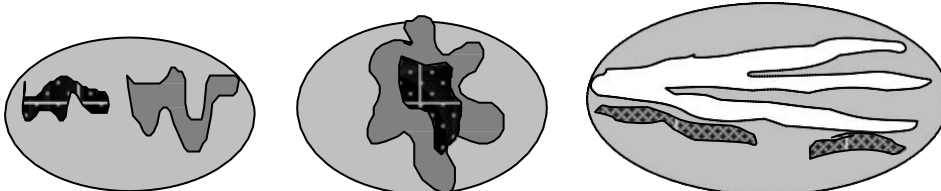
Low = 1 point

Moderate = 2 points

0

All three diagrams in this row are

HIGH = 3points



Wetland name or number:

<p>H 1.5. Special habitat features:</p> <p>Check the habitat features that are present in the wetland. <i>The number of checks is the number of points.</i></p> <ul style="list-style-type: none"> <input type="checkbox"/> Large, downed, woody debris within the wetland (> 4 in diameter and 6 ft long). <input type="checkbox"/> Standing snags (dbh > 4 in) within the wetland. <input type="checkbox"/> Undercut banks are present for at least 6.6 ft (2 m) AND/OR overhanging plants extends at least 3.3 ft (1 m) over a stream (or ditch) in, or contiguous with the wetland, for at least 33 ft (10 m). <input type="checkbox"/> Stable steep banks of fine material that might be used by beaver or muskrat for denning (> 30 degree slope) OR signs of recent beaver activity are present (<i>cut shrubs or trees that have not yet weathered where wood is exposed</i>). <input type="checkbox"/> At least ¼ ac of thin-stemmed persistent plants or woody branches are present in areas that are permanently or seasonally inundated (<i>structures for egg-laying by amphibians</i>). <input type="checkbox"/> Invasive plants cover less than 25% of the wetland area in every stratum of plants (<i>see H 1.1 for list of strata</i>). 		0
Total for H 1	Add the points in the boxes above	2

Rating of Site Potential If score is: 15-18 = H 7-14 = M 0-6 = L *Record the rating on the first page*

H 2.0. Does the landscape have the potential to support the habitat functions of the site?		
<p>H 2.1. Accessible habitat (include <i>only habitat that directly abuts wetland unit</i>).</p> <p><i>Calculate:</i> % undisturbed habitat + [(%moderate and low intensity land uses)/2] = 1% + (32.9%/2) = 17.4%</p> <p>If total accessible habitat is:</p> <ul style="list-style-type: none"> <input type="checkbox"/> > 1/3 (33.3%) of 1 km Polygon points = 3 <input type="checkbox"/> 20-33% of 1 km Polygon points = 2 <input checked="" type="checkbox"/> 10-19% of 1 km Polygon points = 1 <input type="checkbox"/> < 10% of 1 km Polygon points = 0 		1
<p>H 2.2. Undisturbed habitat in 1 km Polygon around the wetland.</p> <p><i>Calculate:</i> % undisturbed habitat + [(%moderate and low intensity land uses)/2] = 4.4% + (89.7%/2) = 49.2%</p> <ul style="list-style-type: none"> <input type="checkbox"/> Undisturbed habitat > 50% of Polygon points = 3 <input checked="" type="checkbox"/> Undisturbed habitat 10-50% and in 1-3 patches points = 2 <input type="checkbox"/> Undisturbed habitat 10-50% and > 3 patches points = 1 <input type="checkbox"/> Undisturbed habitat < 10% of 1 km Polygon points = 0 		2
<p>H 2.3. Land use intensity in 1 km Polygon: If</p> <ul style="list-style-type: none"> <input type="checkbox"/> > 50% of 1 km Polygon is high intensity land use points = (- 2) <input checked="" type="checkbox"/> ≤ 50% of 1 km Polygon is high intensity points = 0 		0
Total for H 2	Add the points in the boxes above	3

Rating of Landscape Potential If score is: 4-6 = H 1-3 = M < 1 = L *Record the rating on the first page*

H 3.0. Is the habitat provided by the site valuable to society?		
<p>H 3.1. Does the site provide habitat for species valued in laws, regulations, or policies? <i>Choose only the highest score that applies to the wetland being rated.</i></p> <p>Site meets ANY of the following criteria: points = 2</p> <ul style="list-style-type: none"> <input type="checkbox"/> It has 3 or more priority habitats within 100 m (see next page) <input type="checkbox"/> It provides habitat for Threatened or Endangered species (any plant or animal on the state or federal lists) <input type="checkbox"/> It is mapped as a location for an individual WDFW priority species <input type="checkbox"/> It is a Wetland of High Conservation Value as determined by the Department of Natural Resources <input type="checkbox"/> It has been categorized as an important habitat site in a local or regional comprehensive plan, in a Shoreline Master Plan, or in a watershed plan <input checked="" type="checkbox"/> Site has 1 or 2 priority habitats (listed on next page) within 100 m points = 1 <input type="checkbox"/> Site does not meet any of the criteria above points = 0 		1

Rating of Value If score is: 2 = H 1 = M 0 = L *Record the rating on the first page*

Wetland name or number:

WDFW Priority Habitats

Priority habitats listed by WDFW (see complete descriptions of WDFW priority habitats, and the counties in which they can be found, in: Washington Department of Fish and Wildlife. 2008. Priority Habitat and Species List. Olympia, Washington. 177 pp. <http://wdfw.wa.gov/publications/00165/wdfw00165.pdf> or access the list from here: <http://wdfw.wa.gov/conservation/phs/list/>)

Count how many of the following priority habitats are within 330 ft (100 m) of the wetland unit: **NOTE:** *This question is independent of the land use between the wetland unit and the priority habitat.*

- Aspen Stands:** Pure or mixed stands of aspen greater than 1 ac (0.4 ha).
- Biodiversity Areas and Corridors:** Areas of habitat that are relatively important to various species of native fish and wildlife (*full descriptions in WDFW PHS report*).
- Herbaceous Balds:** Variable size patches of grass and forbs on shallow soils over bedrock.
- Old-growth/Mature forests:** Old-growth west of Cascade crest – Stands of at least 2 tree species, forming a multi-layered canopy with occasional small openings; with at least 8 trees/ac (20 trees/ha) > 32 in (81 cm) dbh or > 200 years of age. Mature forests – Stands with average diameters exceeding 21 in (53 cm) dbh; crown cover may be less than 100%; decay, decadence, numbers of snags, and quantity of large downed material is generally less than that found in old-growth; 80-200 years old west of the Cascade crest.
- Oregon White Oak:** Woodland stands of pure oak or oak/conifer associations where canopy coverage of the oak component is important (*full descriptions in WDFW PHS report p. 158 – see web link above*).
- Riparian:** The area adjacent to aquatic systems with flowing water that contains elements of both aquatic and terrestrial ecosystems which mutually influence each other.
- Westside Prairies:** Herbaceous, non-forested plant communities that can either take the form of a dry prairie or a wet prairie (*full descriptions in WDFW PHS report p. 161 – see web link above*).
- Instream:** The combination of physical, biological, and chemical processes and conditions that interact to provide functional life history requirements for instream fish and wildlife resources.
- Nearshore:** Relatively undisturbed nearshore habitats. These include Coastal Nearshore, Open Coast Nearshore, and Puget Sound Nearshore. (*full descriptions of habitats and the definition of relatively undisturbed are in WDFW report – see web link on previous page*).
- Caves:** A naturally occurring cavity, recess, void, or system of interconnected passages under the earth in soils, rock, ice, or other geological formations and is large enough to contain a human.
- Cliffs:** Greater than 25 ft (7.6 m) high and occurring below 5000 ft elevation.
- Talus:** Homogenous areas of rock rubble ranging in average size 0.5 - 6.5 ft (0.15 - 2.0 m), composed of basalt, andesite, and/or sedimentary rock, including riprap slides and mine tailings. May be associated with cliffs.
- Snags and Logs:** Trees are considered snags if they are dead or dying and exhibit sufficient decay characteristics to enable cavity excavation/use by wildlife. Priority snags have a diameter at breast height of > 20 in (51 cm) in western Washington and are > 6.5 ft (2 m) in height. Priority logs are > 12 in (30 cm) in diameter at the largest end, and > 20 ft (6 m) long.

Note: All vegetated wetlands are by definition a priority habitat but are not included in this list because they are addressed elsewhere.

Wetland name or number:

CATEGORIZATION BASED ON SPECIAL CHARACTERISTICS

Wetland Type	Category
<i>Check off any criteria that apply to the wetland. Circle the category when the appropriate criteria are met.</i>	
<p>SC 1.0. Estuarine wetlands Does the wetland meet the following criteria for Estuarine wetlands? <input type="checkbox"/> The dominant water regime is tidal, <input type="checkbox"/> Vegetated, and <input type="checkbox"/> With a salinity greater than 0.5 ppt <input type="checkbox"/> Yes – Go to SC 1.1 <input checked="" type="checkbox"/> No = Not an estuarine wetland</p>	
<p>SC 1.1. Is the wetland within a National Wildlife Refuge, National Park, National Estuary Reserve, Natural Area Preserve, State Park or Educational, Environmental, or Scientific Reserve designated under WAC 332-30-151? <input type="checkbox"/> Yes = Category I <input type="checkbox"/> No - Go to SC 1.2</p>	Cat. I
<p>SC 1.2. Is the wetland unit at least 1 ac in size and meets at least two of the following three conditions? <input type="checkbox"/> The wetland is relatively undisturbed (has no diking, ditching, filling, cultivation, grazing, and has less than 10% cover of non-native plant species. (If non-native species are <i>Spartina</i>, see page 25) <input type="checkbox"/> At least ¾ of the landward edge of the wetland has a 100 ft buffer of shrub, forest, or un-grazed or un-mowed grassland. <input type="checkbox"/> The wetland has at least two of the following features: tidal channels, depressions with open water, or contiguous freshwater wetlands. <input type="checkbox"/> Yes = Category I <input type="checkbox"/> No = Category II</p>	Cat. I Cat. II
<p>SC 2.0. Wetlands of High Conservation Value (WHCV) SC 2.1. Has the WA Department of Natural Resources updated their website to include the list of Wetlands of High Conservation Value? <input checked="" type="checkbox"/> Yes – Go to SC 2.2 <input type="checkbox"/> No – Go to SC 2.3 SC 2.2. Is the wetland listed on the WDNR database as a Wetland of High Conservation Value? http://www.dnr.wa.gov/NHPwetlandviewer <input type="checkbox"/> Yes = Category I <input checked="" type="checkbox"/> No = Not a WHCV SC 2.3. Is the wetland in a Section/Township/Range that contains a Natural Heritage wetland? http://file.dnr.wa.gov/publications/amp_nh_wetlands_trs.pdf <input type="checkbox"/> Yes – Contact WNHP/WDNR and go to SC 2.4 <input type="checkbox"/> No = Not a WHCV SC 2.4. Has WDNR identified the wetland within the S/T/R as a Wetland of High Conservation Value and listed it on their website? <input type="checkbox"/> Yes = Category I <input type="checkbox"/> No = Not a WHCV</p>	Cat. I
<p>SC 3.0. Bogs Does the wetland (or any part of the unit) meet both the criteria for soils and vegetation in bogs? <i>Use the key below. If you answer YES you will still need to rate the wetland based on its functions.</i> SC 3.1. Does an area within the wetland unit have organic soil horizons, either peats or mucks, that compose 16 in or more of the first 32 in of the soil profile? <input type="checkbox"/> Yes – Go to SC 3.3 <input checked="" type="checkbox"/> No – Go to SC 3.2 SC 3.2. Does an area within the wetland unit have organic soils, either peats or mucks, that are less than 16 in deep over bedrock, or an impermeable hardpan such as clay or volcanic ash, or that are floating on top of a lake or pond? <input type="checkbox"/> Yes – Go to SC 3.3 <input checked="" type="checkbox"/> No = Is not a bog SC 3.3. Does an area with peats or mucks have more than 70% cover of mosses at ground level, AND at least a 30% cover of plant species listed in Table 4? <input type="checkbox"/> Yes = Is a Category I bog <input type="checkbox"/> No – Go to SC 3.4 NOTE: If you are uncertain about the extent of mosses in the understory, you may substitute that criterion by measuring the pH of the water that seeps into a hole dug at least 16 in deep. If the pH is less than 5.0 and the plant species in Table 4 are present, the wetland is a bog. SC 3.4. Is an area with peats or mucks forested (> 30% cover) with Sitka spruce, subalpine fir, western red cedar, western hemlock, lodgepole pine, quaking aspen, Engelmann spruce, or western white pine, AND any of the species (or combination of species) listed in Table 4 provide more than 30% of the cover under the canopy? <input type="checkbox"/> Yes = Is a Category I bog <input type="checkbox"/> No = Is not a bog</p>	Cat. I

Wetland name or number:

<p>SC 4.0. Forested Wetlands</p> <p>Does the wetland have at least <u>1 contiguous acre</u> of forest that meets one of these criteria for the WA Department of Fish and Wildlife's forests as priority habitats? <i>If you answer YES you will still need to rate the wetland based on its functions.</i></p> <p><input type="checkbox"/> Old-growth forests (west of Cascade crest): Stands of at least two tree species, forming a multi-layered canopy with occasional small openings; with at least 8 trees/ac (20 trees/ha) that are at least 200 years of age OR have a diameter at breast height (dbh) of 32 in (81 cm) or more.</p> <p><input type="checkbox"/> Mature forests (west of the Cascade Crest): Stands where the largest trees are 80- 200 years old OR the species that make up the canopy have an average diameter (dbh) exceeding 21 in (53 cm).</p> <p><input type="checkbox"/> Yes = Category I <input checked="" type="checkbox"/> No = Not a forested wetland for this section</p>	<p>Cat. I</p>
<p>SC 5.0. Wetlands in Coastal Lagoons</p> <p>Does the wetland meet all of the following criteria of a wetland in a coastal lagoon?</p> <p><input type="checkbox"/> The wetland lies in a depression adjacent to marine waters that is wholly or partially separated from marine waters by sandbanks, gravel banks, shingle, or, less frequently, rocks</p> <p><input type="checkbox"/> The lagoon in which the wetland is located contains ponded water that is saline or brackish (> 0.5 ppt) during most of the year in at least a portion of the lagoon (<i>needs to be measured near the bottom</i>)</p> <p><input type="checkbox"/> Yes – Go to SC 5.1 <input checked="" type="checkbox"/> No = Not a wetland in a coastal lagoon</p> <p>SC 5.1. Does the wetland meet all of the following three conditions?</p> <p><input type="checkbox"/> The wetland is relatively undisturbed (has no diking, ditching, filling, cultivation, grazing), and has less than 20% cover of aggressive, opportunistic plant species (see list of species on p. 100).</p> <p><input type="checkbox"/> At least ¾ of the landward edge of the wetland has a 100 ft buffer of shrub, forest, or un-grazed or un-mowed grassland.</p> <p><input type="checkbox"/> The wetland is larger than 1/10 ac (4350 ft²)</p> <p><input type="checkbox"/> Yes = Category I <input type="checkbox"/> No = Category II</p>	<p>Cat. I</p> <p>Cat. II</p>
<p>SC 6.0. Interdunal Wetlands</p> <p>Is the wetland west of the 1889 line (also called the Western Boundary of Upland Ownership or WBUO)? <i>If you answer yes you will still need to rate the wetland based on its habitat functions.</i></p> <p>In practical terms that means the following geographic areas:</p> <p><input type="checkbox"/> Long Beach Peninsula: Lands west of SR 103</p> <p><input type="checkbox"/> Grayland-Westport: Lands west of SR 105</p> <p><input type="checkbox"/> Ocean Shores-Copalis: Lands west of SR 115 and SR 109</p> <p><input type="checkbox"/> Yes – Go to SC 6.1 <input checked="" type="checkbox"/> No = not an interdunal wetland for rating</p> <p>SC 6.1. Is the wetland 1 ac or larger and scores an 8 or 9 for the habitat functions on the form (rates H,H,H or H,H,M for the three aspects of function)?</p> <p><input type="checkbox"/> Yes = Category I <input type="checkbox"/> No – Go to SC 6.2</p> <p>SC 6.2. Is the wetland 1 ac or larger, or is it in a mosaic of wetlands that is 1 ac or larger?</p> <p><input type="checkbox"/> Yes = Category II <input type="checkbox"/> No – Go to SC 6.3</p> <p>SC 6.3. Is the unit between 0.1 and 1 ac, or is it in a mosaic of wetlands that is between 0.1 and 1 ac?</p> <p><input type="checkbox"/> Yes = Category III <input type="checkbox"/> No = Category IV</p>	<p>Cat I</p> <p>Cat. II</p> <p>Cat. III</p> <p>Cat. IV</p>
<p>Category of wetland based on Special Characteristics</p> <p>If you answered No for all types, enter "Not Applicable" on Summary Form</p>	<p>NA</p>

^AWetland name or number:

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2014 Ecology Wetland Rating Form Figures

WILLIAMS SUMAS COMPRESSOR STATION

Wetlands A - C.....	1
Figure 1. Cowardin plant classes – D1.3, H1.1, H1.4	1
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Figure 6. Screen-capture of TMDL map for sub-basin in which unit is found – D3.3, S3.3	7

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WETLANDS A - C

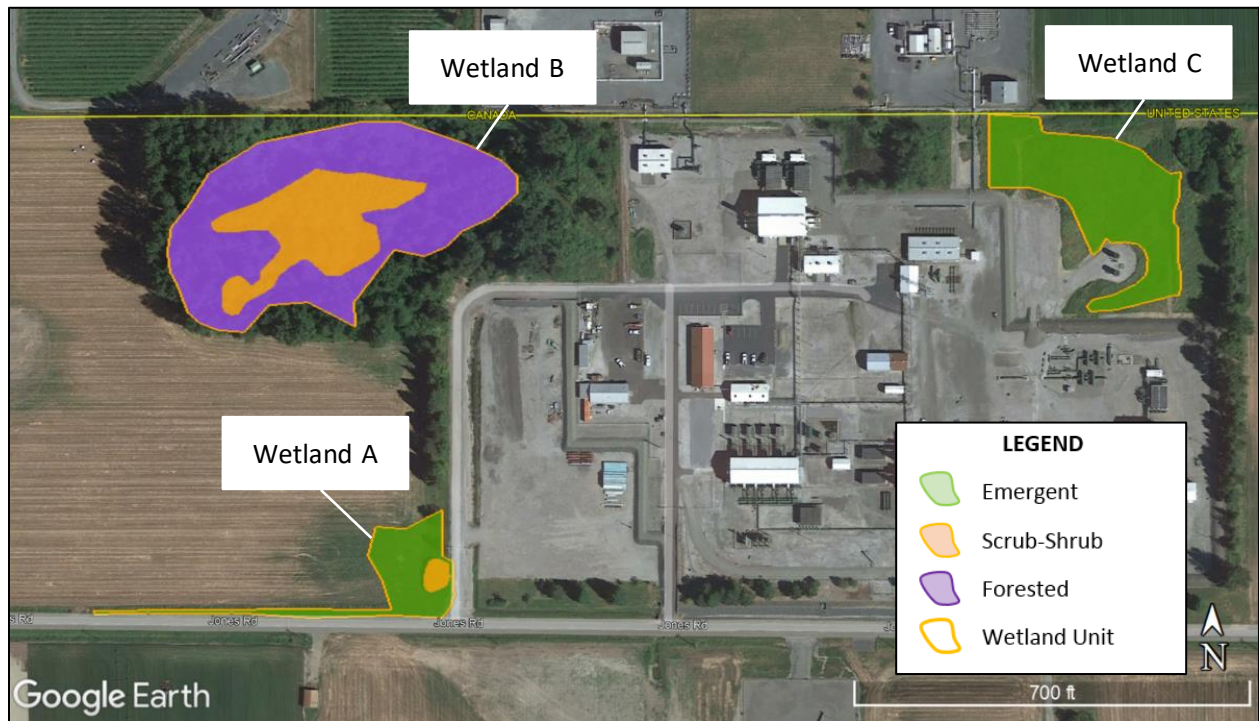


Figure 1. Cowardin plant classes – D1.3, H1.1, H1.4

Features depicted are not to scale. Sketches are based on available data and best professional judgment.

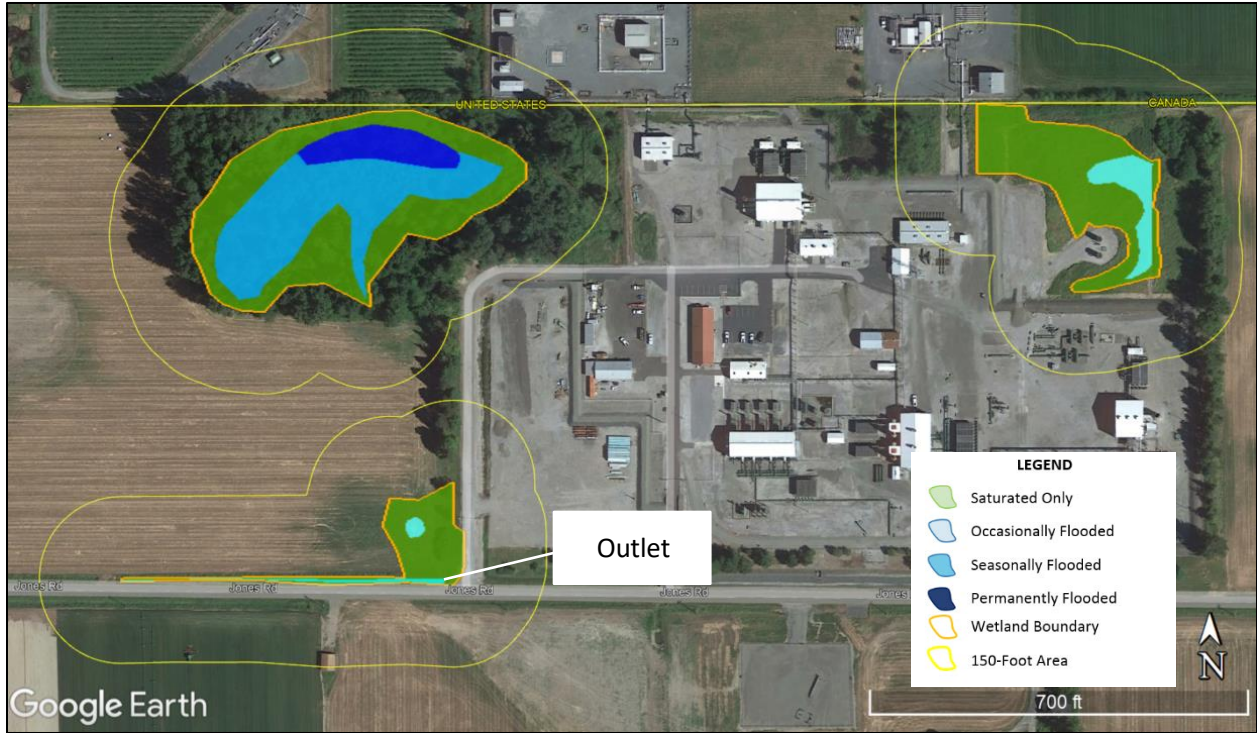


Figure 2. Hydroperiods, outlet(s), and 150-ft area – D1.1, D1.4, H1.2, D2.2, D5.2, S2.1, S5.1

Features depicted are not to scale. Sketches are based on available data and best professional judgment.

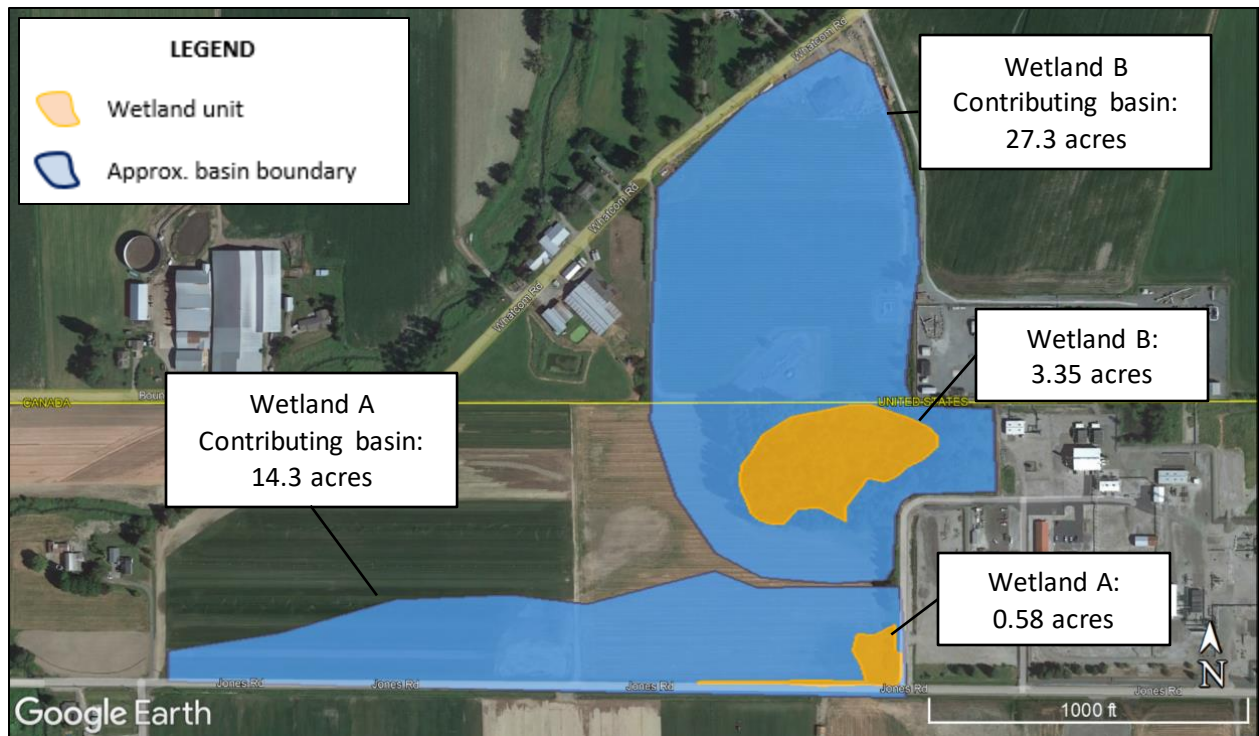


Figure 3. Map of the contributing basin of Wetlands A and B – D4.3, D5.3

Features depicted are not to scale. Sketches are based on available data and best professional judgment.



Figure 3. Plant cover of dense and rigid trees, shrubs, and herbaceous plants for Wetland C – S1.3, S4.1

Features depicted are not to scale. Sketches are based on available data and best professional judgment.



Figure 4. Undisturbed habitat and moderate-low intensity land uses within 1 km from wetland edge including polygon for accessible habitat – H2.1, H2.2, H2.3

Features depicted are not to scale. Sketches are based on available data and best professional judgment.

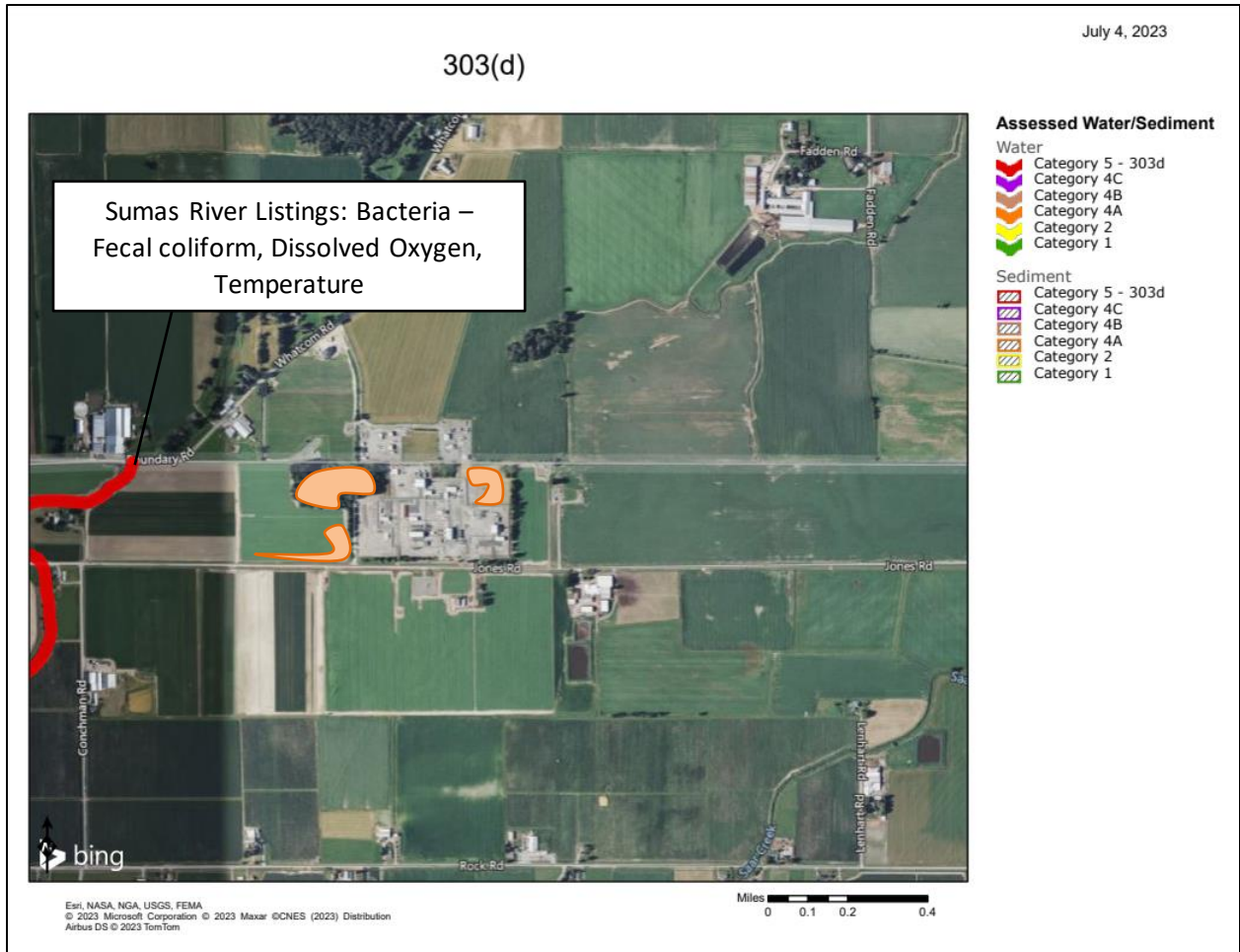


Figure 5. Screen-capture of 303(d) listed waters in basin – D3.1, D3.2, S3.1, S3.2

Features depicted are not to scale. Sketches are based on available data and best professional judgment.

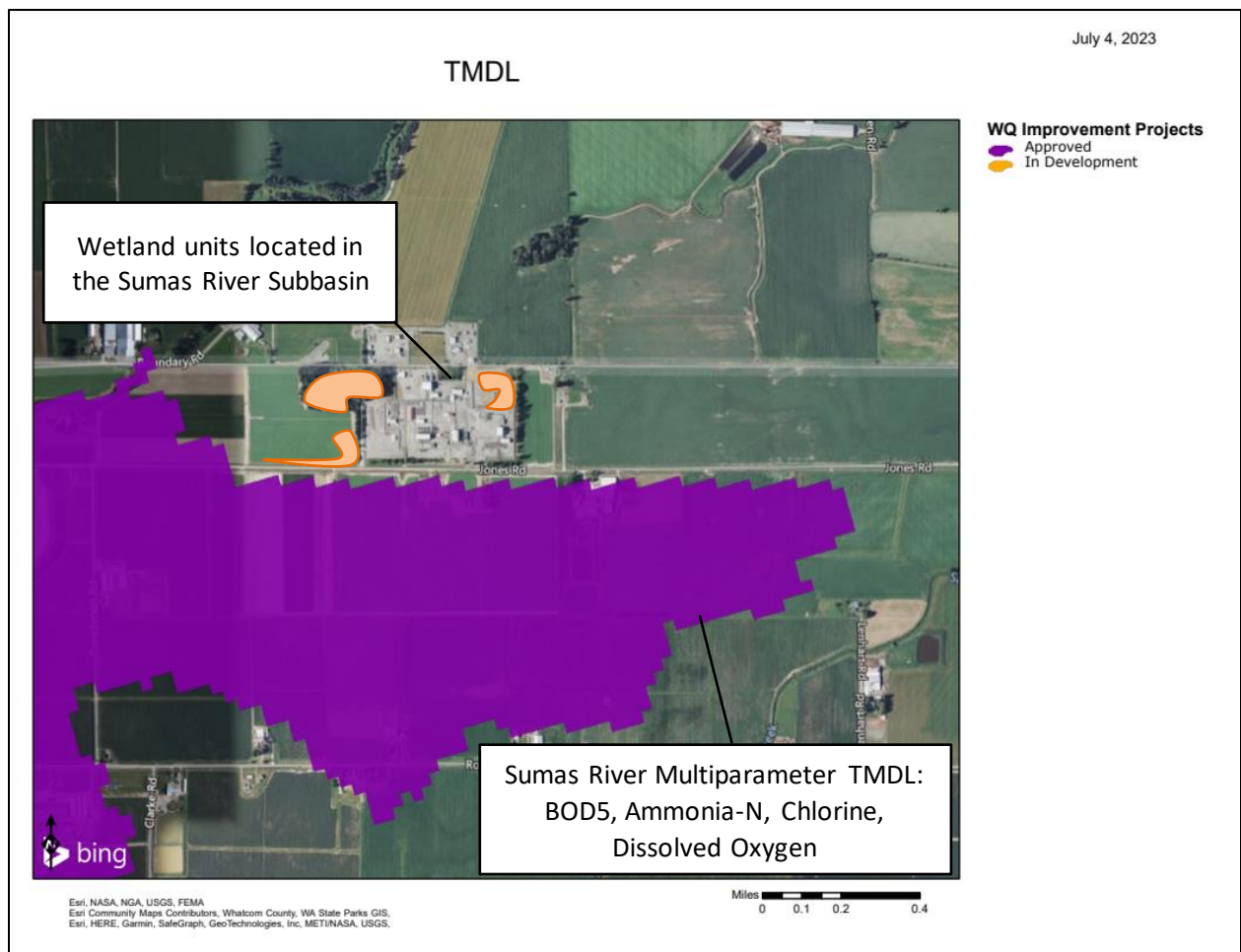


Figure 6. Screen-capture of TMDL map for sub-basin in which unit is found – D3.3, S3.3

Features depicted are not to scale. Sketches are based on available data and best professional judgment.

ATTACHMENT C

Spill Plan for Oil and Hazardous Materials

SPILL PLAN FOR OIL AND HAZARDOUS MATERIALS

SECTION 1 - GENERAL INFORMATION

1.1 Project Location & Description

This Spill Plan will be followed to prevent any spills that may occur during the project from entering any waterway and to mitigate any spills that do occur.

SECTION 2 - DRAINAGE PATTERNS AND SPILL PREVENTION PRACTICES

2.1 Drainage Patterns

The Contractor shall always implement Best Management Practices based on site-specific observations that are continuously made during construction. These measures shall minimize off-site impacts should a spill and/or release occur.

2.2 Spill Prevention Practices

The Contractor shall take the following precautions to ensure that an oil or hazardous materials spill does not occur or if one does, it does not enter any waterway:

a) Containers

- (1) Any containers shall be stored on level ground at least 100 feet from the nearest waterway. Additionally, all containers should be located within temporary containment.
- (2) Temporary containment will include, but not be limited to, temporary hay bale berms with plastic sheets underlining the entire contained area.
- (3) Containment areas shall be capable of containing 110% of the volume of hazardous materials being stored.
- (4) All container storage areas shall be routinely inspected for integrity purposes.
- (5) Leaking and/or deteriorated containers shall be replaced as soon as the condition is first detected with clean-up measures immediately taking place.
- (6) No incompatible materials shall be stored in the same containment area.
- (7) No container storage areas shall be left unattended during non-work hours.

b) Tanks

- (1) The Contractor shall operate only those tanks that meet the requirements and specifications of applicable regulations and that are surrounded with temporary containment as described above.
- (2) Self-supporting tanks shall be constructed materials compatible with its contents.
- (3) All tanks shall be routinely inspected for integrity purposes.
- (4) Vehicle mounted tanks shall be equipped with flame/spark arrestors on vents to ensure that self-ignition does not occur.
- (5) Tanks will not be used to store incompatible materials in sequence unless first thoroughly decontaminated.

- (6) Any tank utilized for storing different products between construction locations will be thoroughly decontaminated prior to refilling.

c) Unloading/Loading Areas

- (1) Re-fueling and transferring of any liquids shall only occur in pre-designated locations that are on level ground and at least 100 feet from any waterway. Where conditions require construction equipment (e.g., backhoes, trench dewatering pumps or hydrostatic test water discharge pumps) be re-fueled within 100 feet of any waterway, this activity must be approved by the inspector and continuously manned to ensure that overfilling, leaks or spills do not occur. In addition, all this equipment must be surrounded by temporary containment as described above.
- (2) All service vehicles used to transport fuel must be equipped with an appropriate number of fire extinguishers and an oil spill response kit. At a minimum, this kit must include:
 - Ten, 48" x 3" oil socks
 - Five, 18" x 18" oil pillows
 - One, 10' x 3" oil booms
 - Twenty-five, 24" x 24" oil mats/pads
 - 1 box garden-size, 6-mil, disposable polyethylene bags (w/ ties)
 - 4 pair of oil-proof gloves
 - One, 55-gallon PE open-head drum
 - Blank drum labels
 - 2 shovels

SECTION 3 - EMERGENCY RESPONSE PROCEDURES

This section provides a generic description of emergency response procedures to be performed to address oil and hazardous materials spills during construction of the Project. Each response will vary depending upon the nature and extent of the incident. However, the general procedures outlined below will be followed.

3.1 Contractor Responsibilities

- (1) The Contractor must designate both an Emergency Coordinator (EC) and an Alternate EC for the Project.
- (2) The Contractor is responsible for appropriately addressing all spills that occur directly as a result of construction-related activities.
- (3) All spills must be reported to the Chief Inspector.
- (4) The Contractor shall supply the necessary manpower, personal protective equipment (PPE), and spill response equipment to appropriately address all spills that directly occur as a result of construction-related activities.
- (5) Ensure that all emergency spill response equipment and PPE is well-stocked and kept in good condition. Replace any materials when necessary.
- (6) If the situation warrants it, the Contractor shall immediately notify any local emergency responders for assistance.
- (7) The Contractor shall be responsible for contracting an outside emergency spill response team if the nature of the emergency incident requires it.
- (8) The Contractor is responsible for immediately notifying the CI (or DM) of any spills.

3.2 Company Responsibilities

- (1) Company shall be responsible for ensuring that the Contractor adequately follows the procedures outlined in this Spill Plan at all times.
- (2) Company shall be responsible for all verbal and written external notifications made to any regulatory agency or any local emergency responders.

3.3 Emergency Contacts

Notify Williams Security Operations Center: 855-945-5762

3.4 Duties of Chief Inspector (or District Manager)

The duties of the CI (or DM) include the following:

- (1) Determine the source, character, amount, and extent of the spill.
- (2) Assess the potential hazards to the job site, environment, and surrounding community.
- (3) Evacuate the area if necessary.
- (4) Report the spill in accordance with the Internal Notification Procedures outlined in Section 5.1 and the External Notification Procedures outlined in Section 5.2.
- (5) Commit manpower and equipment for minor incidents that can be reasonably remediated by the Contractor.
- (6) Oversee Contractor's spill response efforts to contain and control all spills to ensure they adequately follow the procedures outlined in this Plan.
- (7) Document the Contractor's response efforts, including taking photographs whenever possible.
- (8) Report all spills Williams Security Operations Center: 855-945-5762.

SECTION 4 - EMERGENCY SPILL RESPONSE AND PERSONNEL PROTECTION EQUIPMENT

Appendix A provides a list of the minimally-required Emergency Spill Response Equipment and PPE for this project. This is in addition to the minimally-required spill response equipment previously specified in Section 2.2(c)(2).

SECTION 5 - SPILL NOTIFICATION PROCEDURES

5.1 Internal Notifications

All spills are to be immediately reported to the CI (or DM) who will contact SOC.

The SOC will call Environmental Compliance and they will jointly determine if the spill constitutes a:

- (1) Reportable Quantity under CERCLA,
- (2) Reportable release under the Clean Water Act or RCRA, or
- (3) Reportable Threshold Quantity under SARA Title II

If any reporting is necessary, Environmental Compliance shall be responsible for immediately contacting the appropriate federal and state regulatory authorities and following-up in writing, if required.

5.2 External Notifications

Environmental Compliance is responsible for submitting any required written follow-up notifications to the LEPC or any local emergency responders.

5.3 Emergency Spill Response Contractors

Company has arrangements with several emergency spill response contractors to address emergency responses beyond the capabilities of the Contractor.

5.4 Local Emergency Response Teams

The Contractor or the CI (or DM) may call local emergency responders should their assistance be required.

SECTION 6 – CLEAN-UP PROCEDURES

The following section outlines specific procedures to be followed when addressing spills:

6.1 Spills

- (1) Small spills and leaks must be remediated as soon as feasible. Use adsorbent pads wherever possible.
- (2) Restrict spills to the containment area if possible, by stopping or diverting flow.
- (3) If the spill exceeds the containment structure's capacity, immediately construct additional containment using sandbags or fill material. Every effort must be made to prevent the spill from entering any waterway.
- (4) If a spill does reach a waterway, immediately place oil booms downstream to contain the material. As soon as possible, remove the floating layer with absorbent pads.
- (5) After all recoverable oil has been collected and drummed, place all contaminated PPE, spill clean-up equipment, and any impacted soil into appropriate drums.
- (6) For significant quantities of impacted soils, construct temporary waste piles using plastic sheets. This material should subsequently be transferred into lined roll-off boxes as soon as feasible.
- (7) Environmental Compliance will coordinate all waste characterization and disposal activities.

6.2 Equipment Cleaning/Storage

- (1) Upon completion of remedial activities, the Contractor shall be responsible for decontaminating the used emergency response equipment as well as the PPE.
- (2) The Contractor shall be responsible for replacing any spent emergency response equipment and PPE prior to resuming construction-related activities.
- (3) Decontamination rinse fluids shall be collected and containerized. Environmental Compliance will coordinate waste characterization and disposal activities.
- (4) Reusable PPE will be tested and inventoried prior to being placed back into service.

6.3 Waste Disposal

The Contractor is responsible for waste management and waste disposal; however, Environmental Compliance will coordinate all waste characterization, profiling, and disposal activities.

APPENDIX A

EMERGENCY SPILL RESPONSE AND PERSONNEL PROTECTION EQUIPMENT

Equipment	Quantity	Location
(1) chemical spill kit	**	Strategically located near construction activities
(2) oil spill kit	**	Strategically located near construction activities

EMERGENCY SPILL RESPONSE EQUIPMENT:

(1) 1 bag loose chemical pulp	3 chemical pillows (18" x 18")
3 chemical socks (48" x 3")	10 chemical mats/pads (24" x 24")
1 box garden-sized, 6-mil, disposable, polyethylene bags (w/ ties)	
Blank waste labels	one 30-gallon PE open-head drum
2 shovels	

(2) 1 oil boom (100' x 3")	10 oil pillows (18" x 18")
10 oil socks (48" x 3")	25 oil mats/pads (24" x 24")
1 box garden-sized, 6-mil, disposable, polyethylene bags (w/ ties)	
Blank waste labels	three, 55-gallon PE open-head drums
4 shovels	

**** The appropriate quantity of spill kits for the project shall be determined and based on site-specific observations that are continuously made during construction. This emergency spill response equipment, in addition to the BMPs implemented in Section 2.1 of this Spill Plan, shall minimize off-site impacts should a spill and/or release occur.**

PERSONNEL PROTECTION EQUIPMENT:

The inventory of PPE should include enough for at least 4 responders reacting to a spill.

Splash goggles, half-face respirators (w/ cartridges for benzene),
Tyvek suits, nitrile gloves, waterproof/ chemical resistant hip-waders



APPENDIX D BACT COST-EFFECTIVENESS
CALCULATIONS



APPENDIX D1 AIR POLLUTION CONTROL COST ESTIMATION FOR
SELECTIVE CATALYTIC REDUCTION (SCR) FROM THE USEPA

D1A: Data Input Sheet for calculating the Cost of an SCR device

D1B: Design Parameters for Proposed SCR

D1C: Cost Effectiveness of NO_x Removal

Data Inputs

Enter the following data for your combustion unit:

Is the combustion unit a utility or industrial boiler?

What type of fuel does the unit burn?

Is the SCR for a new boiler or retrofit of an existing boiler?

Complete all of the highlighted data fields:

What is the maximum heat input rate (QB)?

What is the higher heating value (HHV) of the fuel?

What is the estimated actual annual fuel consumption?

Enter the net plant heat input rate (NPHR)

If the NPHR is not known, use the default NPHR value:

Fuel Type	Default NPHR
Coal	10 MMBtu/MW
Fuel Oil	11 MMBtu/MW
Natural Gas	8.2 MMBtu/MW

Plant Elevation

Not applicable to units burning fuel oil or natural gas

Type of coal burned:

Enter the sulfur content (K%) = percent by weight

Not applicable to units burning fuel oil or natural gas

Note: The table below is pre-populated with default values for HHV and %S. Please enter the actual values for these parameters in the table below. If the actual value for any parameter is not known, you may use the default values provided.

Coal Type	HHV (Btu/lb)	%S	HHV (Btu/scf)
Bituminous	11,841	0.41	11,841
Sub-bituminous	11,841	0.41	11,841
Lignite	8,498	0.62	8,498

Please click the calculate button to calculate weighted average values based on the data in the table above.

For coal-fired boilers, you may use either Method 1 or Method 2 to calculate the catalyst replacement cost. The equations for both methods are shown on rows 85 and 86 on the Cost Estimate tab. Please select your preferred method:

Method 1
 Method 2
 Not applicable

Enter the following design parameters for the proposed SCR:

Number of days the SCR operates (t_{scr})

Number of days the boiler operates (t_{boiler})

Inlet NO_x Emissions (NO_{x,i}) to SCR

Outlet NO_x Emissions (NO_{x,o}) from SCR

Stoichiometric Ratio Factor (SRF)

*The SRF value of 1.05 is a default value. User should enter actual value, if known.

*The NO_x outlet value was calculated by using the same removal efficiency as used in the default calculations of this spreadsheet.

Estimated operating life of the catalyst (t_{cat})

Estimated SCR equipment life

* For industrial boilers, the typical equipment life is between 20 and 25 years.

Concentration of reagent as stored (C_{reagent})

Density of reagent as stored (ρ_{reagent})

Number of days reagent is stored (t_{reagent})

*The reagent concentration of 29% and density of 56 lb/ft³ are default values for ammonia reagent. User should enter actual values for reagent, if different from the default values provided.

Number of SCR reactor chambers (n_{scr})

Number of catalyst layers (R_{cat})

Number of empty catalyst layers (R_{empty})

Ammonia Slip (Slip) provided by vendor

Volume of the catalyst layers (Vol_{cat}) (Enter "UNK" if value is not known)

Flue gas flow rate (Q_{flue}) (Enter "UNK" if value is not known)

Gas temperature at the SCR inlet (T)

Base case fuel gas volumetric flow rate factor (Q_{fuel})

Densities of typical SCR reagents:

50% urea solution	71 lb/ft ³
29.4% aqueous NH ₃	56 lb/ft ³

Select the reagent used

Enter the cost data for the proposed SCR:

Desired dollar-year CEPCI for 2024

Annual Interest Rate (i)

Reagent (Cost_{reagent})

Electricity (Cost_{elec})

Catalyst cost (CC_{reagent})

Operator Labor Rate

Operator Hours/Day

Note: The use of CEPCI in this spreadsheet is not an endorsement of the index, but is there merely to allow for availability of a well-known cost index to spreadsheet users. Use of other well-known cost indexes (e.g., MBS) is acceptable.

CEPCI = Chemical Engineering Plant Cost Index

* 50.293/gallon is a default value for 29% ammonia. User should enter actual value, if known.

* 0.0676 is a default value for the electricity cost based on 2016 prices. User should enter actual value, if known.

* 4 hours/day is a default value for the operator labor. User should enter actual value, if known.

Maintenance and Administrative Charges Cost Factors:

Maintenance Cost Factor (MCF) =

Administrative Charges Factor (ACF) =

Data Sources for Default Values Used in Calculations:

Data Element	Default Value	Sources for Default Value	If you used your own site-specific values, please enter the value used and the reference source...	Recommended data sources for site-specific information
Reagent Cost (\$/gallon)	\$0.293/gallon 29% ammonia solution ammonia cost for 29% solution	U.S. Geological Survey, Minerals Commodity Summaries, January 2017 (https://minerals.usgs.gov/minerals/pubs/commodity/nitrogen/mcs-2017-nitro.pdf)		Check with reagent vendors for current prices.
Electricity Cost (\$/kWh)	0.0676	U.S. Energy Information Administration, Electric Power Monthly, Table 5.3. Published December 2017. Available at: https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_5_6_a	https://www.eia.gov/electricity/monthly/epm_table_grapher.php?epmt_5_6_a Table 5.6.A Average Price of Electricity to Ultimate Customers by End Use Sector, published Feb. 26, 2025 Dec 2024 Industrial - Washington State - 6.13 cents/kWh	Plant's utility bill or use U.S. Energy Information Administration (EIA) data for most recent year. Available at: https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_5_6_a
Percent sulfur content for Coal (% weight)		Not applicable to units burning fuel oil or natural gas		Check with fuel supplier or use U.S. Energy Information Administration (EIA) data for most recent year. Available at http://www.eia.gov/electricity/data/eia923/
Higher Heating Value (HHV) (Btu/lb)	1,033	2016 natural gas data compiled by the Office of Oil, Gas, and Coal Supply Statistics, U.S. Energy Information Administration (EIA) from data reported on EIA Form EIA-923, Power Plant Operations Report. Available at: http://www.eia.gov/electricity/data/eia923/		Fuel supplier or use: U.S. Energy Information Administration (EIA) data for most recent year. Available at http://www.eia.gov/electricity/data/eia923/
Catalyst Cost (\$/cubic foot)	227	U.S. Environmental Protection Agency (EPA), Documentation for EPA's Power Sector Modeling Platform v6 Using the Integrated Planning Model, Office of Air and Radiation, May 2018. Available at: https://www.epa.gov/airmarkets/documentation-epas-power-sector-modeling-platform-v6.		Check with vendors for current prices.
Operator Labor Rate (\$/hour)	\$60.00	U.S. Environmental Protection Agency (EPA), Documentation for EPA's Power Sector Modeling Platform v6 Using the Integrated Planning Model, Office of Air and Radiation, May 2018. Available at: https://www.epa.gov/airmarkets/documentation-epas-power-sector-modeling-platform-v6.	Hourly mean wage \$40.65/hr pipeline transport natural gas plant operator, May 2023 Hourly mean wage \$45.32/hr for Washington State Gas Plant Operators NAICS 486200 - Pipeline Transportation of Natural Gas: https://www.federalreserve.gov/releases/h15/ Bank prime loan rate - Feb 2025	Use payroll data, if available, or check current edition of the Bureau of Labor Statistics, National Occupational Employment and Wage Estimates - United States (https://www.bls.gov/oes/current/oes_nat.html)
Interest Rate (Percent)	5.5	Default bank prime rate	https://www.federalreserve.gov/releases/h15/ Bank prime loan rate - Feb 2025	Use known interest rate or use bank prime rate, available at https://www.federalreserve.gov/releases/h15/

SCR Design Parameters

The following design parameters for the SCR were calculated based on the values entered on the *Data Inputs* tab. These values were used to prepare the costs shown on the *Cost Estimate* tab.

Parameter	Equation	Calculated Value	Units
Maximum Annual Heat Input Rate (Q_B) =	HHV x Max. Fuel Rate =	144	MMBtu/hour
Maximum Annual fuel consumption (mfuel) =	$(Q_B \times 1.0E6 \times 8760) / \text{HHV} =$	1,150,149,635	scf/Year
Actual Annual fuel consumption (Mactual) =		1,150,161,720	scf/Year
Heat Rate Factor (HRF) =	$\text{NPHR} / 10 =$	0.82	
Total System Capacity Factor (CF_{total}) =	$(\text{Mactual} / \text{Mfuel}) \times (\text{tscr} / \text{tplant}) =$	1.000	fraction
Total operating time for the SCR (t_{op}) =	$\text{CF}_{\text{total}} \times 8760 =$	8760	hours
NOx Removal Efficiency (EF) =	$(\text{NOx}_{\text{in}} - \text{NOx}_{\text{out}}) / \text{NOx}_{\text{in}} =$	90.0	percent
NOx removed per hour =	$\text{NOx}_{\text{in}} \times \text{EF} \times Q_B =$	4.66	lb/hour
Total NO _x removed per year =	$(\text{NOx}_{\text{in}} \times \text{EF} \times Q_B \times t_{\text{op}}) / 2000 =$	20.42	tons/year
NO _x removal factor (NRF) =	$\text{EF} / 80 =$	1.13	
Volumetric flue gas flow rate ($q_{\text{flue gas}}$) =	$Q_{\text{fuel}} \times Q_B \times (460 + T) / (460 + 700)n_{\text{scr}} =$	2,500	acfm
Space velocity (V_{space}) =	$q_{\text{flue gas}} / \text{Vol}_{\text{catalyst}} =$	3.73	/hour
Residence Time	$1 / V_{\text{space}} =$	0.27	hour
Coal Factor (CoalF) =	1 for oil and natural gas; 1 for bituminous; 1.05 for sub bituminous; 1.07 for lignite (weighted average is used for coal blends)	1.00	
SO ₂ Emission rate =	$(\%S / 100) \times (64 / 32) \times 1 \times 10^6 / \text{HHV} =$		Not applicable; factor applies only to coal-fired boilers
Elevation Factor (ELEVf) =	$14.7 \text{ psia} / P =$		Not applicable; elevation factor does not apply to plants located at elevations below 500 feet.
Atmospheric pressure at sea level (P) =	$2116 \times [(59 - (0.00356 \times h) + 459.7) / 518.6]^{2.56} \times (1 / 144) * =$	14.7	psia
Retrofit Factor (RF)	New Construction	0.80	

* Equation is from the National Aeronautics and Space Administration (NASA), Earth Atmosphere Model. Available at <https://spaceflightsystems.grc.nasa.gov/education/rocket/atmos.html>.

Catalyst Data:

Parameter	Equation	Calculated Value	Units
Future worth factor (FWF) =	$(\text{interest rate}) / (1 + (\text{interest rate})^Y - 1)$, where $Y = \text{H}_{\text{catalyst}} / (\text{t}_{\text{SCR}} \times 24 \text{ hours})$ rounded to the nearest integer	0.3095	Fraction
Catalyst volume ($\text{Vol}_{\text{catalyst}}$) =	$2.81 \times Q_B \times \text{EF}_{\text{adj}} \times \text{Slip}_{\text{adj}} \times \text{NOx}_{\text{adj}} \times S_{\text{adj}} \times (T_{\text{adj}} / N_{\text{scr}})$	670.02	Cubic feet
Cross sectional area of the catalyst (A_{catalyst}) =	$q_{\text{flue gas}} / (16 \text{ ft} / \text{sec} \times 60 \text{ sec} / \text{min})$	3	ft ²
Height of each catalyst layer (H_{layer}) =	$(\text{Vol}_{\text{catalyst}} / (R_{\text{layer}} \times A_{\text{catalyst}})) + 1$ (rounded to next highest integer)	87	feet

SCR Reactor Data:

Parameter	Equation	Calculated Value	Units
Cross sectional area of the reactor (A_{SCR}) =	$1.15 \times A_{\text{catalyst}}$	3	ft ²
Reactor length and width dimensions for a square reactor =	$(A_{\text{SCR}})^{0.5}$	1.7	feet
Reactor height =	$(R_{\text{layer}} + R_{\text{empty}}) \times (7 \text{ ft} + h_{\text{layer}}) + 9 \text{ ft}$	384	feet

Reagent Data:

Type of reagent used: Ammonia Molecular Weight of Reagent (MW) = 17.03 g/mole
Density = 56 lb/ft³

Parameter	Equation	Calculated Value	Units
Reagent consumption rate (m_{reagent}) =	$(\text{NOx}_{\text{in}} \times Q_B \times \text{EF} \times \text{SRF} \times \text{MW}_R) / \text{MW}_{\text{NOx}} =$	2	lb/hour
Reagent Usage Rate (m_{sol}) =	$m_{\text{reagent}} / \text{Csol} =$	6	lb/hour
	$(m_{\text{sol}} \times 7.4805) / \text{Reagent Density}$	1	gal/hour
Estimated tank volume for reagent storage =	$(m_{\text{sol}} \times 7.4805 \times t_{\text{storage}} \times 24) / \text{Reagent Density} =$	300	gallons (storage needed to store a 14 day reagent supply rounded to the nearest 100 gallons)

Capital Recovery Factor:

Parameter	Equation	Calculated Value
Capital Recovery Factor (CRF) =	$i(1+i)^n / (1+i)^n - 1 =$ Where n = Equipment Life and i = Interest Rate	0.0897

Other parameters	Equation	Calculated Value	Units
Electricity Usage:			
Electricity Consumption (P) =	$A \times 1,000 \times 0.0056 \times (\text{CoalF} \times \text{HRF})^{0.43} =$ where A = $(0.1 \times Q_B)$ for industrial boilers.	73.99	kW

Cost Estimate

Total Capital Investment (TCI)

TCI for Oil and Natural Gas Boilers

For Oil and Natural Gas-Fired Utility Boilers between 25MW and 500 MW:

$$TCI = 86,380 \times (200/B_{MW})^{0.35} \times B_{MW} \times ELEV \times RF$$

For Oil and Natural Gas-Fired Utility Boilers >500 MW:

$$TCI = 62,680 \times B_{MW} \times ELEV \times RF$$

For Oil-Fired Industrial Boilers between 275 and 5,500 MMBTU/hour :

$$TCI = 7,850 \times (2,200/Q_B)^{0.35} \times Q_B \times ELEV \times RF$$

For Natural Gas-Fired Industrial Boilers between 205 and 4,100 MMBTU/hour :

$$TCI = 10,530 \times (1,640/Q_B)^{0.35} \times Q_B \times ELEV \times RF$$

For Oil-Fired Industrial Boilers >5,500 MMBtu/hour:

$$TCI = 5,700 \times Q_B \times ELEV \times RF$$

For Natural Gas-Fired Industrial Boilers >4,100 MMBtu/hour:

$$TCI = 7,640 \times Q_B \times ELEV \times RF$$

Total Capital Investment (TCI) =	\$4,189,213	in 2024 dollars
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Annual Costs

Total Annual Cost (TAC)

TAC = Direct Annual Costs + Indirect Annual Costs

Direct Annual Costs (DAC) =		\$78,513 in 2024 dollars
Indirect Annual Costs (IDAC) =		\$377,804 in 2024 dollars
Total annual costs (TAC) = DAC + IDAC		\$456,317 in 2024 dollars

Direct Annual Costs (DAC)

DAC = (Annual Maintenance Cost) + (Annual Reagent Cost) + (Annual Electricity Cost) + (Annual Catalyst Cost)

Annual Maintenance Cost =	0.005 x TCI =	\$20,946 in 2024 dollars
Annual Reagent Cost =	$m_{sol} \times Cost_{reag} \times t_{op} =$	\$2,142 in 2024 dollars
Annual Electricity Cost =	$P \times Cost_{elect} \times t_{op} =$	\$39,734 in 2024 dollars
Annual Catalyst Replacement Cost =		\$15,691 in 2024 dollars
	$n_{scr} \times Vol_{cat} \times (CC_{replace}/R_{layer}) \times FWF$	
Direct Annual Cost =		\$78,513 in 2024 dollars

Indirect Annual Cost (IDAC)

IDAC = Administrative Charges + Capital Recovery Costs

Administrative Charges (AC) =	0.03 x (Operator Cost + 0.4 x Annual Maintenance Cost) =	\$2,032 in 2024 dollars
Capital Recovery Costs (CR)=	CRF x TCI =	\$375,772 in 2024 dollars
Indirect Annual Cost (IDAC) =	AC + CR =	\$377,804 in 2024 dollars

Cost Effectiveness

Cost Effectiveness = Total Annual Cost/ NOx Removed/year

Total Annual Cost (TAC) =		\$456,317 per year in 2024 dollars
NOx Removed =		20.421 tons/year
Cost Effectiveness =	CE = TAC / Nox removed	\$22,345 per ton of NOx removed in 2024 dollars



APPENDIX D2 COST ANALYSIS FOR OXIDATION CATALYST (CO & VOC BACT
& tBACT)

D2: Cost Effectiveness for use of Oxidation Catalyst (CO, VOC, and TAP)¹²

¹² USEPA, "EPA Air Pollution Control Cost Manual, 7th Edition," EPA-452-02-001, 2002.

Northwest Pipeline LLC
Sumas Compressor Station

Cost Analysis for Oxidation Catalyst (CO BACT and VOC BACT)

all in 2024 Dollars

Parameter	Formula	Reference	Cost
Direct Capital Cost	DC		
Equipment Cost	EC	Vendor estimate	\$ 1,000,000
Instrumentation	10% of EC	EPA Cost Manual	\$ 100,000
Sales Tax	5% of EC	Estimated	\$ 50,000
Freight	5% of EC	EPA Cost Manual	\$ 50,000
Total Equipment Cost	TEC		\$ 1,200,000

Parameter	DI	Reference	Cost
Direct Installation Cost	DI		
Foundation & Supports	8% of TEC	EPA Cost Manual	\$ 96,000
Handling & Erection	14% of TEC	EPA Cost Manual	\$ 168,000
Electrical	4% of TEC	EPA Cost Manual	\$ 48,000
Piping	2% of TEC	EPA Cost Manual	\$ 24,000
Insulation	1% of TEC	EPA Cost Manual	\$ 12,000
Painting	1% of TEC	EPA Cost Manual	\$ 12,000
Total Direct Installation	DI		\$ 360,000
Site Preparation	as req.	assumed none required	\$ -
Building	as req.	assumed none required	\$ -
Total Direct Cost	DC = TEC + DI + SP + bldg		\$ 1,560,000

Parameter	IC	Reference	Cost
Indirect Installation Cost	IC		
Engineering	10% of TEC	EPA Cost Manual	\$ 120,000
Construction & field expenses	5% of TEC	EPA Cost Manual	\$ 60,000
Start-up	2% of TEC	EPA Cost Manual	\$ 24,000
Performance test	1% of TEC	EPA Cost Manual	\$ 12,000
Total Installation Cost	IC		\$ 216,000
Contractor fees	10%*(DC+IC)	EPA Cost Manual	\$ 177,600
Contingencies	C = CF*(DC+IC)	CF = 10% factor used	\$ 177,600
Total Capital Investment (TCI)	TCI = DC + IC + C + fees		\$ 2,131,200

Parameter	DAC	Reference	Cost
Direct Annual Cost	DAC		
Labor			
Operator	0.5hr/shift, 3 shifts/day, \$30/hr, 365 days	EPA Cost Manual	\$ 16,425
Supervisor	15% of Oper costs	EPA Cost Manual	\$ 2,464
Maintenance			
Labor & Materials	1.5% of TCI	EPA Cost Manual	\$ 31,968
Catalyst replacement cost	6 yr catalyst life	Vendor estimate	\$ 116,667
Total Direct Annual Cost	DAC = Labor costs		\$ 50,857

Parameter	IAC	Reference	Cost
Indirect Annual Cost	IAC		
Capital Recovery Factor (CFR)	15yr equip life, 7% interest	EPA Cost Manual	0.1098
Capital Recovery	CR = CFR * TCI	EPA Cost Manual	\$ 233,994
Property Tax	1% of TCI	EPA Cost Manual	\$ 21,312
Insurance	1% of TCI	EPA Cost Manual	\$ 21,312
General & Administrative	2% of TCI	EPA Cost Manual	\$ 42,624
Overhead	80% of Labor costs	EPA Cost Manual	\$ 40,685
Total Indirect Annual Cost	IAC		\$ 359,928

Total Annualized Cost (\$/yr)	TAC = DAC + IAC		\$ 410,784
--------------------------------------	------------------------	--	-------------------

Parameter	Reference	Cost
Cost Effectiveness		
Annual CO emissions (tons/yr)	facility estimate	37.00
CO Control efficiency	EPA Cost Manual	60%
Annual CO removed (tons/yr)		22.20
Cost Effectiveness (\$/ton)		\$ 18,504

Parameter	Reference	Cost
Cost Effectiveness		
Annual VOC emissions (tons/yr)	facility estimate	4.32
VOC Control efficiency	EPA Cost Manual	60%
Annual VOC removed (tons/yr)		2.59
Cost Effectiveness (\$/ton)		\$ 158,482

Parameter	Reference	Cost
Cost Effectiveness		
Annual TAP emissions (tons/yr)	facility estimate	0.19
HAPs Control efficiency	EPA Cost Manual	60%
Annual HAPs removed (tons/yr)		0.11
Cost Effectiveness (\$/ton)		\$ 3,610,784

Parameter	Reference	Cost
Cost Effectiveness		
Annual combined emissions (tons/yr)	facility estimate	41.51
Pollutant Control efficiency	EPA Cost Manual	60%
Annual pollutants removed (tons/yr)		24.91
Cost Effectiveness (\$/ton)		\$ 16,494



ERM

APPENDIX E EQUIPMENT MANUFACTURER
SPECIFICATIONS



APPENDIX E1 SOLAR PRODUCT INFORMATION LETTERS

E1A: PIL 168 – Volatile Organic Compound, Sulfur Dioxide, and Formaldehyde Emission Estimates

E1B: PIL 170 – Emission Estimates at Start-Up, Shutdown, and Commissioning for SoLoNO_xTM
Combustion Products

E1C: PIL 251 – Emissions from Centrifugal Compressor Dry Gas Seal System

Volatile Organic Compound, Sulfur Dioxide, and Formaldehyde Emission Estimates

Leslie Witherspoon

PURPOSE

This Product Information Letter (PIL) summarizes emission factors commonly utilized to estimate emissions of volatile organic compounds (VOC), sulfur dioxide (SO₂), and formaldehyde from gas turbines.

Volatile Organic Compounds

Many permitting agencies require gas turbine users to include emissions of VOC, a subpart of the unburned hydrocarbon (UHC) emissions, during the air permitting process. Volatile organic compounds, non-methane hydrocarbons (NMHC), and reactive organic gases (ROG) are different ways of referring to the non-methane (and non-ethane) portion of an “unburned hydrocarbon” emission estimate.

For natural gas fuel, Solar’s customers often use 10-20% of the UHC emission rate to conservatively estimate VOC emissions. Solar can offer a 5 ppm VOC warranty level upon request. For liquid fuel, it is appropriate to estimate that 100% of the UHC estimate is VOC. The emissions estimates are assumed valid for natural gas at ambient temperatures >-4°F (-20C) from 50-100% load (80-100% load for the Saturn® 20 and >-20°F (-29C) and 40-100% for the Titan™ 250) and for liquid fuel from 65-100% load (80-100% for the Saturn 20 and Centaur® 40).

Environmental Protection Agency (EPA’s) AP-42¹ document and WebFIRE² database also contain VOC emission estimates for gas turbines. These sources are not commonly used by Solar’s customers.

Sulfur Dioxide

Sulfur dioxide emissions are produced by conversion of any sulfur in the fuel to SO₂. Solar customers usually either use a mass balance calculation or reference AP-42 to estimate SO₂ emissions. Because Solar does not control the amount of sulfur in the fuel, no SO₂ emissions warranty is available.

The mass balance method assumes that any sulfur in the fuel converts to SO₂. For reference, the typical mass balance equation is shown below.

$$\frac{\text{lb SO}_2}{\text{hr}} = \left(\frac{\text{wt\% Sulfur}}{100} \right) \left(\frac{\text{lb fuel}}{\text{Btu}} \right) \left(\frac{10^6 \text{ Btu}}{\text{MMBtu}} \right) \left(\frac{\text{MMBtu fuel}}{\text{hr}} \right) \left(\frac{\text{MW SO}_2}{\text{MW Sulfur}} \right)$$

Variables: wt% of sulfur in fuel
Btu/lb fuel (LHV)
MMBtu/hr fuel flow (LHV)

As an alternative to the mass balance calculation, EPA’s AP-42 document can be used. AP-42 (Table 3.1-2a, April 2000) suggests emission factors of 0.94S lb/MMBtu (HHV) (where S=Sulfur % in fuel) or 0.0034 lb/MMBtu (HHV) for gas fuel and 1.01S lb/MMBtu (HHV) (where S=Sulfur% in fuel) or 0.33 lb/MMBtu (HHV) for liquid fuel.

¹AP-42 is an EPA document containing a compilation of air pollutant emission factors by source category.

² WebFIRE is an EPA electronic based repository and retrieval tool for emission factors.

Formaldehyde

For gas turbines, formaldehyde emissions are a result of incomplete combustion and are unstable in the exhaust stream. In this section, regulatory background, recommended emission factors, and testing considerations are discussed.

Regulatory Background and Emissions Factors – U.S. and EU

In 2004 the U.S. EPA published a Maximum Achievable Control Technology (MACT) standard (40 CFR 63 Subpart YYYYY) for natural gas fired combustion turbines with a formaldehyde limit of 91 ppb (15% O₂). The standard was stayed a few months later for the natural gas subcategories essentially rendering the regulation “on hold”. The stay was lifted on March 9, 2022. After ~18 years of not having to comply with the MACT standard, natural gas fired combustion turbines located **at major sources of hazardous air pollutants** need to comply with the standard. The initial compliance date is September 4, 2022. With the lifting of the stay, four of the eight subcategories outlined in the Subpart YYYYY must comply with the MACT standard. They are:

- stationary lean premix combustion turbines when firing gas and when firing oil at sites where all turbines fire oil no more than an aggregate total of 1,000 hours annually
- stationary lean premix combustion turbines when firing oil at sites where all turbines fire oil more than an aggregate total of 1,000 hours annually
- stationary diffusion flame combustion turbines when firing gas and when firing oil at sites where all turbines fire oil no more than an aggregate total of 1,000 hours annually
- stationary diffusion flame combustion turbines when firing oil at sites where all turbines fire oil more than an aggregate total of 1,000 hours annually

For U.S. customers with a combustion turbine that must comply with Subpart YYYYY, an emission factor of 91 ppb @ 15% O₂ (~0.00021 lb/MMBtu HHV) is recommended.

The formaldehyde emissions estimate of 91 ppb @15%O₂ (~0.00021 lb/MMbtu HHV) can be used for all new, current production, SoLoNO_x models and ratings when firing pipeline quality natural gas or ultra-low sulfur (ULSD) diesel fuel. The emissions estimate is valid for natural gas from 50-100% load (40-100% load for Titan 250) or for liquid fuel from 65-100% load (80-100% load for the Centaur 40) and at ambient temperatures >-4°F (-20C) [> -20 °F (-29C) for Titan 250].

Alternative emission factors for combustion turbines **not** affected by Subpart YYYYY (or non-U.S. based combustion turbines) are from U.S. EPA’s AP-42 document and are 0.00071 lb/MMBtu (HHV) for natural gas and 0.00028 lb/MMBtu (HHV) for distillate oil³. Note that both of the aforementioned formaldehyde emission factors are higher than the MACT standard. Since ~2003 many gas turbine users have used the emission factors found in an EPA memo Revised HAP Emission Factors for Stationary Combustion Turbines⁴ for estimating hazardous air pollutant emissions. The memo presents hazardous air pollutant emission factor data in several categories. While the memo presents several formaldehyde emissions factors, the most common formaldehyde emission factor used to estimate emissions from gas turbines from this document is 0.00288 lb/MMBtu HHV (Table 16). Note that this emission factor is an order of magnitude higher than the MACT standard.

In the EU, Germany has established a formaldehyde limit of 5 mg/Nm³ for combustion turbines (13.BImSchV Section 33). This limit applies for operation at 70-100% load and it is anticipated that something similar will be adopted in other EU member states. The 5 mg/Nm³ limit is equivalent to ~0.0038 kg/GJ or ~3.7 ppm.

Formaldehyde Emissions Testing Considerations

Actual emissions of formaldehyde from Solar’s gas turbines, in the SoLoNO_x operating range, are predicted to be less than 91 ppb @15%O₂. However, **the 91 ppb level can only be verified if the proper testing equipment is utilized**. To properly measure formaldehyde emissions, Fourier Transform Infrared (FTIR) instrumentation with limits of detection well below the standard must be utilized. Most “traditional” FTIR systems have formaldehyde

³ AP-42, Table 3.1-3 for Natural Gas and Table 3.1-4 for Distillate Oil, 4/00.

⁴ Revised HAP Emission Factors for Stationary Combustion Turbines, OAR-2002-0060, IV-B-09,8/22/03.

limits of detection in the 120-150 ppb range and are not suitable to measure formaldehyde from combustion turbines.

Solar recommends the MKS Multi Gas 2030 FTIR with StarBoost™ System, the Spectrum WaveRunIR-EXT or an equivalent system with similar path lengths and detection levels.

EPA Method 320 (or equivalent method for non-U.S. testing) should be used to measure formaldehyde. Testing should include three – 120-minute test runs. To ensure accurate formaldehyde measurements, the testing company, in addition to following the requirements of Method 320 (or equivalent method), should take necessary steps to optimize signal-to-noise, verify the FTIR is fully temperature stabilized and purged, ensure the FTIR signal is optimized before testing by maximizing alignment and cleanliness of optics, minimize sampling line bias by using clean sample lines at 250°F to prevent off-gassing and minimize contamination with other compounds, verify absence of sampling system bias via system zero measurements, measure a source specific moisture spectrum while at the test site using a water/N₂ delivery systems at +/-10% of turbine moisture content, and use the source specific water spectrum as an interferent in the analysis.

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Emission Estimates at Start-up, Shutdown, and Commissioning for SoLoNOx™ Combustion Products

Leslie Witherspoon

PURPOSE

The purpose of this Product Information Letter (PIL) is to provide emission estimates for start-up and shutdown events for Solar® gas turbines with SoLoNOx™ dry low emissions combustion systems.¹ For start-up and shutdown emissions estimates for conventional combustion turbines, landfill gas, digester gas, or other alternative fuel applications, contact Solar's Environmental Programs team.

INTRODUCTION

The information presented in this document is representative for both generator set (GS) and compressor set/mechanical drive (CS/MD) SoLoNOx combustion turbine applications. Operation of duct burners and/or any add-on control equipment is not accounted for in the emissions estimates. Emissions estimates related to the start-up, shutdown, and commissioning of combustion turbines will not be warranted. The estimates in this document are based on limited engine testing and analysis. The engine testing was conducted at idle and other non-SoLoNOx mode load points. An actual start-up/shutdown event was not measured.

The start-up and shutdown estimates are most commonly used for potential to emit calculations to determine air permitting status. **Solar discourages customers from accepting the estimates in this document as permit limits, with or without source testing requirements.** Accurately measuring emissions during a – non-steady state – start-up or shutdown event with steady state source test methods may prove to be very challenging. In the event customers take permit limits and accept compliance testing permit conditions, Solar recommends adding significant margin to the estimates in this document.

START-UP PROCESS

The duration of a nominal start-up is the same for a cold start, warm start, or hot start (e.g., a Solar Turbine is programmed to start-up in "x" minutes whether it's a cold, warm, or hot start).

The start-up and shutdown time for a Solar turbine in a simple-cycle or combine heat and power application is the same. Heat recovery steam generator (HRSG) steam pressure is usually 250 psig or less. At 250 psig or less, thermal stress within the HRSG is minimized and, therefore, firing ramp-up/ramp-down is not limited. However, some combined heat and power plant applications will desire or dictate longer start-up/shutdown times due to external requirements.

The start-up sequence and attaining SoLoNOx combustion mode takes three steps:

1. Purge-crank
2. Ignition and acceleration to idle
3. Loading/thermal stabilization

¹Start-up and shutdown emissions for the Mercury™50 engine are found in PIL 205

During the “purge-crank” step, rotation of the turbine shaft is accomplished with a starter motor to remove any residual fuel gas in the engine flow path and exhaust. During “ignition and acceleration to idle,” fuel is introduced into the combustor and ignited in a diffusion flame mode and the engine rotor is accelerated to idle speed.

The third step consists of applying up to 50% load² while allowing the combustion flame to transition and stabilize. Once 50% load is achieved, the turbine transitions to SoLoNOx combustion mode and the engine control system begins to maintain the combustion primary zone temperature and limit pilot fuel to achieve the targeted nitrogen oxides (NOx), carbon monoxide (CO), and unburned hydrocarbons (UHC) emission levels.

SHUTDOWN PROCESS

Normal, planned cool down/shutdown duration varies by engine model. Once the shutdown process starts the engine unloads and moves into a cooldown mode.

START-UP AND SHUTDOWN EMISSIONS ESTIMATES

Tables 1 through 5 summarize the estimated pounds of emissions per start-up and shutdown event for SoLoNOx products. The mass emissions estimates are calculated using exhaust characteristics at ISO conditions in conjunction with ppm emissions estimates at various load points. The estimates in Tables 1 and 2 are representative of new production units ordered from 2006 up until the implementation of Enhanced Emissions Control (EEC). Tables 3 and 4 summarize emissions estimates for turbine models and ratings equipped with EEC. Enhanced Emission Control is a control regime that will result in lower CO and UHC values at lower loads thus reducing the estimated emissions per start-up and shutdown sequence. The Titan™ 250 and the Titan 130 23001/23502 (and 22401/22402) ratings have always been equipped with EEC. As testing is completed and other models/ratings are qualified and able to be equipped with the updated controls PIL170 will be updated. Reference PIL 220, specifically pages 7 and 8, for additional information about Enhanced Emission Control. Table 5 summarizes start-up and shutdown emissions estimates for liquid fuel applications.

Please contact Solar Environmental Programs, Leslie Witherspoon (858.694.6609) or Anthony Pocengal (858.505.8554) for support.

COMMISSIONING EMISSIONS

Commissioning generally takes place over a two-week period. Static testing, where no combustion occurs, usually requires one week and no emissions are expected. Dynamic testing, where combustion will occur, typically includes a number of engine start and shutdown cycles and a variety of loads will be placed on the system. It is impossible to predict how long the turbine will run and in what combustion/emissions mode it will be running. The dynamic testing period is generally followed by one to two days of final commissioning during which the turbine is running at various loads.

²40% load for the Titan 250 Engine on natural gas. 65% load for all engines on liquid fuel (except 80% load for the Centaur™ 40).

Table 2: Estimation of Start-up and Shutdown Emissions (lbs/event) for SoLoNOx CS/MD Applications
Nominal Start-up and Shutdown, Natural Gas Fuel
Production Units from 2006 and without Enhanced Emissions Control
Emissions estimates will NOT be warranted.

Engine	Total Emissions Per Start (lbs)					Total Emissions Per Shutdown (lbs)				
	NOx	CO	UHC	VOC	CO2	NOx	CO	UHC	VOC	CO2
Centaur 40 4702S	1	21	17	3	188	1	19	18	4	194
Centaur 50 6102S	1	21	17	3	184	1	20	19	4	169
Taurus 60 7802S	1	22	17	3	180	1	20	18	4	161
Taurus 70 10802S	1	88	88	18	381	1	78	83	17	295
Mars 90 13000S CS/MD	1	45	20	4	437	1	56	28	6	590
Mars 100 15000S/16000S CS/MD	1	46	20	4	385	1	58	28	6	490
Titan 130 20502S	1	55	37	7	662	1	61	43	9	751

Assumes ISO conditions: 59°F, 60% RH, sea level, no losses.

Assumes unit is operating at >50% load prior to shutdown.

Assumes natural gas fuel; ES 9-98 (Fuel Air and Water or Steam for Solar Gas Turbine Engines) compliant.

Table 4: Estimation of Start-up and Shutdown Emissions (lbs/event) for SoLoNOx CS/MD Applications

Nominal Start-up and Shutdown, Natural Gas Fuel

Production Units with Enhanced Emissions Control

Emissions estimates will NOT be warranted.

Engine	Total Emissions Per Start (lbs)					Total Emissions Per Shutdown (lbs)				
	NOx	CO	UHC	VOC	CO2	NOx	CO	UHC	VOC	CO2
Taurus 60 7802S (Post 9/2020 Orders)	1	6	5	1	247	1	7	6	1	235
Taurus 70 10802S (Post 2/2018 Orders)	1	20	28	6	381	1	19	27	5	295
Mars 90 13000S CS/MD (Post 9/2020 Orders)	1	17	12	2	437	1	24	18	4	564
Mars 100 15000S CS/MD (Post 9/2020 Orders)	1	20	13	3	474	1	30	18	4	612
Mars 100 16000S CS/MD (Post 8/2017 Orders)	1	19	13	3	496	1	28	19	4	642
Titan 130 20502S (Post 9/2020 Orders)	1	11	6	1	682	1	14	8	2	762
Titan 130 22402S (All Units)	1	13	15	3	690	1	15	17	3	775
Titan 130 23502S (All Units)	1	17	19	4	767	1	20	23	5	869
Titan 250 30000S CS/MD (All Units)	2	33	13	3	1172	2	28	11	2	1036
Titan 250 31900S CS/MD (All Units)	1	21	8	2	987	1	18	7	1	880

Assumes ISO conditions: 59°F, 60% RH, sea level, no losses.

Assumes unit is operating at >50% load prior to shutdown.

Assumes natural gas fuel; ES 9-98 (Fuel Air and Water or Steam for Solar Gas Turbine Engines) compliant.

Emissions from Centrifugal Compressor Dry Gas Seal System

Anthony Pocengal and Sean Garceau

PURPOSE

This product information letter (PIL) provides estimates of methane emitted from the dry gas seal systems installed in Solar® centrifugal gas compressors.

INTRODUCTION

The standard design of dry seal systems includes characteristic ‘seal leakage’ which in most configurations results in methane emissions to the atmosphere from the primary seal vent. Figure 1 below shows a cutaway diagram of a typical compressor shaft and dry seal system showing some of the basic components. The primary seal uses a high-pressure seal gas to maintain the process gas within the gas compressor body. The seal gas is typically pressurized process gas, i.e. methane for a typical natural gas compression station, and since the seal gas pressure is slightly higher than the suction and discharge pressures, most of the seal gas is returned to the compression process thru the labyrinth seal passage. A portion of the seal gas leaks across the primary seal face per design and is emitted through the primary vent to atmosphere. The volume of methane emitted from the seal vent is directly proportional to the operating suction pressure of the gas compressor.

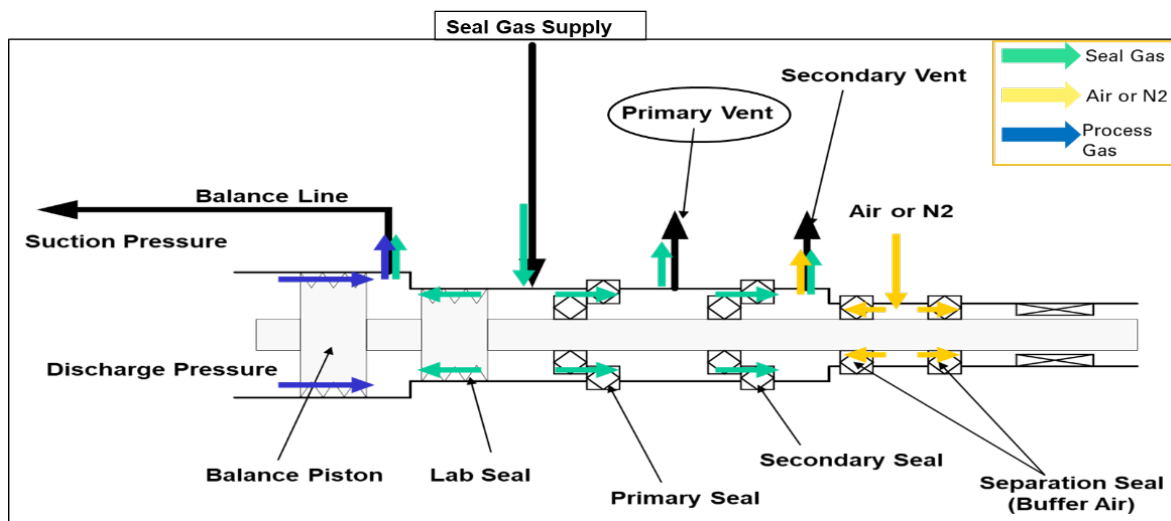


Figure 1: Centrifugal Compressor Dry Gas Seal System – Basic Components

Solar offers a dry seal emissions recompression system which captures the emissions from the primary vent and allows routing of these emissions back into the compression process or for another beneficial use onsite. Solar PIL 279 has further information on this application which virtually eliminates methane emissions from the dry seal system.

DRY GAS SEAL EMISSIONS DATA

The figures below may be used to estimate dry gas seal emissions ('seal leakage') emitted through the primary vent based on the compressor suction pressure (P1). The charts show the maximum expected leakage rates per each compressor. Actual emissions are expected to be lower.

For further technical information on Dry Gas Seal systems refer to PIL 140 Dry Gas Face Seals for Solar Gas Compressors.

Note regarding PIL 140: The maximum dynamic leakage rates from PIL 140 Table 1a are the highest possible guaranteed flow rates and are based on maximum allowable speed and pressure and should not be utilized for emission inventories or expected emissions from Solar compressors.

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The charts shown below provide estimates for the seal leakage from the two primary dry gas seals on Solar gas compressors. The dry gas seal leakage flow is a function of the compressor suction pressure. The charts show seal gas vented flow (scfm) vs compressor suction pressure (psig)

Solar Turbines Inc.
Compressor Model: C505J
Total Gas Seal Gas Vented
SG: 0.59701 - Gas K: 1.2799 - Gas Temperature: 120° F
Results based on the maximum dry gas seal dynamic leakage flow seal
Solar Turbines Incorporated

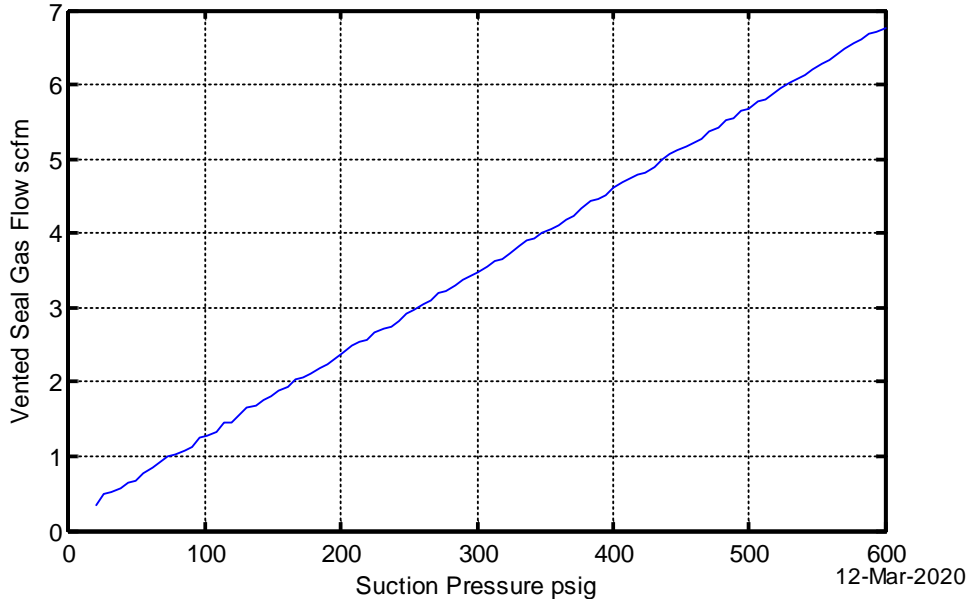


Figure 10: C505J

Solar Turbines Inc.
Compressor Model: C505U
Total Gas Seal Gas Vented
SG: 0.59701 - Gas K: 1.2799 - Gas Temperature: 120° F
Results based on the maximum dry gas seal dynamic leakage flow seal
Solar Turbines Incorporated

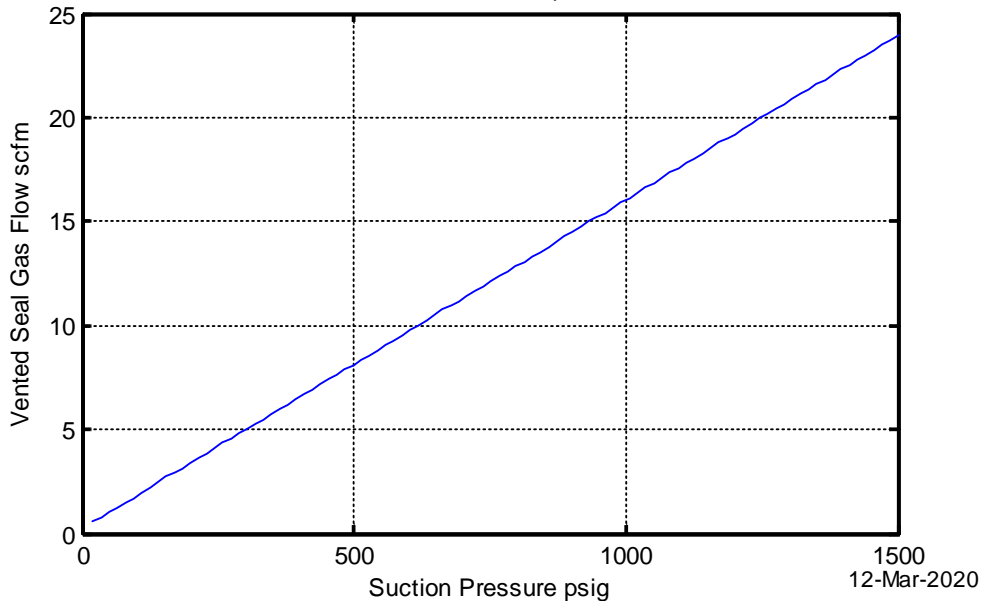


Figure 11: C505 U



APPENDIX E2 MANUFACTURER SPECIFICATIONS

E2A: Solar Mars 100 Engine Performance Specifications

E2B: Cummins QSK60G Engine Performance Specifications

E2C: Catalytic Heater Performance Specifications

SOLAR TURBINES INCORPORATED
ENGINE PERFORMANCE CODE REV. 4.20.2.28.14
JOB ID:

DATE RUN: 9-Aug-24
RUN BY: David Anthony Pocengal

--- SUMMARY OF ENGINE EXHAUST ANALYSIS ---
POINT NUMBER 1

HP=17549, %Full Load=100.0, Elev= 35ft, %RH= 60.0, Temperature= 0.0F

GENERAL INPUT SPECIFICATIONS

ENGINE FUEL: CHOICE GAS
29.89 in Hg AMBIENT PRESSURE
60.0 percent RELATIVE HUMIDITY
0.0006 --- SP. HUMIDITY (LBM H2O/LBM DRY AIR)

FUEL GAS COMPOSITION (VOLUME PERCENT)
LHV (Btu/Scf) = 988.1 SG = 0.6149 W.I. @60F (Btu/Scf) = 1260.1
Gas Fuel Suitability (GFS)# 101908

Methane (CH4)	=	90.3787
Ethane (C2H6)	=	7.0371
Propane (C3H8)	=	1.5380
I-Butane (C4H10)	=	0.1993
N-Butane (C4H10)	=	0.2195
I-Pentane (C5H12)	=	0.0371
N-Pentane (C5H12)	=	0.0267
Hexane (C6H14)	=	0.0281
Heptane (C7H16)	=	0.0069
Octane (C8H18)	=	0.0032
Carbon Dioxide (CO2)	=	0.2864
Nitrogen (N2)	=	0.2389
Sulfur Dioxide (SO2)	=	0.0001

STANDARD CONDITIONS FOR GAS VOLUMES: Temperature: 60 deg F Pressure: 29.92 in Hg
NORMAL CONDITIONS FOR GAS VOLUMES: Temperature: 32 deg F Pressure: 29.92 in Hg

Solar's turbines are capable of operating over a wide range of fuel blends, however Engineering review is required when methane drops below 80% or other constituents exceed standard boundaries. Performance as modeled here should be accurate, but note that alterations to the combustion and package systems may be necessary.

GENERAL OUTPUT DATA

6152.	lbm/hr	FUEL FLOW
2184.62	Scfm	FUEL FLOW
21053.	Btu/lbm	LOWER HEATING VALUE
988.	Btu/Scf	LOWER HEATING VALUE
81005.	Scfm	EXHAUST FLOW @ 14.7 PSIA & 60F
206758.	Acfm	ACTUAL EXHAUST FLOW CFm
366331.	lbm/hr	EXHAUST GAS FLOW
4649.9	deg R	ADIA STOICH FLAME TEMP, CHOICE GAS
4638.0	deg R	ADIA STOICH FLAME TEMP, SDNG
28.61	---	MOLECULAR WEIGHT OF EXHAUST GAS
58.70	---	AIR/FUEL RATIO

EXHAUST GAS ANALYSIS

ARGON	CO2	H2O	N2	O2
-------	-----	-----	----	----

0.91	3.03	5.76	75.80	14.51	VOLUME PERCENT WET
0.96	3.22	0.00	80.43	15.39	VOLUME PERCENT DRY
4637.	17081.	13280.	271888.	59437.	lbm/hr
0.75	2.78	2.16	44.20	9.66	g/(g FUEL)

SOLAR TURBINES INCORPORATED
ENGINE PERFORMANCE CODE REV. 4.20.2.28.14
JOB ID:

DATE RUN: 9-Aug-24
RUN BY: David Anthony Pocengal

--- SUMMARY OF ENGINE EXHAUST ANALYSIS ---
POINT NUMBER 2

HP=17013, %Full Load=100.0, Elev= 35ft, %RH= 60.0, Temperature= 20.0F

GENERAL INPUT SPECIFICATIONS

ENGINE FUEL: CHOICE GAS
29.89 in Hg AMBIENT PRESSURE
60.0 percent RELATIVE HUMIDITY
0.0014 --- SP. HUMIDITY (LBM H2O/LBM DRY AIR)

FUEL GAS COMPOSITION (VOLUME PERCENT)
LHV (Btu/Scf) = 988.1 SG = 0.6149 W.I. @60F (Btu/Scf) = 1260.1
Gas Fuel Suitability (GFS)# 101908

Methane (CH4)	= 90.3787
Ethane (C2H6)	= 7.0371
Propane (C3H8)	= 1.5380
I-Butane (C4H10)	= 0.1993
N-Butane (C4H10)	= 0.2195
I-Pentane (C5H12)	= 0.0371
N-Pentane (C5H12)	= 0.0267
Hexane (C6H14)	= 0.0281
Heptane (C7H16)	= 0.0069
Octane (C8H18)	= 0.0032
Carbon Dioxide (CO2)	= 0.2864
Nitrogen (N2)	= 0.2389
Sulfur Dioxide (SO2)	= 0.0001

STANDARD CONDITIONS FOR GAS VOLUMES: Temperature: 60 deg F Pressure: 29.92 in Hg
NORMAL CONDITIONS FOR GAS VOLUMES: Temperature: 32 deg F Pressure: 29.92 in Hg

Solar's turbines are capable of operating over a wide range of fuel blends, however Engineering review is required when methane drops below 80% or other constituents exceed standard boundaries. Performance as modeled here should be accurate, but note that alterations to the combustion and package systems may be necessary.

GENERAL OUTPUT DATA

5964.	lbm/hr	FUEL FLOW
2117.84	Scfm	FUEL FLOW
21053.	Btu/lbm	LOWER HEATING VALUE
988.	Btu/Scf	LOWER HEATING VALUE
79058.	Scfm	EXHAUST FLOW @ 14.7 PSIA & 60F
203818.	Acfm	ACTUAL EXHAUST FLOW CFm
357385.	lbm/hr	EXHAUST GAS FLOW
4664.4	deg R	ADIA STOICH FLAME TEMP, CHOICE GAS
4652.4	deg R	ADIA STOICH FLAME TEMP, SDNG
28.60	---	MOLECULAR WEIGHT OF EXHAUST GAS
59.08	---	AIR/FUEL RATIO

EXHAUST GAS ANALYSIS

ARGON	CO2	H2O	N2	O2
-------	-----	-----	----	----

0.91	3.01	5.84	75.71	14.53	VOLUME PERCENT WET
0.96	3.20	0.00	80.41	15.43	VOLUME PERCENT DRY
4521.	16547.	13153.	265063.	58094.	lbm/hr
0.76	2.77	2.21	44.45	9.74	g/(g FUEL)

SOLAR TURBINES INCORPORATED
ENGINE PERFORMANCE CODE REV. 4.20.2.28.14
JOB ID:

DATE RUN: 9-Aug-24
RUN BY: David Anthony Pocengal

--- SUMMARY OF ENGINE EXHAUST ANALYSIS ---
POINT NUMBER 3

HP=16315, %Full Load=100.0, Elev= 35ft, %RH= 60.0, Temperature= 40.0F

GENERAL INPUT SPECIFICATIONS

ENGINE FUEL: CHOICE GAS
29.89 in Hg AMBIENT PRESSURE
60.0 percent RELATIVE HUMIDITY
0.0031 --- SP. HUMIDITY (LBM H2O/LBM DRY AIR)

FUEL GAS COMPOSITION (VOLUME PERCENT)
LHV (Btu/Scf) = 988.1 SG = 0.6149 W.I. @60F (Btu/Scf) = 1260.1
Gas Fuel Suitability (GFS)# 101908

Methane (CH4)	= 90.3787
Ethane (C2H6)	= 7.0371
Propane (C3H8)	= 1.5380
I-Butane (C4H10)	= 0.1993
N-Butane (C4H10)	= 0.2195
I-Pentane (C5H12)	= 0.0371
N-Pentane (C5H12)	= 0.0267
Hexane (C6H14)	= 0.0281
Heptane (C7H16)	= 0.0069
Octane (C8H18)	= 0.0032
Carbon Dioxide (CO2)	= 0.2864
Nitrogen (N2)	= 0.2389
Sulfur Dioxide (SO2)	= 0.0001

STANDARD CONDITIONS FOR GAS VOLUMES: Temperature: 60 deg F Pressure: 29.92 in Hg
NORMAL CONDITIONS FOR GAS VOLUMES: Temperature: 32 deg F Pressure: 29.92 in Hg

Solar's turbines are capable of operating over a wide range of fuel blends, however Engineering review is required when methane drops below 80% or other constituents exceed standard boundaries. Performance as modeled here should be accurate, but note that alterations to the combustion and package systems may be necessary.

GENERAL OUTPUT DATA

5748.	lbm/hr	FUEL FLOW
2041.42	Scfm	FUEL FLOW
21053.	Btu/lbm	LOWER HEATING VALUE
988.	Btu/Scf	LOWER HEATING VALUE
76713.	Scfm	EXHAUST FLOW @ 14.7 PSIA & 60F
199869.	Acfm	ACTUAL EXHAUST FLOW CFm
346458.	lbm/hr	EXHAUST GAS FLOW
4678.2	deg R	ADIA STOICH FLAME TEMP, CHOICE GAS
4666.2	deg R	ADIA STOICH FLAME TEMP, SDNG
28.57	---	MOLECULAR WEIGHT OF EXHAUST GAS
59.42	---	AIR/FUEL RATIO

EXHAUST GAS ANALYSIS

ARGON	CO2	H2O	N2	O2
-------	-----	-----	----	----

0.90	2.98	6.07	75.52	14.52	VOLUME PERCENT WET
0.96	3.18	0.00	80.40	15.46	VOLUME PERCENT DRY
4376.	15923.	13256.	256541.	56355.	lbm/hr
0.76	2.77	2.31	44.63	9.80	g/(g FUEL)

SOLAR TURBINES INCORPORATED
ENGINE PERFORMANCE CODE REV. 4.20.2.28.14
JOB ID:

DATE RUN: 9-Aug-24
RUN BY: David Anthony Pocengal

--- SUMMARY OF ENGINE EXHAUST ANALYSIS ---
POINT NUMBER 4

HP=15419, %Full Load=100.0, Elev= 35ft, %RH= 60.0, Temperature= 60.0F

GENERAL INPUT SPECIFICATIONS

ENGINE FUEL: CHOICE GAS
29.89 in Hg AMBIENT PRESSURE
60.0 percent RELATIVE HUMIDITY
0.0067 --- SP. HUMIDITY (LBM H2O/LBM DRY AIR)

FUEL GAS COMPOSITION (VOLUME PERCENT)
LHV (Btu/Scf) = 988.1 SG = 0.6149 W.I. @60F (Btu/Scf) = 1260.1
Gas Fuel Suitability (GFS)# 101908

Methane (CH4)	= 90.3787
Ethane (C2H6)	= 7.0371
Propane (C3H8)	= 1.5380
I-Butane (C4H10)	= 0.1993
N-Butane (C4H10)	= 0.2195
I-Pentane (C5H12)	= 0.0371
N-Pentane (C5H12)	= 0.0267
Hexane (C6H14)	= 0.0281
Heptane (C7H16)	= 0.0069
Octane (C8H18)	= 0.0032
Carbon Dioxide (CO2)	= 0.2864
Nitrogen (N2)	= 0.2389
Sulfur Dioxide (SO2)	= 0.0001

STANDARD CONDITIONS FOR GAS VOLUMES: Temperature: 60 deg F Pressure: 29.92 in Hg
NORMAL CONDITIONS FOR GAS VOLUMES: Temperature: 32 deg F Pressure: 29.92 in Hg

Solar's turbines are capable of operating over a wide range of fuel blends, however Engineering review is required when methane drops below 80% or other constituents exceed standard boundaries. Performance as modeled here should be accurate, but note that alterations to the combustion and package systems may be necessary.

GENERAL OUTPUT DATA

5502.	lbm/hr	FUEL FLOW
1953.81	Scfm	FUEL FLOW
21053.	Btu/lbm	LOWER HEATING VALUE
988.	Btu/Scf	LOWER HEATING VALUE
73826.	Scfm	EXHAUST FLOW @ 14.7 PSIA & 60F
194701.	Acfm	ACTUAL EXHAUST FLOW CFm
332765.	lbm/hr	EXHAUST GAS FLOW
4691.5	deg R	ADIA STOICH FLAME TEMP, CHOICE GAS
4679.4	deg R	ADIA STOICH FLAME TEMP, SDNG
28.51	---	MOLECULAR WEIGHT OF EXHAUST GAS
59.64	---	AIR/FUEL RATIO

EXHAUST GAS ANALYSIS

ARGON	CO2	H2O	N2	O2
-------	-----	-----	----	----

0.90	2.96	6.56	75.12	14.47	VOLUME PERCENT WET
0.96	3.16	0.00	80.39	15.48	VOLUME PERCENT DRY
4189.	15188.	13789.	245571.	54022.	lbm/hr
0.76	2.76	2.51	44.63	9.82	g/(g FUEL)

SOLAR TURBINES INCORPORATED
ENGINE PERFORMANCE CODE REV. 4.20.2.28.14
JOB ID:

DATE RUN: 9-Aug-24
RUN BY: David Anthony Pocengal

--- SUMMARY OF ENGINE EXHAUST ANALYSIS ---
POINT NUMBER 5

HP=14323, %Full Load=100.0, Elev= 35ft, %RH= 60.0, Temperature= 80.0F

GENERAL INPUT SPECIFICATIONS

ENGINE FUEL: CHOICE GAS
29.89 in Hg AMBIENT PRESSURE
60.0 percent RELATIVE HUMIDITY
0.0133 --- SP. HUMIDITY (LBM H2O/LBM DRY AIR)

FUEL GAS COMPOSITION (VOLUME PERCENT)
LHV (Btu/Scf) = 988.1 SG = 0.6149 W.I. @60F (Btu/Scf) = 1260.1
Gas Fuel Suitability (GFS)# 101908

Methane (CH4)	=	90.3787
Ethane (C2H6)	=	7.0371
Propane (C3H8)	=	1.5380
I-Butane (C4H10)	=	0.1993
N-Butane (C4H10)	=	0.2195
I-Pentane (C5H12)	=	0.0371
N-Pentane (C5H12)	=	0.0267
Hexane (C6H14)	=	0.0281
Heptane (C7H16)	=	0.0069
Octane (C8H18)	=	0.0032
Carbon Dioxide (CO2)	=	0.2864
Nitrogen (N2)	=	0.2389
Sulfur Dioxide (SO2)	=	0.0001

STANDARD CONDITIONS FOR GAS VOLUMES: Temperature: 60 deg F Pressure: 29.92 in Hg
NORMAL CONDITIONS FOR GAS VOLUMES: Temperature: 32 deg F Pressure: 29.92 in Hg

Solar's turbines are capable of operating over a wide range of fuel blends, however Engineering review is required when methane drops below 80% or other constituents exceed standard boundaries. Performance as modeled here should be accurate, but note that alterations to the combustion and package systems may be necessary.

GENERAL OUTPUT DATA

5220.	lbm/hr	FUEL FLOW
1853.72	Scfm	FUEL FLOW
21053.	Btu/lbm	LOWER HEATING VALUE
988.	Btu/Scf	LOWER HEATING VALUE
70538.	Scfm	EXHAUST FLOW @ 14.7 PSIA & 60F
188216.	Acfm	ACTUAL EXHAUST FLOW CFm
316766.	lbm/hr	EXHAUST GAS FLOW
4702.6	deg R	ADIA STOICH FLAME TEMP, CHOICE GAS
4690.5	deg R	ADIA STOICH FLAME TEMP, SDNG
28.41	---	MOLECULAR WEIGHT OF EXHAUST GAS
59.84	---	AIR/FUEL RATIO

EXHAUST GAS ANALYSIS

ARGON	CO2	H2O	N2	O2
-------	-----	-----	----	----

0.89	2.92	7.49	74.36	14.34	VOLUME PERCENT WET
0.96	3.15	0.00	80.38	15.50	VOLUME PERCENT DRY
3962.	14317.	15048.	232269.	51163.	lbm/hr
0.76	2.74	2.88	44.50	9.80	g/(g FUEL)

SOLAR TURBINES INCORPORATED
 ENGINE PERFORMANCE CODE REV. 4.20.2.28.14
 JOB ID:

DATE RUN: 9-Aug-24
 RUN BY: David Anthony Pocengal

MARS 100-16000S
 CS/MD
 STANDARD
 GAS
 TMG-2S REV. 1.0

DATA FOR NOMINAL PERFORMANCE

Fuel Type	CHOICE GAS					
Elevation	feet	35				
Inlet Loss	in H2O	4.0				
Exhaust Loss	in H2O	4.0				
Accessory on GP Shaft	HP	27.8				
Engine Inlet Temp.	deg F	0	20.0	40.0	60.0	80.0
Relative Humidity	%	60.0	60.0	60.0	60.0	60.0
Elevation Loss	HP	22	21	20	19	18
Inlet Loss	HP	271	264	256	245	232
Exhaust Loss	HP	102	101	99	97	94
Driven Equipment Speed	RPM	9390	9316	9208	9051	8852
Optimum Equipment Speed	RPM	9390	9316	9208	9051	8852
Gas Generator Speed	RPM	11168	11168	11168	11154	11152
Specified Load	HP	FULL	FULL	FULL	FULL	FULL
Net Output Power	HP	17549	17013	16315	15419	14323
Fuel Flow	mmBtu/hr	129.51	125.56	121.03	115.83	109.90
Heat Rate	Btu/HP-hr	7380	7380	7418	7512	7673
Therm Eff	%	34.476	34.478	34.302	33.870	33.161
Inlet Air Flow	lbm/hr	361118	352337	341598	328117	312358
Engine Exhaust Flow	lbm/hr	366331	357385	346458	332765	316766
PCD	psiG	264.1	258.0	250.2	240.4	228.7
Compensated PTIT	deg F	1335	1344	1353	1360	1360
PT Exit Temperature	deg F	865	878	893	909	925
Exhaust Temperature	deg F	865	878	893	909	925

FUEL GAS COMPOSITION (VOLUME PERCENT)

LHV (Btu/Scf) = 988.1 SG = 0.6149 W.I. @60F (Btu/Scf) = 1260.1
 Gas Fuel Suitability (GFS)# 101908

Methane (CH4)	= 90.3787
Ethane (C2H6)	= 7.0371
Propane (C3H8)	= 1.5380
I-Butane (C4H10)	= 0.1993
N-Butane (C4H10)	= 0.2195
I-Pentane (C5H12)	= 0.0371
N-Pentane (C5H12)	= 0.0267
Hexane (C6H14)	= 0.0281
Heptane (C7H16)	= 0.0069
Octane (C8H18)	= 0.0032
Carbon Dioxide (CO2)	= 0.2864
Nitrogen (N2)	= 0.2389

Sulfur Dioxide (SO₂) = 0.0001

STANDARD CONDITIONS FOR GAS VOLUMES: Temperature: 60 deg F Pressure: 29.92 in Hg
NORMAL CONDITIONS FOR GAS VOLUMES: Temperature: 32 deg F Pressure: 29.92 in Hg

Solar's turbines are capable of operating over a wide range of fuel blends, however Engineering review is required when methane drops below 80% or other constituents exceed standard boundaries. Performance as modeled here should be accurate, but note that alterations to the combustion and package systems may be necessary.

This performance was calculated with a basic inlet and exhaust system. Special equipment such as low noise silencers, special filters, heat recovery systems or cooling devices will affect engine performance. Performance shown is "Expected" performance at the pressure drops stated, not guaranteed.



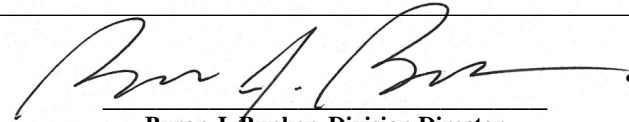
**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
2025 MODEL YEAR
CERTIFICATE OF CONFORMITY
WITH THE CLEAN AIR ACT**

**OFFICE OF TRANSPORTATION
AND AIR QUALITY
ANN ARBOR, MICHIGAN 48105**

Certificate Issued To: Cummins Inc.
(U.S. Manufacturer or Importer)
Certificate Number: SCEXB60.0AAB-011

Effective Date:
12/08/2024

Expiration Date:
12/31/2025


Byron J. Bunker, Division Director
Compliance Division

Issue Date:
12/08/2024

Revision Date:
N/A

Manufacturer: Cummins Inc.
Engine Family: SCEXB60.0AAB
Mobile/Stationary Certification Type: Mobile and Stationary
Fuel : Natural Gas (CNG/LNG)
Emission Standards :
Mobile Part 1048
CO (g/kW-hr) : 4.4
NMHC + NOx (g/kW-hr) : 2.7
Part 60 Subpart JJJJ Table 1
CO (g/Hp-hr) : 2.0
NOx (g/Hp-hr) : 1.0
VOC (g/Hp-hr) : 0.7
Emergency Use Only : N

Pursuant to Section 213 of the Clean Air Act (42 U.S.C. section 7547) and 40 CFR Part 1048, 40 CFR Part 60, 1065, 1068, and 60 (stationary only and combined stationary and mobile) and subject to the terms and conditions prescribed in those provisions, this certificate of conformity is hereby issued with respect to the test engines which have been found to conform to applicable requirements and which represent the following nonroad engines, by engine family, more fully described in the documentation required by 40 CFR Part 1048, 40 CFR Part 60 and produced in the stated model year.

This certificate of conformity covers only those new nonroad spark-ignition engines which conform in all material respects to the design specifications that applied to those engines described in the documentation required by 40 CFR Part 1048, 40 CFR Part 60 and which are produced during the model year stated on this certificate of the said manufacturer, as defined in 40 CFR Part 1048, 40 CFR Part 60. This certificate of conformity does not cover nonroad engines imported prior to the effective date of the certificate.

It is a term of this certificate that the manufacturer shall consent to all inspections described in 40 CFR 1068.20 and authorized in a warrant or court order. Failure to comply with the requirements of such a warrant or court order may lead to revocation or suspension of this certificate for reasons specified in 40 CFR Part 1048, 40 CFR Part 60. It is also a term of this certificate that this certificate may be revoked or suspended or rendered void *ab initio* for other reasons specified in 40 CFR Part 1048, 40 CFR Part 60.

This certificate does not cover large nonroad engines sold, offered for sale, or introduced, or delivered for introduction, into commerce in the U.S. prior to the effective date of the certificate.



Exhaust emission data sheet C1300N6 60 Hz spark-ignited generator set (GenSet)

Natural gas exhaust emissions data @ 1800 rpm

Exhaust component		50% load		75% load		Full load	
		g/hp-hr	ppm	g/hp-hr	ppm	g/hp-hr	ppm
Oxides of nitrogen (as NO _x , DRY)	NO _x	1.0	150	1.0	155	1.0	158
Total hydrocarbons (WET)	THC	1.0	3.7	3.8	1484	3.4	1357
Carbon Monoxide (DRY)	CO	N/A	N/A	1.7	405	1.6	406

Engine information:

Model:	Cummins QSK60G	Bore:	6.25 in. (159 mm)
Emission certification:	EPA-certified for stationary emergency and non-emergency applications	Stroke:	7.48 in. (190 mm)
Aspiration:	Turbocharged and coolant-air aftercooled	Displacement:	3672 in ³ (60 L)
		Cylinders:	16
		Combustion:	Advanced lean burn
		Compression ratio:	11.4:1

Test conditions

Steady-state emissions recorded per ISO 8178-1 during operation at rated engine speed (+/- 2%) and stated constant load (+/- 2%) with engine temperatures, pressures, and emission rates stabilized.

Fuel specifications:	Dry processed natural gas fuel with 905 BTU per standard cubic foot lower heating value. The percentage of NMHCs found in exhaust emissions are typically 2-3 times the percentage of NMHCs found in fuel. If there is no NMHC in the fuel, NMHC and VOC emissions in exhaust will be insignificant.
Air inlet temperature:	77 °F (25 °C)
Barometric pressure:	29.39 in. Hg (99.5 kPa) at 500 ft. (152 m) altitude
Relative humidity:	30%
Emissions data tolerance:	NO _x : +/-10%, HC: +/-15%, CO: +/-10%

The NO_x, HC, CO and particulate matter (PM) emissions data tabulated here are representative of test data taken from a single engine under the test conditions shown above. These data are subjected to instrumentation and engine-to-engine variability. Field emission test data are not guaranteed to these levels. Actual field test results may vary due to engine tuning, test site conditions, installation, fuel specification, test procedures, and instrumentation. Engine operation with excessive air intake or exhaust restrictions beyond published maximum limits, or with improper maintenance, may result in elevated emissions levels.

Estimated Emissions based on scale up of 12-6-2010 Air Hygiene Study (Run 4)

Description	Units	IFS Proposed Heater
Model Number		S2472-2B053
Number of Heaters		1
Size of Heaters	inches	24 X 72
Area of Each Catalytic Heater	sq. ft.	12
Fuel Input Rating of Heater Addition	BTUH	72,000
Type of Fuel		Natural Gas
Estimated Fuel Caloric Value	BTU / SCF	1,020
Fuel Flow - Max	SCFH	70.59
Fuel Specific Gravity		0.60
Estimated Molecular Weight of Fuel (0.60 SG)	g/mole	17.37
Estimated Moles of Fuel @ standard conditions	Moles	89.271
Estimated Moles of Reaction Products	Moles	267.813
Estimated Duty Cycle of Heater	%	100
NOx Actual Reading	ppmvd	0.24
NOx Corrected to Air Free Reading	ppmvd	3.9188
NOx Weight - Estimated Actual Running	g/hr	0.0483
NOx Weight - Suggested Instantaneous Permitting Value	g/hr	0.0531
Annual NOx Weight - Running Estimate	lbs. / year	0.93
Annual NOx Weight - Recommended Minimum Permitted Weight Estimate	lbs. / year	1.03
SO ₂ Actual Reading	ppmvd	0.14
SO ₂ Corrected to Air Free Reading	ppmvd	2.29
SO ₂ Weight - Estimated Actual Running	g/hr	0.04
SO ₂ Weight - Suggested Instantaneous Permitting Value	g/hr	0.04
Annual SO ₂ Weight - Running Estimate	tons / year	0.000
Annual SO ₂ Weight - Recommended Minimum Permitted Weight Estimate	tons / year	0.000
THC Actual Reading	ppmvd	697.13
THC Corrected to Air Free Reading	ppmvd	11382.83
THC Weight - Estimated Actual Running	g/hr	134.13
THC Weight - Suggested Instantaneous Permitting Value	g/hr	147.55
Annual THC Weight - Running Estimate	tons / year	1.295
Annual THC Weight - Recommended Minimum Permitted Weight Estimate #	tons / year	1.425
CH ₄ Actual Reading	ppmvd	681.58
CH ₄ Corrected to Air Free Reading	ppmvd	11128.92
CH ₄ Weight - Estimated Actual Running	g/hr	47.72
CH ₄ Weight - Suggested Instantaneous Permitting Value	g/hr	52.49
Annual CH ₄ Weight - Running Estimate	tons / year	0.461
Annual CH ₄ Weight - Recommended Minimum Permitted Weight Estimate #	tons / year	0.507
C ₂ H ₆ Actual Reading	ppmvd	13.34
C ₂ H ₆ Corrected to Air Free Reading	ppmvd	217.82
C ₂ H ₆ Weight - Estimated Actual Running	g/hr	1.05
C ₂ H ₆ Weight - Suggested Instantaneous Permitting Value	g/hr	1.16
Annual C ₂ H ₆ Weight - Running Estimate	tons / year	0.010
Annual C ₂ H ₆ Weight - Recommended Minimum Permitted Weight Estimate #	tons / year	0.011

Estimated Emissions based on scale up of 12-6-2010 Air Hygiene Study (Run 4)

VOC Actual Reading	ppmvd	2.21
VOC Corrected to Air Free Reading	ppmvd	36.09
VOC Weight - Estimated Actual Running	g/hr	0.15
VOC Weight - Suggested Instantaneous Permitting Value	g/hr	0.17
Annual VOC Weight - Running Estimate	tons / year	0.001
Annual VOC Weight - Recommended Minimum Permitted Weight Estimate #	tons / year	0.002
HCHO Actual Reading	ppmvd	0.21
HCHO Corrected to Air Free Reading	ppmvd	3.43
HCHO Weight - Estimated Actual Running	g/hr	0.03
HCHO Weight - Suggested Instantaneous Permitting Value	g/hr	0.03
Annual HCHO Weight - Running Estimate	tons / year	0.000
Annual HCHO Weight - Recommended Minimum Permitted Weight Estimate #	tons / year	0.000
C ₃ H ₈ Actual Reading	ppmvd	1.76
C ₃ H ₈ Corrected to Air Free Reading	ppmvd	28.74
C ₃ H ₈ Weight - Estimated Actual Running	g/hr	0.34
C ₃ H ₈ Weight - Suggested Instantaneous Permitting Value	g/hr	0.37
Annual C ₃ H ₈ Weight - Running Estimate	tons / year	0.003
Annual C ₃ H ₈ Weight - Recommended Minimum Permitted Weight Estimate #	tons / year	0.004
Residual VOC Component	ppmvd	0.240
CO Actual Reading	ppmvd	226.38
CO Corrected to Air Free Reading	ppmvd	3696.36
CO Weight - Estimated Actual Running	g/hr	27.73
CO Weight - Suggested Instantaneous Permitting Value	g/hr	30.50
Annual CO Weight - Running Estimate	tons / year	0.268
Annual CO Weight - Recommended Minimum Permitted Weight Estimate #	tons / year	0.295
Carbon Dioxide	%	0.780
Oxygen	%	19.6200

THC (Total Hydrocarbons) typically is defined as Methane (CH₄), Ethane (C₂H₆), and VOCs.

VOCs are typically defined as Formaldehydes (HCHO), heavier Hydrocarbons, primarily Propane (C₃H₈), and Ammonia (NH₄).

Many jurisdictions allow formaldehydes and propane to be excluded from VOC quantities.

They are listed separately here, so the component parts can be accounted for.

CO (Carbon Monoxide) is not a component of either the THC or VOC constituent numbers.

If required. VOCs resulting from combustion of Natural Gas are exempt in at least some jurisdictions.

SOx is typically not an issue with Natural Gas fuels.

Particulates are not generated by this process, so there are no PM-10 emissions.

ppmvd is parts per million by volume (dry)

ppmvw is parts per million by volume (wet)

Recommended permitted weight represents 110% of recorded 100% duty number. Owner can adjust, as he sees fit.

Numbers shown are from an actual test and do not form any sort of performance guarantee.

Actual test was conducted in a controlled indoor setting and may provide more variable results in a field setting.

Many values are small and variances in sampling or measurement can cause significant percentage changes in these results.



APPENDIX F DISPERSION MODELLING FILES

To be provided electronically.



APPENDIX G GAS COMPOSITION DATA

Gas Composition / Representative Inlet Gas Analysis

47% C6,
36% C7,
17% C8

	Relative Density	0.615737109
	Heating Value	1098.662903
N2	N2	0.238926482
C1	Methane	90.39613323
CO2	CO2	0.286436013
C2	Ethane	7.038414844
C3	Propane	1.538330352
IC4	ISO-Butane	0.199335937
NC4	N-Butane	0.219519104
IC5	ISO-Pentane	0.037075268
NC5	N-Pentane	0.026723719
C6+	Hexanes	0.019106418
C6	Hexane	0.008980017
C7	Heptane	0.006878311
C8	Octane	0.003248091
	SUM	100.0000014