

NORTHWEST NATURAL GAS COMPANY

**EVALUATION OF NEED FOR A SITE
CERTIFICATE AMENDMENT UNDER
OAR 345-027-0050(5)**

**PEARL PROJECT (PHASE 2)
NORTHWEST NATURAL GAS MIST
INTERSTATE STORAGE PROJECT**

**Proposed Modifications to the Mist Storage Facility to Increase the
Combined Total Mist Storage Peak-Day Delivery to 515 MMcfd, as
Anticipated and Approved in Site Certificate Amendment No. 9**

Submitted to the
Oregon Energy Facility Siting Council
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1.0 PROJECT DESCRIPTION

On September 30, 1981, the Energy Facility Siting Council (“EFSC” or the “Council”) issued a site certificate to the Oregon Natural Gas Development Corporation (“ONG”), a wholly owned subsidiary of Northwest Natural Gas Company (“NW Natural” and “certificate holder”), for an underground natural gas storage facility near Mist in Columbia County, Oregon. The “Energy Facility Site Certificate for the Northwest Natural Mist Underground Gas Storage Facility” application approved by the Site Certificate (the “Mist Storage Site Certificate” or “Site Certificate”) has been amended nine times since 1981, as more fully described below in Section 1.3.

In Mist Storage Site Certificate Amendment No. 9 (“Amendment No. 9”), approved on December 5, 2003, the Council authorized an increase of the permitted daily throughput from 317 MMcfd to 515 MMcfd. This involved the installation of new dehydration facilities, gas quality and monitoring equipment, and two new injection withdrawal wells connected with pipelines to the existing Calvin Creek facilities permitted in a prior amendment.

NW Natural’s recent plans to increase underground natural gas storage and delivery facilities are dubbed the “Pearl Project.” The purpose of the Pearl Project is to provide additional storage capacity and deliverability by further developing the existing underground storage resources at the Bruer Pool in the Bruer Flora Storage Area of the Mist Field. The Pearl Project is being implemented in two phases. “Phase 1” of the Pearl Project added two new injection withdrawal wells in Bruer Pool with the supporting wellsite appurtenances, approximately 2,000 feet of pipeline to connect the new wells to the existing system, and Bruer Meter Area enhancements for the additional flow from the new wells. An additional observation well was also drilled near the Bruer Pool.

After careful consideration and discussion with the Oregon Department of Energy (“ODOE”) and legal counsel, NW Natural concluded that a tenth amendment to the Site Certificate was not necessary to implement Phase 1 of the Pearl Project. On August 19, 2005, NW Natural submitted a written evaluation supporting NW Natural’s conclusion that under Oregon Administrative Rule (“OAR”) 345-027-0050(5),¹ an amendment to the Site Certificate was not needed under OAR 345-027-0060 for Phase 1 of the Pearl Project. In 2005, the Department approved NW Natural’s “Evaluation of Need for a Site Certificate Amendment under OAR 345-027-0050(5) for Pearl Project (Phase 1).”

NW Natural is now pursuing additional enhancements to further implement the Pearl Project and Amendment No. 9, dubbed “Pearl Phase 2,” or the “Project” herein. The Project area is located as shown on **Exhibit 1**. Similar to Phase 1, after thorough deliberation and dialogue with ODOE staff and legal counsel, the certificate holder has concluded that under the criteria of OAR 345-027-0050, a request for amendment to the Site Certificate is not necessary under OAR 345-027-0060 to implement Pearl Phase 2. The purpose of this document is to provide adequate

¹ On March 13, 1998, the Council approved a request to amend the storage site certificate by replacing the amendment provisions in the site certificate with requirements that future site certificate amendments be governed by the “duly adopted rules of the Energy Facility Siting Council for the amendment of site certificates.”

analysis and justification to support the certificate holder's conclusion. The certificate holder has completed an investigation sufficient to demonstrate that Pearl Phase 2 would comply with the applicable standards in OAR Chapter 345, divisions 22, 23 and 24. This document is the written evaluation describing that investigation.

1.1 Description of Proposed Facilities

The Project will (1) add two new well facilities in the Flora pool and one new well facility in a new reservoir (St. Helens Pool) within the Bruer Flora storage area so that additional storage capacity can be made available for use by interstate customers in the near term, pursuant to the FERC Section 284.224 certificate, and eventually to NW Natural's LDC customers as their needs grow;² (2) install additional pipelines; and (3) expand the existing Miller Station facilities to increase the combined total Mist storage peak-day compressed delivery to 515 MMcfd from the current maximum capability of 425 MMcfd with compressors. The additional pipelines and modifications to the Miller Station fall within the Council's jurisdiction under OAR 345-027-0050(1). However, the underground storage reservoir, as well as the injection, withdrawal and monitoring wells and the individual wellhead equipment, remains under the DOGAMI authority. ORS 469.300(9)(a)(H)(i)-(ii); see Or Laws 1993, ch 544, § 3. **Exhibit 2** shows the new well locations and the 12-inch pipeline location. **Exhibit 3** shows pipeline locations in relation to wildlife habitat.

The two new Flora Pool wells are utilizing existing well sites so the new wells will be connected to the existing facilities at the well site location. The St. Helens site is also using an existing well site but its connection to the existing pipelines will require a 200 foot pipeline connection. All of the facilities under Council jurisdiction are located within the existing site boundary.

As noted in the Pearl Phase 1 Evaluation of the Need for a Site Certificate Amendment, the Pearl upgrades are intended to further implement and enable the facilities approved by the Council in Amendment No. 9. The following table was submitted with the Phase 1 evaluation, and is provided again for convenience.

Table 1. Comparison of the Pearl Project Phase 1 Project to Amendment No. 9 Facilities:

PEARL PROJECT PHASE 1 FACILITIES	AMENDMENT NO. 9 FACILITIES
Gathering line connecting wells to Miller Station	Gathering lines connecting wells to Miller Station
Two injection/withdrawal wells	Two injection/withdrawal wells
Equipment modifications at Miller Station: <ul style="list-style-type: none"> • upgrade metering and flow control facilities at Bruer metering area; 	Equipment modifications at Miller Station: <ul style="list-style-type: none"> • gas dehydration train

² For the purposes of providing the Department with a complete picture of the Project, the well facilities and underground storage reservoirs are described. However, as noted above, DOGAMI has jurisdiction over the wells (and associated facilities) and underground reservoirs.

<ul style="list-style-type: none"> • upgrade communications to new Bruer Pool wells 	<ul style="list-style-type: none"> • new interconnect piping and valves • fuel gas piping • gas quality and monitoring equipment
No increase in daily throughput	Increase in daily throughput at Miller Station to 515 MMcfd
One observation/monitoring well	n/a
n/a	End vibration monitoring program

As noted in the Pearl Phase 1 evaluation, the information provided by the 1981 Site Certificate is now approximately twenty-six years old, and its usefulness as a reference document is limited for evaluating the need for another Site Certificate Amendment. However, Amendment No. 9 was approved on December 5, 2003 under the existing Council standards. As noted, the Pearl Project (Phases 1 and 2) further implements Amendment No. 9. Similar to NW Natural’s approach to Phase 1, Amendment No. 9 is an appropriate document to use in evaluating potential impacts from the Pearl Project, and is used as such in this investigation.

In essence, Amendment No. 9 allowed NW Natural to increase the existing Miller Station facility throughput so that an additional 108 MMcfd of storage capacity could be available to interstate customers under NW Natural’s FERC Section 284.224 certificate. That expansion increased the total permitted Mist storage peak-day delivery to 515 MMcfd from the previously permitted maximum of 317 MMcfd. This was accomplished by installing new dehydration facilities, gas quality and monitoring equipment, and two new injection withdrawal wells.

The reservoir development, addition of three wells, coupled with Miller Station improvements and pipeline expansion will provide the additional infrastructure to increase the compressed withdrawal capabilities from 425 MMcfd to 515 MMcfd, as approved in Amendment No. 9.

1.1.1 Miller Station Improvements.

The existing compressor capacity consists of one ISO-rated 7,800-BHP gas-turbine-driven compressor, one ISO-rated 5,500-BHP gas-turbine-driven compressor and two 1,350-BHP reciprocating compressors. The 7,800-BHP gas-turbine-driven compressor was installed in 2001 and the 5,500-BHP unit in 1998. Both units are equipped with low-emission burners and controls to minimize NOx emissions. The two reciprocating compressors have engines that utilize clean-burn technology, which also reduces NOx emissions.

Under current conditions, the 515 MMcfd peak-day rate as approved in Amendment No. 9 could only occur early in the withdrawal season under free flow conditions. The 425 MMcfd rate can currently be accomplished with the existing compressors under design day conditions. At this time, NW Natural proposes to increase the design day compressed rate to 515 MMcfd. To accomplish this, no new compression facilities are required. Rather, Miller Station improvements will include the replacement of an existing 6” pipeline with a 12” line that currently bisects the Miller Station property, additional valves and piping at the Miller Station

North Valve Manifold, and expanded metering and flow control capabilities in the Flora Pool gathering area.

The following major components are included as changes to the Flora Metering Area and Miller Station North Valve Manifold:

- Replace existing valves with larger valves
- Replace an existing 1300 foot, 6" pipeline that connects Flora Pool to Miller Station with a new 12" pipeline that begins at the North Valve Manifold and terminates in the Flora Metering Area
- Install a Bi-Directional Separator at the Flora Metering area where the new 12" line comes above grade
- Replace the existing 8" Ultrasonic Meter with a 10" meter to account for the additional flow from the three new wells
- Replace the existing Flow Control Valve with a larger valve to reduce the pressure drop in the Flora Metering Area
- The Miller Station North Valve Manifold will consist of new 8" and 12" valves. It will be installed to direct the flow of gas during withdrawal season and at high flow rates from a similar valve manifold to be located at the St. Helens well site into the existing 12" North Mist Feeder and to the new 12" line that begins at the Miller Station North Valve Manifold.

Under new operating conditions as proposed, the Miller Station withdrawal capacity will be 515 MMcfd. The operating model used to determine CO2 emissions utilizes only the existing compression and represents the most realistic use of these facilities during both the withdraw and injection cycles.

1.1.2 Reservoir Development Phase (DOGAMI Jurisdiction).

The Bruer/Flora storage area is located immediately west and north of NW Natural's Miller Station compressor plant near Mist, Oregon. The Flora Pool and St. Helens reservoirs are located within its boundaries, approximately one mile north of Miller Station. NW Natural plans to drill two horizontal injection withdrawal wells in to Flora Pool. This will increase the maximum flow rate from Flora Pool by 50 MMcfd. In addition, NW Natural will convert an existing shut in injection withdrawal well to an observation well for the Flora Pool.

The third injection withdrawal well will be directionally drilled into a pool located south of Flora Pool (St. Helens Pool). Interpretation of the seismic data indicates a new reservoir of sufficient size for underground storage development. Although the well is not within EFSC's jurisdiction, approximately 200 feet of pipeline connecting the new well to the existing facilities are under Council jurisdiction.

The following major components are included as additions to the new well sites:

- Above ground 6" and 8" valves
- Bi-directional horizontal separator capable of handling a flow rate of 25 MMcfd

- 300 gallon waste liquid storage tank
- 2000 gallon methanol storage tank
- Instrument and Control Building
- Radio/communications tower

At the St. Helens site, in addition to the above listed equipment, the following will be installed:

- Chromatograph – located inside Control Building
- Moisture Analyzer
- Flow Control Valve with Shelter

1.1.3 Pipeline System.

The existing pipeline system at Miller Station will be modified and expanded for the increased peak day compressed flow rate as proposed herein. The existing 6” pipeline within the Miller Station, connecting the 8” Flora Pool looped gathering system to the Flora Pool gathering area will be replaced with approximately 1,300 feet of 12” pipe. This will greatly reduce the pressure drop brought on by the additional flow from the new Flora Pool and St. Helens wells.

The Flora Pool wells will not require any new pipeline as the new wells will be drilled from existing well sites and connection to the existing pipeline system will only require connections to the existing pipeline at the well site location.

The St. Helens Pool well will connect to the existing Flora Pool pipeline system adjacent to the existing well site. Although the site is close to the existing pipeline infrastructure, it will require approximately 200 feet of new pipeline to make the connections. The new pipeline will require less than 100 feet of new construction right-of-way for two new 8” pipelines and tree removal will likely be required. As described below, all pipelines will be located within or adjacent to existing pipeline easements and ROWs, and will not require any expansion of project site boundaries.

1.1.4 Construction and Operation.

The construction improvements at Miller Station will take approximately two to three months and are scheduled to commence July 1, 2007. Construction impacts will be minimal in that the new equipment will either be added to existing structures or be installed immediately adjacent to existing facilities and will not expand the footprint of the station or the pipeline right-of-way corridors. The additional throughput and operation of the new equipment at Miller Station will not require any additional staff.

The 1,300-foot-long, 12-inch Miller Station pipeline will be placed in a 24-inch-wide trench, five to six feet deep. Construction will begin and end inside the station property.

(**Exhibit 2**). The 40-foot right-of-way (20 feet of permanent easement and 20 feet of temporary construction easement) will enter private property at the NW Natural property line with the Mainline Road. The pipeline will be installed in the road right-of-way, approximately five feet outboard from the existing bar ditch. The trench will be backfilled with select materials and compacted to landowner and NW Natural specifications. Topsoil will be placed back on top where appropriate. Where native materials are not acceptable for backfill, six inches of select granular bedding material will be placed around the pipe before backfill. Construction areas will be revegetated or rock will be applied after construction in a manner that will permit necessary maintenance of the pipeline during operation.

Construction of the Miller Station gathering line will take approximately two weeks and is scheduled to commence in August 2007. The road will be impassable and closed during a short time during the construction period (a maximum of one week). Local traffic or emergency response can be routed through the Miller Station compound or on other logging roads to avoid the closure. NW Natural will work with the local landowners to minimize these impacts.

Each of the two, 200-foot-long 8" pipelines connecting the St. Helens well to the Flora Pool pipeline system will be placed in a 20-inch-wide trench, five feet deep. The 40-foot right-of-way (or less) will begin at the edge of the existing well site and end after crossing the Mainline Road. The trench will be backfilled with select materials and compacted to landowner and NW Natural specifications. Topsoil will be placed back on top where appropriate. Where native materials are not acceptable for backfill, six inches of select granular bedding material will be placed around the pipe before backfill. Construction areas will be revegetated or rock will be applied after construction in a manner that will permit necessary maintenance of the pipeline during operation.

Pipeline (and well site) maintenance activities are minimal. Operators travel in pickup trucks and visit the well sites daily. The pipeline routes will be surveyed four times annually, two times by foot and two times aerially. The pipeline system block valves are inspected and maintained annually as part of NW Natural's ongoing maintenance. Crews also control right-of-way vegetation using hand tools while performing one of the annual visits.

Two temporary staging areas will be required at the St. Helens well tie ins and will be revegetated after construction. Each site measures approximately 20' x 100' and will lie within the existing 20-foot right-of-way. All sites will be restored. As discussed further below, a 1200-C erosion control permit will not be obtained for construction activity as the disturbed area is less than one acre, and best management practices will be utilized to reduce construction impacts.

A further summary of the existing facilities and Site Certificate and all amendments thereto is attached as **Appendix A**.

2.0 RESPONSE TO OAR 345-027-0050 REQUIREMENTS

2.1 OAR 345-027-0050(1)

OAR 345-027-0050(1) requires a site certificate amendment in the following circumstances:

“To change the site boundary or otherwise to design, construct, operate or retire a facility in a manner different from the description in the site certificate, the certificate holder shall submit an amendment request, as described in OAR 345-027-0060, to the Office of Energy if the proposed change:

“(a) Could result in a significant adverse impact that the Council did not evaluate and address in the final order granting a site certificate affecting any resource protected by applicable standards in divisions 22 and 24 of this chapter;

“(b) Could result in a significant adverse impact that the Council did not evaluate and address in the final order granting a site certificate affecting geographic areas or human, animal or plant populations;

“(c) Could impair the certificate holder’s ability to comply with a site certificate condition; or

“(d) Could require a new condition or a change to a condition in the site certificate.”

Discussion.

(a) No significant adverse impact that the Council did not evaluate and address in the final order, as amended, affecting any resource protected by division 22 and 24 standards. Section 3 of this document assesses compliance with applicable standards in division 22 and 24. The assessment concludes that the proposed changes comply with division 22, and will not result in a significant adverse impact not previously evaluated by the Council. With the exception of OAR 345-024-0030, the criteria in division 24 do not apply because the project is not a wind energy facility, transmission line, or power plant. With regard to OAR 345-024-0030 (specific standards for surface facilities related underground gas storage reservoirs), NW Natural addresses compliance in Section 3.3 below.

The Final Order and Site Certificate Amendment No. 9, Condition C, amended the SCA Condition (5)(b) pertaining to CO₂ Standards in division 24, providing that NW Natural shall replenish the offset credit account when the account “contains fewer than 6,000 tons of carbon dioxide credits.” While it is possible that the Project will cause a greater level of CO₂ emissions, under the provisions of division 24, and the SCA conditions related thereto, the effect will be that NW Natural may need to replenish the offset credit account more frequently.

(b) No significant adverse impact that the Council did not evaluate and address in the final order, as amended, affecting geographic areas or human, animal or plant populations. All elements of the project will occur within the existing site boundaries. As described above, the new pipelines will be situated within the existing pipeline ROWs, with no expansion needed. As discussed below, the “Environmental Studies Report,” **Exhibit 4**, shows that the Project will not cause significant impacts to animal and plant beyond those previously evaluated by the Council.

(c) *No impairment of NW Natural's ability to comply with a site certificate condition.* NW Natural has reviewed the site certificate conditions, in the original SCA and in the nine amendments thereto, in relation to the proposed changes.³ Amendment No. 9 found that the amendment complied with all Council standards and applicable requirements of other agencies. Amendment No. 9 authorized the increase of the allowed throughput at the Mist storage facility to 515 MMcfd, and further authorized gathering pipelines and associated facilities. NW Natural does not propose any change in the site boundary, and all new pipelines will be installed within or adjacent to the existing pipeline corridor ROWs (and within the existing site boundaries). NW Natural proposes to increase the compressed throughput that was functionally limited due to well flowrates from 425 MMcfd to 515 MMcfd, to match the free flow throughput, by installing additional wells (subject to DOGAMI's exclusive jurisdiction) and pipelines within the site boundaries. This increase in compressed throughput is allowed by the SCA, as amended by Amendment No. 9. All construction activities will comply with all conditions imposed by the Council in the SCA and all subsequent amendments thereto. Consequently, NW Natural finds no reason that the proposed changes would impair its ability to comply with site certificate conditions, as amended.

(d) *Will not require a new condition or changed condition in the site certificate.* For the same reasons outlined above, NW Natural can find no reason that the proposal would require any new condition or change to a condition in the site certificate.

Conclusion. For the reasons stated above, NW Natural concludes that the proposed changes:

(a) Would not result in any significant adverse impacts that the Council did not evaluate and address in the final order granting a site certificate affecting resources and all amendments thereto;

(b) Would not result in any significant adverse impacts that the Council did not evaluate and address in the final order granting a site certificate affecting geographic areas or human, animal or plant populations;

(c) Would not impair the certificate holder's ability to comply with the site certificate conditions; and

(d) Would not require new conditions or modifications to existing conditions in the site certificate.

The certificate holder concludes that an amendment request is not necessary because the proposal does not meet any of the four tests in subsections (a)-(d).

³ As requested by ODOE staff, NW Natural is working on a consolidated, restated Site Certificate for Mist Field, to include all amendments thereto. NW Natural intends to submit the restated Site Certificate at the time it makes its next application to amend the Certificate.

2.2 *OAR 345-027-0050(2)*

“(2) Notwithstanding section (1), the Council does not require a site certificate amendment if the proposed change would not violate any condition of the site certificate and is a change: * * *

“(b) In the number or location of pipelines for a surface facility related to an underground gas storage reservoir that would not result in the facility exceeding permitted daily throughput or enlarge the facility site; * * *

“(d) To a pipeline or transmission line that is a related or supporting facility that would extend or modify the pipeline or transmission line or expand the right-of-way, when the change is to serve customers other than the energy facility; or

“(e) To an aspect or feature of the facility, operating procedures, or management structures not specifically addressed in the site certificate that would not violate the site certificate or applicable statutes or rules. [Inapplicable text omitted.]”

Discussion. As discussed earlier, the proposed changes would not violate any condition of the Site Certificate, as amended.

The criteria in subsections (a) and (c) are not set forth above as they do not apply because the proposed changes do not involve electrical generation or geothermal energy facilities. The criteria in subsection (b) above applies because the Project would change the number or location of pipelines for a surface facility (the Miller Station) related to the Mist underground storage facility, but would not result in the facility exceeding permitted daily throughput and would not enlarge the facility site.

The criteria in subsection (d) above applies because the proposed changes would change the number or location of pipelines, and the change is proposed to serve customers “other than the energy facility.” The proposal would expand the right-of-way for any pipeline in limited circumstances where expansion is needed to place pipelines adjacent to existing pipelines and existing ROWs.

The criteria in subsection (e) above applies to the proposed changes because the installation of new pipelines is a change to the existing facility that was not specifically addressed in the Site Certificate, as amended. In Section 3 of this document, the certificate holder assesses compliance and concludes that the proposed changes would comply with applicable rules and statutes.

Conclusion. For these above stated reasons, OAR 345-027-0050(2) is directly on point. Even if the Project would otherwise require an amendment, due to the applicability of the subsections

discussed above, no amendment is needed. The certificate holder concludes that an amendment to the Site Certificate is not required.

2.3 OAR 345-027-0050(3)

“(3) If the certificate holder decides that the Council does not require a site certificate amendment based on the criteria in section (2), the certificate holder shall, nevertheless, complete an investigation sufficient to demonstrate that the proposed change would comply with the applicable standards in divisions 22, 23 and 24 of this chapter before making any change to the facility. The certificate holder shall prepare a written evaluation describing the investigation and shall make the evaluation available to the Office for inspection at any time.”

Discussion. Based on the investigation and conclusions of this document, the certificate holder has decided that the Council does not require a site certificate amendment. Nevertheless, the certificate holder has assessed compliance of the proposed changes with the applicable standards in divisions 22, 23 and 24 in Section 3 of this document.

Conclusion. This document constitutes the written evaluation describing the investigation, and is available to the ODOE Office for inspection at any time. In accordance with OAR 345-027-0050(5), if ODOE concurs with NW Natural and determines that the proposed changes do not require an amendment, NW Natural will not describe the changes discussed in the written evaluation in its annual report required by OAR 345-026-0080.

3.0 COMPLIANCE ASSESSMENT FOR CHANGE IN THROUGHPUT AND NEW PIPELINES AT MIST NATURAL GAS STORAGE FACILITY

3.1 Division 22 Standards (OAR 345-027-0060(1)(E), (F))

Subsection (e) of OAR 345-027-0060(1) requires a list of Council standards relevant to the proposed changes, and subsection (f) requires an analysis of compliance with applicable Council rules and state and local laws, rules and ordinances.

NW Natural’s proposal requires an assessment of compliance with certain Council standards contained in OAR chapter 345, division 22. None of the proposed changes raises issues of compliance with standards in OAR chapter 345, divisions 23 or 24, or with other state or local laws, rules or ordinances.

Compliance with the Council’s division 22 standards is discussed below.

3.1.1 Organizational, Managerial and Technical Expertise (OAR 345-022-0010).

Under this standard, the Council determines whether the applicant has the organizational, managerial and technical expertise to construct and operate the facility. To conclude that the

applicant has the necessary expertise, the Council must determine that the applicant has “[a] reasonable probability of successful construction and operation of the facility considering the experience of the applicant, the availability of technical expertise to the applicant, and, if the applicant has constructed or operated other facilities, the past performance of the applicant, including but not limited to the number and severity of regulatory citations, in constructing or operating a facility, type of equipment, or process similar to the proposed facility.” OAR 345-022-0010(1).

Discussion. Since 1988, NW Natural has operated its underground natural gas storage operation at Mist under the Mist Storage Site Certificate. The Council has approved nine amendments to the SCA, each time confirming that NW Natural possesses the organizational, managerial and technical expertise to operate the facility. NW Natural also has a site certificate authorizing it to build and operate the South Mist Feeder pipeline, which brings natural gas to and from the storage facility.

The storage facility allows NW Natural to store natural gas that it purchases from the interstate pipeline and to withdraw that gas when it is needed. Company personnel who have been managing the existing storage operation will continue to operate the expanded facility. Many of the individuals now working for NW Natural who are involved in the design and construction of Mist facilities have been with the underground storage project at Mist since its inception, as described below.

Conclusion. In its Order approving Amendment No. 7, the Council stated:

“NWN’s experience to date in the Mist Storage Facility, its successful completion of the Calvin Creek expansion in 1997, and the fact that the proposed throughput increase would involve activities identical to those currently authorized provide reasonable assurance that NWN can successfully continue to operate and retire the facility. No new conditions are required.”

In approving Amendment No. 8, the Council recognized that based on NW Natural’s prior experience constructing and operating the Mist storage facility, and the successful completion of the Calvin Creek expansion in 1997 and the South Mist Feeder extension in 1999, NW Natural demonstrated its ability to successfully construct, operate and retire the facility. Added to that is the successful completion of the Miller Station expansion approved in Amendment No. 8. In approving Amendment No. 9, the Council concluded that “NWN’s prior experience constructing and operating the Mist Storage Facility, its development of the Calvin Creek area in 1998, the South Mist Feeder extension in 1999 and the new compressor in 2001 provide reasonable assurance that NWN can successfully construct, operate and retire upgrades requested in amendment 9.” Additionally, in 2004, NW Natural successfully completed and now operates the 62-mile 24-inch South Mist Pipeline Extension (“SMPE”).

At this time, NW Natural does not request approval for a new type of facility, but minor changes and additions in the facilities that are already operating. Given this prior experience and the continued expertise of key personnel, NW Natural has demonstrated that it has a reasonable probability of successful construction and operation of the Project.

3.1.2 Structural (OAR 345-022-0020).

Under the structural standard, the Council determines whether

“(a) The applicant, through appropriate site-specific study, has adequately characterized the site as to seismic zone and expected ground motion and ground failure, taking into account amplification, during the maximum credible and maximum probable seismic events; and

“(b) The applicant can design, engineer, and construct the facility to avoid dangers to human safety presented by seismic hazards affecting the site that are expected to result from all maximum probable seismic events. As used in this rule ‘seismic hazard’ includes ground shaking, landslide, liquefaction, lateral spreading, tsunami inundation, fault displacement, and subsidence;

“(c) The applicant, through appropriate site-specific study, has adequately characterized the potential geological and soils hazards of the site and its vicinity that could, in the absence of a seismic event, adversely affect, or be aggravated by, the construction and operation of the proposed facility; and

“(d) The applicant can design, engineer and construct the facility to avoid dangers to human safety presented by the hazards identified in subsection (c).” OAR 345-022-0020(1).

Discussion. A base seismic study was completed in 1997 by Dames and Moore, to characterize the soils, geology, seismicity and slope stability of the Miller Station area. The base seismic study was reviewed and updated by GeoEngineers, Inc. in 2003 for the facilities proposed by Amendment No. 9. The base seismic study has also been updated to address a mathematical change in the code and has been referenced as the base seismic study for Amendments 4, 6, 8 and 9. Council approvals of Amendment Nos. 4, 6, 8 and 9 were based on the conclusion that the proposed amendments would not change Dames & Moore’s predicted ground response at Miller Station during maximum credible seismic events, and that Miller Station facilities would avoid danger to human safety through appropriate design to Uniform Building Code Seismic Zone 3 requirements.

The Geotechnical and Geologic Hazard Evaluation conducted in by GeoEngineers in 2005 (**Exhibit 5**) identifies, describes and characterizes the geotechnical and geologic hazards in the vicinity of the Pearl Project. The 2005 report was updated by GeoEngineers in April 2007 to include Pearl Phase 2. (**Exhibit 6**). The new pipeline would be constructed from the north end of the Miller Station property and terminate inside the Station property at the south end in an area that was previously studied by Dames and Moore in 1997. New equipment on the existing well pads would include the additional wellhead, above ground valves and piping, a gas/water separator, a meter, a 2,000 gallon methanol tank, an 80 foot communications tower, and two

small ancillary equipment and metering sheds. The geologic analysis of the well pads and pipeline locations is documented in **Exhibit 6**.

The facilities proposed in this Project are similar to those facilities approved by the Council in Amendment No. 9, as analyzed in prior geological hazard reports. This Project does not propose any new buildings or major site changes that would change predicted ground response at Miller Station during the maximum credible seismic events. It does not propose any activities that would change the conclusion that Miller Station facilities are adequately designed to avoid danger to human safety.

The gathering line would be sited to avoid known active landslides and/or unstable slopes. The slope stability assessment provided in **Exhibits 5** and **6** classifies the Project area as “low risk”. It concludes that pipeline damage from ground movement is a low risk occurrence, and that the project area is at low risk from landslide hazard. To maintain this low level of risk, and in accordance with the installation practices in Pearl Phase 1, NW Natural will install the gathering line within the inside edges of roads to minimize the potential for shallow fill failures along road cuts. **Exhibit 5** recommends that cut/fill slopes be maintained at a maximum gradient of 2H: 1V (horizontal: vertical), that fill slopes be keyed into undisturbed, firm native soils, and that roads and pipeline corridors include water bars. (**Exhibit 5** at p. 9). NW Natural will implement these recommendations.

Exhibit 5 and **6** provide specific earthwork recommendations for design and construction of the well pad, including site preparation, wet weather considerations, haul road guidelines, excavation guidelines, cut and fill slopes, site drainage, erosion control, and bedding and structural fill specifications and placement guidelines. The reports also provide foundation support recommendations for the wellheads, gas/water separator, methanol tank and equipment shed.

None of the activities in the Project raise any safety issues not already addressed in Amendment No. 9. NW Natural’s compliance with the conditions in the Site Certificate and subsequent amendments would be sufficient to avoid dangers to human safety. Nothing in the Project alters the basis for the Council’s earlier finding of compliance with the standard.

Conclusion. The Project meets the Structural Standard.

3.1.3 Soil Protection (OAR 345-022-0022).

The Council must find that:

“* * * the design, construction, operation and retirement of the facility, taking into account mitigation, are not likely to result in a significant adverse impact to soils including, but not limited to, erosion and chemical factors such as salt deposition from cooling towers, land application of liquid effluent, and chemical spills.”

Discussion. An Erosion and Sediment Control Plan identifies soil impacts that could occur as a result of construction of the pipeline and well pad for the Pearl Project. Soil protection for installation of the wells would be accomplished by meeting the requirements of the DOGAMI

permit(s). Amendment No. 9 includes an erosion and sediment control plan that lists the best management practices to control and limit soil erosion during construction of the gathering line and well pad. (See Final Order on Amendment No. 9, p. 9). Most of the practices detailed in this plan were adopted from the Erosion Prevention and Sediment Control Manual, which is the most current erosion control guide. No soil impacts would result from the operation of the underground gathering line, wells, or changes to Miller Station as part of the Pearl Project. There would be very little earthwork at Miller Station and the new equipment would not significantly increase loading of soils.

The gathering line would be installed using trenching techniques. Best management practices, as detailed in Amendment No. 9, would be implemented for all trenching activities. To ensure appropriate implementation of erosion control Best Management Practices ("BMP's") at the Pearl Project site, a Certified Professional Erosion and Sediment Control (CPESC) specialist would select and implement the appropriate measures. Erosion control measures to be employed during construction of the gathering line could include:

- Installing sediment fence/straw bale barriers at downslope side of excavations and disturbed areas;
- Straw mulching and disking at locations adjacent to the road that have been affected; and
- Planting designated seed mixes at affected areas adjacent to the road.

Construction of the gathering line is planned for August, 2007. The general construction sequence would include logging and clearing, excavation where necessary, trenching, pipe installation, and backfilling. The project schedule anticipates that pipeline construction would be completed by September 2007. Erosion control measures would be maintained and modified, as necessary, until vegetation is restored and the erosion potential sufficiently reduced to comply with regulatory requirements without additional control measures. The pipeline would be buried, surface gradients restored, and vegetation reestablished to provide long-term sediment control. The project would not include any permanent impermeable surfaces, so permanent storm water control measures are not proposed.

The BMPs meet or exceed the regulatory turbidity limits and the requirements of the National Pollutant Discharge Elimination System ("NPDES") General Permit 1200-C and other regulations that require erosion control. A 1200-C Erosion Control/Stormwater permit had been required for past amendments for the storage field, but will not be required for this project, as a total of less than one acre of land will be disturbed. The trigger for requiring a 1200-C is a total disturbance of one acre or more. As noted, BMPs in prior 1200-C Permit applications were derived from NW Natural's Environmental Procedures Manual. NW Natural will be following its own erosion control standards as set forth in the Company's Environmental Procedures Manual. Based on the BMPs, the certificate holder concludes that with proper erosion control measures, impacts to soils from the Pearl Phase 2 Project would be minimal.

Conclusion. The Pearl Project meets the Soil Protection standard.

3.1.4 Land Use (OAR 345-022-0030).

To issue a site certificate, the Council must find that:

“(1)* * * the proposed facility complies with the statewide planning goals adopted by the Land Conservation and Development Commission.

“(2) The Council shall find that a proposed facility complies with section (1) if:

“(a) The applicant elects to obtain local land use approvals under ORS 469.504(1)(a) and the Council finds that the facility has received local land use approval under the acknowledged comprehensive plan and land use regulations of the affected local government; or

“(b) The applicant elects to obtain a Council determination under ORS 469.504(1)(b) and the Council determines that:

“(A) The proposed facility complies with applicable substantive criteria as described in section (3) and the facility complies with any Land Conservation and Development Commission administrative rules and goals and any land use statutes directly applicable to the facility under ORS 197.646(3)***.”

Discussion. The Land Use standard requires the Council to determine that the proposed facility complies with the Statewide Planning Goals. This standard applies only to those components of the Project under Council jurisdiction (i.e., not including the underground storage reservoir, injection/withdrawal wells, observation/monitoring wells, and individual wellhead equipment. ORS 469.300(11)).

NW Natural obtained all necessary land use approvals in the original Site Certificate and in all subsequent site certificate amendments. The certificate holder concludes that there is no need for a new land use approval because the Project would not require an amendment to the Site Certificate. This conclusion notwithstanding, the certificate holder is providing the following details regarding land use permits obtained for Project facilities:

(1) Background: Miller Station and the existing well pads and proposed pipeline locations are located in the Primary Forest-76 zone of Columbia County. The Primary Forest-76 zone conditionally permits “[o]perations conducted for the exploration, mining and processing * * * of mineral or other subsurface resources not permitted outright.” Columbia County Zoning Ordinance (“CCZO”) §503.2.

(2) Miller Station: In Amendment No. 6 and Amendment No. 9, NW Natural demonstrated that its activities at Miller Station, pipelines, storage wells and reservoirs were approved by

conditional use permit from Columbia County, as well as approved through the EFSC land use decision in Amendment No. 6 and Amendment No. 9. Similarly, the expansion of capacity at Miller Station approved under Amendment No. 8 did not require land use permits from Columbia County. Because the equipment approved under Amendment No. 8 was added to existing structures, Columbia County determined that the expansion fell within the scope of the existing conditional use permits:

“[T]he original permit approval would encompass the modifications you are now seeking. You are not proposing to construct any new buildings and the use of the property is remaining the same. No new land use applications are required. * * *.” (August 14, 2001 letter from Glen Higgins, Chief Planner for Columbia County, to Peter Mostow, Stoel Rives LLP.

Since the Project does not propose any new buildings constructed or expanded, and the use of the property remains the same, no new conditional use or site design review should be required for the Miller Station improvements proposed by the Pearl Phase 2 Project. The current conditional use permit is adequate to allow the changes to Miller Station proposed by the Project.

(3) Wells: NW Natural has obtained conditional use permits from Columbia County for construction of the proposed wells (see **Exhibit 7**). NW Natural has also received authorization from DOGAMI for the installation of the wells. (**Exhibit 8**).

(4) Pipeline: Columbia County has not adopted any additional criteria applicable to pipelines since the last time the Council considered pipeline compliance with the Land Use standard (Amendment No. 9 and Pearl Phase 1). The pipeline associated with this project does not raise any issues of compliance with Columbia County's criteria or the Council's Land Use standard that the Council has not considered in previous amendments to the Site Certificate. Accordingly, the project complies with the Council's Land Use standard.

(5) Compliance with Applicable Substantive Criteria: All of the applicable substantive criteria for the Primary Forest-76 zone were addressed by the certificate holder in Amendment No. 6 and Amendment No. 9. NW Natural incorporates these by reference to demonstrate compliance with local and state land use standards. The Project does not propose any types of uses that are new or different from those approved for Amendment No. 6 and Amendment No. 9. Accordingly, the extensive analysis and the Council's findings on land use apply equally to the Project. (See Final Order on Amendment No. 9, pp 11 – 23).

Conclusion. As discussed above, the certificate holder concludes that there is no need for a new land use approval because the Project would not require an amendment to the Site Certificate. NW Natural obtained all necessary land use approvals in the original Site Certificate and in all subsequent site certificate amendments, as well as those approvals mentioned above specific to the Project. The Project does not propose any types of uses that are new or different from those approved by the Council previously, and does not propose uses in new or different land use zones. For these reasons, the certificate holder concludes that the Project meets the Land Use standard.

3.1.5 Protected Areas (OAR 345-022-0040).

As a general rule, the Council's Protected Areas standard prohibits the siting of an energy facility within any of the protected areas listed in the rule. The standard permits the siting of an energy facility outside the listed protected areas as long as the "design, construction and operation of the facility are not likely to result in significant adverse impact to" any of the protected areas. OAR 345-022-0040(1).

Discussion. The Environmental Studies Report (**Exhibit 4**) identifies and describes the Project's compliance with the Protected Areas standard. Miller Station and Bruer Flora Storage Area (including the proposed well sites and pipeline locations) are not located in any protected areas. The nearest protected area is Oregon State University's Blodgett Research Forest, located approximately 4 miles northwest of the north end of the pipeline route and north of Mist, Oregon. All other protected areas are located from 10 to over 20 miles from the project area.

The design, construction, and operation of the Project would not have any adverse impacts on Blodgett Research Forest or any of the other protected areas identified in **Exhibit 4**. The pipeline would be buried and thus not visible. Temporary construction impacts for the pipeline (e.g., ground disturbance, construction activity and noise) would be unlikely to impact even the closest protected area, which is four miles away. Given the distances from protected areas and the nature of the proposed activities and facilities, the certificate holder concludes that the Project would not impact any protected areas.

Conclusion. The Project meets the Protected Areas standard.

3.1.6 Retirement and Financial Assurance (OAR 345-022-0050).

Under its Retirement and Financial Assurance standard, OAR 345-022-0050, the Council determines whether:

"(1) The site, taking into account mitigation, can be restored adequately to a useful, non-hazardous condition following permanent cessation of construction or operation of the facility.

"(2) The applicant has a reasonable likelihood of obtaining a bond or letter of credit in a form and amount satisfactory to the Council to restore the site to a useful, non-hazardous condition."

Discussion. NW Natural does not foresee retirement of the proposed pipeline or storage facilities because underground natural gas pipelines and storage facilities have indefinite useful lives. Similarly, retirement of Miller Station would be indefinitely delayed by appropriate maintenance and replacement of process equipment. Nonetheless, the processes to retire Miller Station, pipelines, injection/withdrawal and monitoring wells described in Amendment No. 9 are appropriate for the Project and would return the site to a useful, non-hazardous condition. NW Natural incorporates by reference and relies on its discussion in Amendment No. 9 to demonstrate compliance with this standard for the Project.

Based on studies completed for Amendment No. 9, the cost to restore the Project site would be small relative to the value of the existing certificated facilities at Mist and their salvage value. NW Natural holds bonds with SafeCo Insurance Company of America for earlier amendments to the 1981 Site Certificate, and would either update existing bonds or obtain additional bonds in a substantially similar format to cover the retirement costs associated with the Project. Based on past bonding history, NW Natural would likely be able to obtain a bond and restore the site to a useful non-hazardous condition. The proposed Project in no way alters NW Natural's ability to meet their existing financial obligations or the obligations imposed by the Project.

Conclusion. The Project meets the Retirement and Financial Assurances standard.

3.1.7 Fish and Wildlife Habitat (OAR 346-022-0060).

The Council must find that:

“the design, construction, operation and retirement of the facility, taking into account mitigation, are consistent with the fish and wildlife habitat mitigation goals and standards of OAR 635-415-0025 in effect as of September 1, 2000.”

Discussion. The Environmental Studies Report (**Exhibit 4**) identifies and describes the Project's compliance with the Fish and Wildlife Habitat standard. Implementation of the Project would include BMPs to mitigate potential impacts to fish and wildlife habitat. The proposed pipeline would be trenched within and adjacent to existing pipeline and road ROW corridors, except for an approximate 0.03-acre area of trees that would be removed to accommodate connector piping between the new St. Helens Pool well and the existing pipeline on the east side of Main Line Road. The permanent corridor would be 40 feet or less in width. Where the new line would be installed adjacent to an existing forest road, the road could be part of the construction corridor if it is a little-used road. Where a new pipeline is installed adjacent to an existing one, the permanent corridor would typically only be 10 feet wider than the existing corridor.

Impacts to habitats would include the removal of vegetative cover and temporary disturbance of the soil in the trench and of the adjacent surface from movement of construction equipment. The removal of vegetation would be minimized and BMPs would be implemented to prevent erosion and the spread of weeds. The vegetation would be encouraged to grow back in the construction corridor, with the exception of trees and large shrubs in the area directly over the pipe. The habitat value of existing forested areas would not be diminished except for the temporary impact from construction activities. Erosion and sediment control procedures within construction areas would be implemented to minimize sediment input in streams. (**Exhibit 4**). BMPs in prior 1200-C Permit applications were derived from NW Natural's Environmental Procedures Manual.

Based on the environmental study, the certificate holder concludes that the design, construction, operation, and retirement of the Project, taking mitigation into account, are consistent with the habitat mitigation goals and standards of OAR 635-415-0025. Therefore, the

certificate holder concludes that the Project would not have any significant adverse impact on fish and wildlife habitat.

Conclusion. The Project meets the Fish and Wildlife Habitat standard.

3.1.8 Threatened and Endangered Species (OAR 345-022-0070).

The Council must find that:

“(1) For plant species that the Oregon Department of Agriculture has listed as threatened or endangered under ORS 564.105(2), the design, construction, operation and retirement of the proposed facility, taking into account mitigation:

“(a) Are consistent with the protection and conservation program, if any, that the Oregon Department of Agriculture has adopted under ORS 564.105(3); or

“(b) If the Oregon Department of Agriculture has not adopted a protection and conservation program, are not likely to cause a significant reduction in the likelihood of survival or recovery of the species; and

“(2) For wildlife species that the Oregon Fish and Wildlife Commission has listed as threatened or endangered under ORS 496.172(2), the design, construction, operation and retirement of the proposed facility, taking into account mitigation, are not likely to cause a significant reduction in the likelihood of survival or recovery of the species.”

Discussion. The Environmental Studies Report (**Exhibit 4**) identifies and describes the Project’s compliance with the Threatened and Endangered Species standard. A biologist conducted a site-specific field reconnaissance of a 200-foot wide corridor surrounding the proposed pipeline segments on March 27, 2007. Lists of state and federally listed species expected to occur in the vicinity of the project, along with mapped information on the species, previous reports and studies for the area, were used to complete the evaluation. The literature and field research highlighted four threatened or endangered species that could potentially be impacted by activities in the project area: bald eagle, northern spotted owl, Columbian white-tailed deer, and Nelson’s checker-mallow. The certificate holder concludes there would be no significant adverse impacts to any of these listed species, for the following reasons:

(1) Bald Eagle: The proposed project is located more than 1 mile from the nearest known eagle nest to the southwest. The presence of eagle nesting or other activities would be determined before construction began to preclude unnecessary disturbance to nesting or other identified activities.

(2) Northern Spotted Owl: The proposed pipeline segments would pass through a patchwork of second-growth forest stands (i.e., 20-40 years old) that are unsuitable for northern spotted owl

nesting. These forest patches are small in size, surrounded by clear cuts and lack the diversity of vegetation, snags, and other late-successional forest characteristics that are associated with the northern spotted owl. The small number of trees that would be removed (to accommodate the St. Helens Pool well connector) do not provide spotted owl habitat; therefore, removal of these trees would not affect the species.

(3) Columbian White-Tailed Deer: There are no riparian areas in the project area, and the project is over 7 miles from the closest known population of Columbian White-Tailed Deer occurring near the Columbia River.

(4) Nelson's Checker-Mallow: Nelson's Checker-Mallow would not be affected because there is not suitable habitat for this plant species in the project area.

Based on the studies and conclusions in **Exhibit 4**, the certificate holder concludes that the Project would not cause a significant reduction in the likelihood of survival or recovery of the above mentioned species.

Conclusion. The Project meets the Threatened and Endangered Species standard.

3.1.9 Scenic/Aesthetic (OAR 345-022-0080).

The Council must find that:

“(1) Except for facilities described in sections (2), to issue a site certificate, the Council must find that the design, construction, operation and retirement of the facility, taking into account mitigation, are not likely to result in significant adverse impact to scenic and aesthetic values identified as significant or important in applicable federal land management plans or in local land use plans in the analysis area described in the project order. * * *.”

Discussion. Amendment No. 9 and Amendment No. 6 provide detailed discussions of scenic and aesthetic values for the Mist Field area. In the final order for Amendment No. 6, the Council concluded that there was no federally owned land in the vicinity of the gas storage area.

The applicable local land use plan is Columbia County's Comprehensive Plan. The Columbia County Comprehensive Plan was updated in March 2001 and did not add any new scenic resources. The Project area is not visible from or within the viewshed of any area identified by Columbia County as a "scenic resource."

The Columbia County Comprehensive Plan identifies portions of Highway 47 as a state-designated scenic highway, and Miller Station is visible from two points along Highway 47. However, the changes proposed to Miller Station by the Project would not affect the appearance of the station because the equipment would blend in with existing facilities at Miller Station, and match in both scale and material. The new equipment and modifications would not be visible from Highway 47. The new pipeline would not affect scenic or aesthetic values because the lines would be buried underground. Vegetative disturbances during construction of the pipeline and wells would be temporary and not visible from Highway 47. The wells and wellhead

facilities are low relief items (i.e., less than 8 feet vertical) that would not be visible from Highway 47.

The Project would not adversely impact any scenic or aesthetic values identified as significant or important in any applicable federal land management or local land use plans for the site or its vicinity.

Conclusion. The Project meets the Scenic and Aesthetic Values standard.

3.1.10 Historic, Cultural and Archeological Resources (OAR 345-022-0090).

The Council must find that:

“the construction, operation and retirement of the facility, taking into account mitigation, are not likely to result in significant adverse impacts to:

“(a) Historic, cultural or archaeological resources that have been listed on, or would likely be listed on the National Register of Historic Places;

“(b) For a facility on private land, archaeological objects, as defined in ORS 358.905(1)(a), or archaeological sites, as defined in ORS 358.905(1)(c); and

“(c) For a facility on public land, archaeological sites, as defined in ORS 358.905(1)(c).”

Discussion. The Environmental Studies Report (**Exhibit 4**) identifies and describes the Project’s compliance with the Historical, Cultural and Archaeological Resources standard. There are no resources listed or likely to be listed on the National Register of Historic Places at or near the project area. The pipeline segments would be located in previously disturbed areas including a roadway and through an approximately 0.03-acre area of second growth commercial forest.

Given the terrain and environment of the project area, as well as the results of previous inventories in the immediate vicinity (**Exhibit 4**), the certificate holder considers the overall archaeological sensitivity along the project corridor to be relatively low. Nevertheless, a brief archaeological inventory of the proposed alignment was conducted on March 27, 2007. No previously recorded or newly recognized cultural resources were identified during the inventory process.

Should any potential archaeological resources be encountered during project construction, all work in the immediate vicinity would cease until a qualified archaeologist could evaluate the find and recommend an appropriate course of action. Based on the available information, the certificate holder concludes that the Project would have no adverse impacts on historical, cultural or archaeological resources.

Conclusion. The Project meets the Historic, Cultural and Archeological Resources standard.

3.1.11 Recreation (OAR 345-022-0100).

The Council must find that:

“the design, construction and operation of a facility, taking into account mitigation, are not likely to result in a significant adverse impact to important recreational opportunities in the analysis area as described in the project order. The Council shall consider the following factors in judging the importance of a recreational opportunity:

“(a) Any special designation or management of the location;

“(b) The degree of demand;

“(c) Outstanding or unusual qualities;

“(d) Availability or rareness;

“(e) Irreplaceability or irretrievability of the opportunity.”

Discussion. The Environmental Studies Report (**Exhibit 4**) states that there are no recreational facilities identified at or within one mile of the Project area. However, there is some light recreational use of the area by hunters and fishermen on a seasonal basis. The proposed pipeline would be buried and thus not visible, and the construction impacts for the pipeline and wells (e.g., ground disturbance, construction activity and noise) would be temporary. Given these mitigating factors, and considering the limited recreational uses and resources in the area, the certificate holder concludes that the Project would not adversely affect any recreational resources.

Conclusion. The Project meets the Recreation standard.

3.1.12 Public Services (OAR 345-022-0110)

The Council must find that:

“the construction and operation of the facility, taking into account mitigation, are not likely to result in significant adverse impact to the ability of public and private providers within the analysis area described in the project order to provide: sewers and sewage treatment, water, storm water drainage, solid waste management, housing, traffic safety, police and fire protection, health care and schools.”

Discussion. For the same reasons described in Amendment No. 9, the construction and operation of the Project would not impact existing sewers and sewage treatment, water, solid waste management, housing, traffic safety, police and fire protection, health care or schools.

The existing facilities at Miller Station would be adequate to handle the small water and sewer needs of the Project. Storm water drainage during construction and operation of the pipeline and wells would be handled on-site through BMPs and natural drainage, and would not affect existing collection systems. No community currently provides solid waste management in the project vicinity, so solid waste would be handled through private contracts. Housing would not be adversely impacted, given the limited number of workers and temporal nature of the construction work. Upon completion, the Project would not generate any additional traffic, and during construction increased traffic would be minimal. Hot work permits and fire watches would be required for all construction activity within Miller Station, and the general contractor would maintain a constant and dedicated fire watch during equipment modifications and installation. Police and fire protection, health care and school needs are not expected to increase as a result of the Project, based on the certificate holder's research completed for similar activities in Amendment No. 9.

When installing the 1,300 feet of gathering line, the Mainline Road will be closed near Miller Station. The closure will last approximately one week. Efforts will be made to coordinate the closure with the local timber companies to reduce the impact on business. An alternate route will be provided for local business travel and emergency vehicles, if necessary. A second alternate route through the Miller Station facilities will also be available for passenger and emergency vehicles.

For these reasons, the certificate holder concludes that the Project would not have adverse impact to the ability of public or private providers to provide the above listed services.

Conclusion. The Project meets the Public Services standard.

3.1.13 Waste Minimization (OAR 346-022-0120).

The Council must find that:

“(a) The applicant’s solid waste and wastewater plans are likely to minimize generation of solid waste and wastewater in the construction, operation, and retirement of the facility, and when solid waste or wastewater is generated, to result in recycling and reuse of such wastes;

“(b) The applicant’s plans to manage the accumulation, storage, disposal and transportation of waste generated by the construction and operation of the facility are likely to result in minimal adverse impact on surrounding and adjacent areas.”

Discussion. Minimization and storage of solid wastes during construction would follow the same procedures described in Amendment No. 9. No solid waste would be generated during the operational phase of the Project. Water use during gathering line testing would be limited, and

waste water would be disposed of by the recycling of the water for dust abatement or processed through the Miller Station's stormwater treatment system. The water used for the hydrostatic testing of the pipelines would be collected from the well at Miller Station.

The Project would participate in the hazardous and non-hazardous waste reduction and recycling program that is currently in place for all NW Natural facilities. This program, described in Amendment No. 9, is appropriate for construction, operation and retirement activities. When applied to the Project, this program would result in minimal adverse impact on surrounding and adjacent areas. The Project would not impact, in any way, the ability of the certificate holder to implement the above referenced solid waste and wastewater plans for construction, operation and retirement of existing and proposed facilities.

Conclusion. The Project meets the Waste Minimization standard.

3.2 Compliance with Division 23 Standards

Division 23 applies to non-generating facilities as defined in OAR 345-001-0010, "except non-generating facilities that are related or supporting facilities." OAR 345-001-005. The observation/monitoring well, injection/withdrawal wells, well pad and wellhead equipment proposed by the Project do not meet the definition for non-generating facilities. ORS 469.300(11)(I)). The pipeline and modifications to Miller Station proposed by the Project are "related and supporting facilities." Based on these definitions and for the reasons mentioned previously, the Project facilities are exempt from the Division 23 requirements⁴.

3.3 Compliance with Division 24 Standards

Division 24 provides carbon dioxide emission standards for non-generating facilities and means of compliance with these standards in OAR 345-024-0620 and -0630. However, the Project would not exceed the 515 MMcfd throughput permitted by Amendment No. 9 and does not propose additional compression or any other changes that would alter carbon dioxide emissions from their current levels. Therefore, the Project satisfies the carbon dioxide emissions standards in Division 24. As noted above, in the event the Project will cause a greater level of CO₂ emissions, under the provisions of Division 24, and the SCA conditions related thereto, the effect will be that NW Natural would need to replenish the offset credit account more frequently.

Division 24 also provides specific standards for surface facilities related to underground gas storage reservoirs in OAR 345-024-0030.

⁴ In general, an applicant for an amendment to an existing site certificate does not have to demonstrate compliance with the "Need for Facility" standard in OAR chapter 345, division 23. NW Natural did not address that standard in Amendment No. 9 because underground storage was specifically exempted from the "need" standard by the former OAR 345-023-0010(1)(f) and no current "need" standard applies to surface facilities associated with underground natural gas storage.

“To issue a site certificate for a proposed surface facility related to an underground gas storage reservoir, the Council must make the following findings:

“(1) The proposed facility is located at distances in accordance with the schedule below from any existing permanent habitable dwelling:

- (a) Major facilities, such as compressor stations, stripping plants and main line dehydration stations— 700 feet;
- (b) Minor facilities, such as offices, warehouses, equipment shops and odorant storage and injection equipment— 50 feet;
- (c) Compressors rated less than 1,000 horsepower— 350 feet;
- (d) Roads and road maintenance equipment housing— 50 feet.

“(2) The applicant can construct and maintain the facility in accordance with the applicable requirements of the U.S. Department of Transportation as set forth in 49 CFR, Part 192, and OAR 860-024-0020 in effect as of the date of this rule;

“(3) The applicant has developed a program using technology that is both practicable and reliable to monitor the facility to ensure the public health and safety; and

“(4) The applicant can design, construct and operate the facility so as not to produce or contribute to seismic hazards that could endanger the public health and safety or result in damage to property.”

Discussion. The Project does not propose any major facilities, compressors, roads or road maintenance equipment housing. The facilities proposed by the Project include installation of three injection/withdrawal wells, conversion of an existing shut in injection withdrawal well to an observation well for Flora Pool, wellhead equipment (all within DOGAMI’s jurisdiction) and two 200-foot 8” pipelines to connect the St. Helens well to the existing pipelines, a 1,300-foot 12” pipeline, and minor modifications to Miller Station (within EFSC’s jurisdiction). The Project complies with subsection (1) because the nearest habitable dwelling is more than 5,500 feet from the nearest location proposed for any Project facilities.

The Project facilities would be constructed and maintained in accordance with the applicable requirements of the U.S. Department of Transportation as set forth in 49 CFR, Part 192, and OAR 860-024-0020. The existing underground storage facility at Mist was constructed and is maintained in accordance with these same regulations. The Oregon Public Utility Commission (“PUC”), which administers these rules under a delegation from the federal government, last inspected the current facility and its operation and maintenance procedures in August 2005. No report from that inspection has been issued.

The Project facilities would be designed, constructed, operated and maintained in accordance with federal pipeline safety regulations enforced by PUC. These regulations require

measures to prevent leakage, including factory-installed pipeline coating, individual joint wrap, effective cathodic protection systems and isolation from other pipes that could cause inadvertent electrical contact. The wellheads' and pipelines' numerous safety features would include relief valves and automatic shutdown systems. In addition, trained personnel from Miller Station would monitor these facilities⁵. The plant has a staff consisting of one supervisor and eight operators, maintenance, and electronics personnel working rotating shifts.

NW Natural continues its commitment to public health and safety by maintaining the following programs:

- fire training school for plant operators and maintenance personnel
- written action emergency procedures for company gas dispatchers and plant personnel
- maintenance of both life flight and C-Com procedures and phone numbers
- existing emergency plans that would be expanded to include the equipment proposed by the Project at Miller Station; and
- facility would be designed, constructed and operated so as not to produce or contribute to seismic hazards.

In approving the Site Certificate application and nine subsequent amendments, the Council has concluded that the existing storage facilities would not produce or contribute to seismic hazards that could endanger public health and safety or result in property damage. The Project does not propose any changes to the existing facilities that would alter that conclusion.

Conclusion. For these above stated reasons, the Project meets the applicable standards in division 24.

3.4 Other Standards and Permits

- A. Noise:** A moderate amount of noise will occur during the construction process. Due to the distance from residences and duration of construction, the Project will meet Oregon's noise regulations.
- B. Air Quality:** NW Natural does not propose to add equipment that will constitute an additional emission source. No modification of the existing air quality permit for Miller Station is required for this action.

⁵ At Miller Station, an emergency shutdown system exists that could be either manually or automatically activated. It stops all plant processes, closes all plant inlet and outlet valves, shuts off engine fuel and start gas systems and upon closure of necessary valves, vertically vents to the atmosphere all process and fuel gas within the plant. These systems are maintained on a regular basis and tested at least annually to ensure proper response. There are also systems in place to monitor compressor, process and control building atmospheres for the presence of flammable vapors, as well as systems that detect the presence of a fire. These instruments would trigger an alarm or plant shutdown when certain preset levels are reached.

- C. **Wetlands:** There are no impacts to wetlands at either the location near the well pad or the location of the pipeline in the road bed near Miller Station. The impacts near the well pad are within an existing rocked facility, through a narrow (40' or less) section of timber, and terminate across a road bed that are all classified as uplands. The section of pipeline near Miller Station is within a road bed with the exception of exiting the upper end of Miller Station which is within an existing permitted ROW. There are no streams immediately adjacent to any of the facilities.

4.0 CONCLUSION

None of the proposed changes within the scope of the Project raise issues of compliance with standards in OAR chapter 345, divisions 23 or 24, or with other state or local laws, rules or ordinances. Therefore, the Project complies with relevant standards, state and local laws, rules and ordinances.

APPENDIX A

Summary of Existing Facilities Site Certificate (as Amended)

Summary of Existing Facilities

NW Natural is a natural gas utility that delivers energy to more than 600,000 customers. Energy needs generally change significantly on a daily, monthly and seasonal basis due to changes in space-heating requirements, harvest processing, annual production cycles and other factors. In Oregon, however, gas usage is generally lowest during summer months and peaks during December, January and February. Underground gas storage provides the most efficient means of balancing relatively constant pipeline gas supplies with widely fluctuating seasonal, daily and hourly market requirements. Gas is injected into storage during off-peak periods when market requirements are less than supply availability, and is withdrawn from storage when market demand exceeds available supplies from other sources. Storage reservoirs usually are replenished from April through September and are drawn down between October and March.

Underground reservoir storage requires suitable underground geological conditions in a specific geographic area. These conditions occur in depleted oil or gas pools like the pools in the Mist storage area. An underground storage reservoir, reduced to simplest terms, is little more than a gas production reservoir retrofitted to inject gas back into the ground and withdraw it on a cyclical basis.

The principal differences between a natural gas production field and an underground storage reservoir are operational. The gas wells in a production field are designed to produce gas at flow rates that permit the efficient drainage of the reservoir over time. DOGAMI regulates the spacing of gas wells. Generally, no more than one well per quarter section (160 acres) is allowed. Closer well spacing could result in higher development costs with negligible increase in overall gas production. Competing wells could also cause the premature demise of a reservoir, leaving behind gas that is uneconomical to produce.

A different operating concept applies to a storage reservoir. Instead of producing the major portion of the underground gas by careful management of field pressures and auxiliary compression over a period of years, the goal changes to that of an annual fill-and-empty cycle. In order to rapidly fill and withdraw from a reservoir without harming it, a more closely spaced pattern of wells designed for high rates of injection and withdrawal is used for storage operations. Compressors allow the storage pressure to be restored during a six-month injection period and provide for sustained high delivery rates during withdrawal as the reservoir pressure depletes.

Summary of Site Certificate and Amendments

On September 30, 1981, EFSC issued the Site Certificate to ONG, a wholly owned subsidiary of NW Natural, for an underground natural gas storage facility near Mist, Oregon in Columbia County (the "Mist Storage Site Certificate" or "Site Certificate"). The Site Certificate has been amended nine times.

The Site Certificate authorized ONG to construct and operate “two naturally existing underground gas reservoirs (the Flora and Bruer pools) * * *; Miller Station with attendant equipment (including, but not limited to, compressors), gathering lines, access roads, existing natural gas wells, monitoring wells and proposed injection/withdrawal wells,” located in rural Columbia County in parts of Sections 2, 3, 4, 10 and 11 of Township 6 North, Range 5 West, Willamette Meridian (the “Mist Site”). (1981 Mist Storage Site Certificate at 2.)

In 1990, ONG assigned the Site Certificate to its parent, NW Natural. The Council approved three amendments to the Site Certificate, in 1987 (Amendment No. 1), 1988 (Amendment No. 2) and 1990 (Amendment No. 3). The amendments modified several terms of the Site Certificate and authorized the construction and replacement of wells.

In 1997, the Council approved Amendment No. 4. That amendment approved an expansion of the Mist Site that increased the combined total Mist storage peak-day delivery capability from 100 MMcfd to 145 MMcfd. The expansion included (1) improvements to the Miller Station gas-processing facility, including the replacement of two older 550-horsepower compressor units with one larger, more efficient unit; (2) total available compression of 6,650 brake horsepower (“BHP”); (3) construction of a building for the new compressor and updates to related equipment; (4) natural gas storage in one additional naturally occurring underground pool, Al’s Pool, in the Calvin Creek storage area; (5) up to four new sites for injection/withdrawal wells, including one to four wells at each site; (6) approximately one mile of buried eight-inch and six-inch gathering pipeline; and (7) approximately two and one-half miles of buried twin 16-inch transmission pipeline.

On March 13, 1998, the Council approved Amendment No. 5, which replaced the amendment provisions in the Site Certificate with a requirement that future site certificate amendments be governed by the Council’s amendment rules.

In 1999, the Council approved Amendment No. 6, increasing the capacity of the Mist storage facility. The gas storage portion of that project included (1) upgrades to the dehydration and metering systems at Miller Station; (2) natural gas storage in one additional naturally occurring underground pool, the Reichhold Pool, within the existing site boundary; (3) up to four new sites for injection/withdrawal wells, including one to four wells at each site; (4) approximately 6,500 feet of buried gathering pipeline no greater than 12 inches in diameter; and (5) the removal of the 6,650 compressor horsepower limitation currently in place for the Miller Station facility. Approval of Amendment No. 6 allowed Miller Station to operate at rates of up to 190 MMcfd without any restriction on the use of the three existing compressor units, which have a total rating of 8,200 BHP.

On May 17, 2001, the Federal Energy Regulatory Commission (“FERC”) granted NW Natural a limited jurisdiction blanket certificate under Section 284.224 of FERC’s regulations. Under that certificate, NW Natural is authorized to use existing and expanded facilities at Mist to provide FERC jurisdictional bundled firm and interruptible storage and related transportation services in interstate commerce. Northwest Natural Gas Company, 95 FERC ¶ 61,242 (2001). FERC’s jurisdiction, however, only extends to the interstate services themselves. NW Natural provides the interstate storage services using existing and expanded facilities at Mist that are not needed to serve its core LDC customer needs. NW Natural also has agreements in place with its

state utility regulators regarding this use. To make increased capacity available to the interstate market, NW Natural amended its site certificate (Amendment No. 7) by increasing the permitted throughput of the Mist facility to 245 MMcfd. Amendment No. 7 was approved on November 17, 2000.

In Amendment No. 8, approved October 26, 2001, the Council authorized an increase of the permitted daily throughput from 245 MMcfd to 317 MMcfd. This involved the installation of new metering facilities, new interconnect piping to the South Mist and North Mist pipelines and a new gas-turbine-driven compressor. The new compressor added 7,800 horsepower, bringing the total compression capability to 16,000 horsepower.

As noted above, in Amendment No. 9, the Council authorized an increase of the permitted daily throughput from 317 MMcfd to 515 MMcfd. This involved the installation of new dehydration facilities, gas quality and monitor equipment, and two new injection withdrawal wells connected with pipelines to the existing Calvin Creek facilities permitted in Amendment No. 4. At the time NW Natural requested Amendment No. 9, the compressed throughput was 425 MMcfd, and 515 MMcfd freeflow. However, Amendment No. 9 did not restrict the throughput accordingly, and authorized the increase in permitted daily throughput to 515 MMcfd, along with improvements at Miller Station to enable the increased maximum throughput.

The Pearl Phase 1 "Evaluation of Need for a Site Certificate Amendment" was approved using the same evaluation process suggested in this request. Pearl Phase 1 was completed in 2005, and added two new injection withdrawal wells in Bruer Pool with the supporting wellsite appurtenances, approximately 2000 feet of pipeline to connect the new wells to the existing system, and Bruer Meter Area enhancements for the additional flow from the new wells. An additional observation well was also drilled near the Bruer Pool.



SOURCE: USGS 7.5-minute topographic map, Marshland, Oregon, 1985



Scale in Miles

Figure 1
Project Vicinity

Job No. 25696445



Interstate Storage Project - Pearl Phase II
Environmental Studies Report
Northwest Natural

R 5 W

T 6 N

Pearl Phase II Project

4

3

2

IW 23adH-3-65

IW 23acH-3-65

OM 33d-3-65

NWN 44-3-65

St. Helens

Miller Station

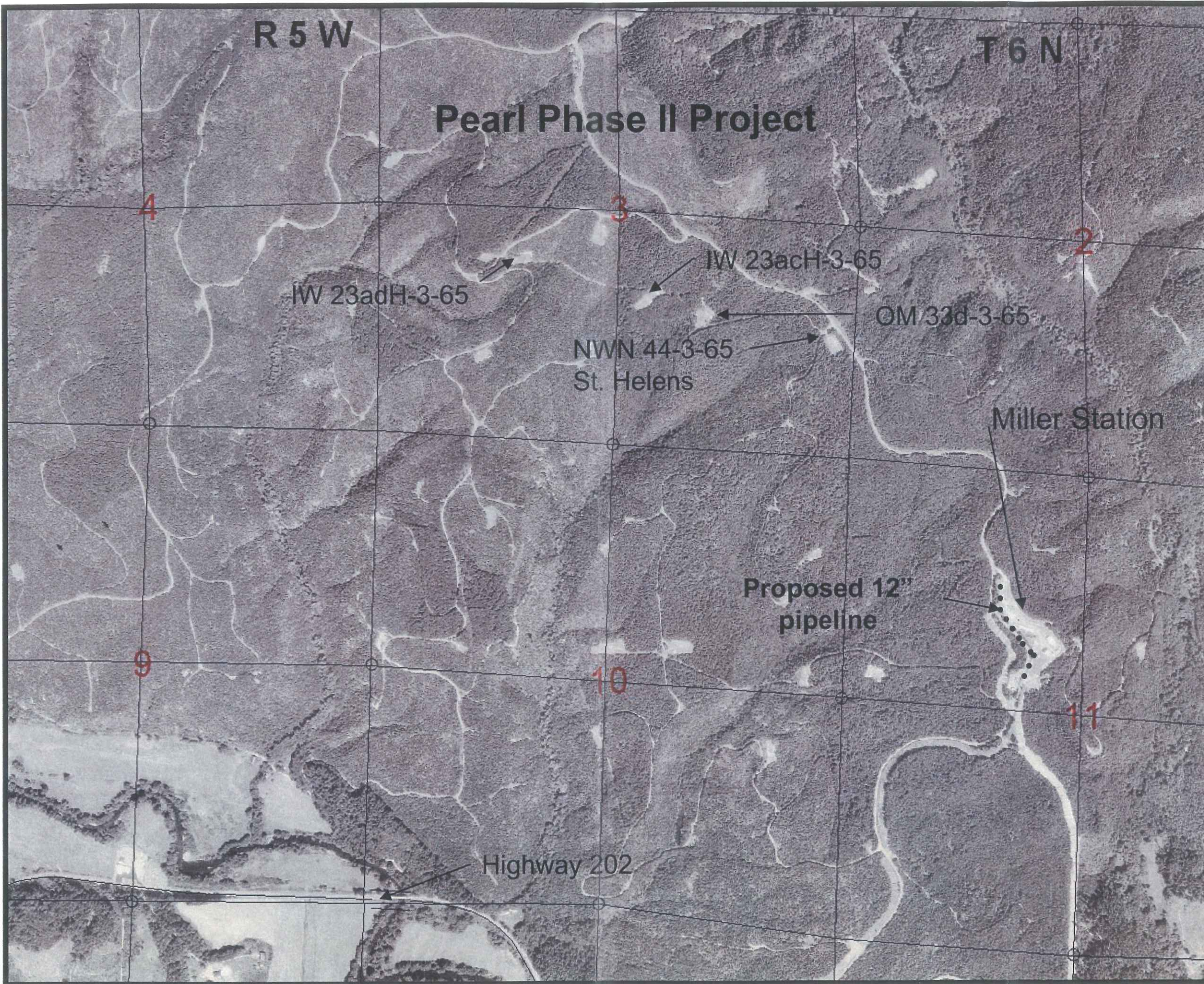
Proposed 12"
pipeline

9

10

11

Highway 202



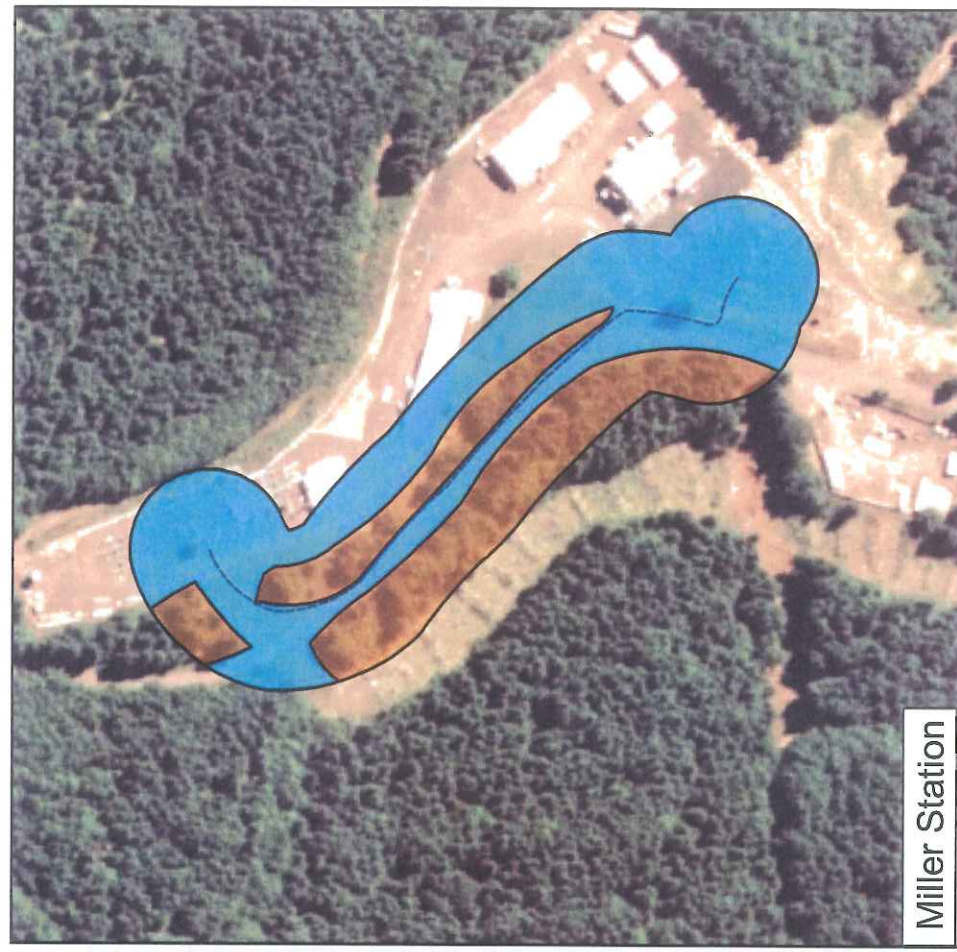


Figure 2
Wildlife Habitat

0 250 500 Feet

EXHIBIT 4

ENVIRONMENTAL STUDIES REPORT

Interstate Storage Project – Pearl Phase II

Prepared for:
Northwest Natural

April 20, 2007

URS

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Suite 1500
Portland, Oregon 97201
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1.0 INTRODUCTION

Northwest Natural owns and operates an existing underground gas storage facility near Mist, Oregon. As part of its Interstate Storage Project, Northwest Natural has been expanding the facility in recent years through enlargement of the facilities at Miller Station and the available deliverability from the Bruer Flora Storage Area.

The Pearl Phase 2 of the Interstate Storage Project includes (1) adding well facilities to utilize additional and existing underground reservoirs; and (2) expanding the existing Miller Station facilities to increase the combined total Mist storage peak-day delivery to 515 MMcfd from the current maximum compressed capability of 425 MMcfd. Most of the project would occur in areas where NW Natural has an existing right-of-way, with the exception of a 12-inch diameter, 1,300-foot long pipeline in the privately-owned roadway adjacent to Miller Station, and approximately 200 feet of 8-inch diameter connector pipe between new well at St. Helens Pool and an existing natural gas pipeline on the other side (east) of the existing roadway.

Northwest Natural contracted URS Corporation to conduct baseline surveys and impact studies of the environmental resources in the project area. Environmental resources analyzed include: protected areas, fish and wildlife habitat, threatened and endangered species, cultural resources, recreation, and wetlands. This report presents the pertinent Oregon Administrative Rules (OAR) for each resource, existing conditions, and conclusions about project impacts as far as they are understood at this preliminary planning stage.

1.1 Landscape Setting

The project area is located in rural Columbia County in the Township 6 North Range 5 West, Section 2 E ½, Section 3 W ½, and Section 11 NW ¼, Willamette Meridian (Figure 1). The Coast Range mountains of northwestern Oregon dominate the larger landscape. The upper reaches of the Nehalem River flow from east to west about 2 miles south of the project area near Mist, Oregon.

The region's climate is shaped by the Coast Range's geologic uplift capturing 100 plus inches of precipitation yearly. Topography ranges from river bottom to steep ridges with the primary land-use being industrial forestry. Portland, Oregon is about 45 miles to the southeast and Astoria, Oregon is approximately 28 miles to the northwest. The Columbia River is 8 miles due north.

2.0 PROTECTED AREAS

The State of Oregon's protected areas standard prohibits the siting of an energy facility in any of the protected areas listed in the rule. The standard permits the siting of a facility outside the listed protected areas so long as the "design, construction and operation" of the facility "is not likely to result in significant adverse impact to" any of the protected areas, per OAR 345-22-040(1).

Protected areas as defined in OAR 345-022-040 include national parks, national monuments, wilderness areas, national and state wildlife refuges, national coordination areas, national and state fish hatcheries, national recreation and scenic areas, state parks and waysides, state natural heritage areas, state estuarine sanctuaries, scenic waterways, experimental areas established by the Rangeland Resources Program, agricultural experimental stations, research forests, Bureau of Land Management (BLM) areas of critical environmental concern, and state wildlife and management areas.

Several map sources were used for identifying protected areas in northwestern Oregon in the vicinity of the Project Area. Most of the protected areas in the region were found on a set of maps created by the Oregon Department of Energy covering national, state, BLM, and Oregon State University protected areas. Information from the Oregon State Department of Fish and Wildlife was used to identify state hatcheries. Oregon Natural Heritage Program staff provided location information on state natural heritage areas. The nearest protected areas of various kinds are noted below even when they are at a distance greater than any potential impact from the proposed project.

Oregon State University's Blodgett Research Forest is located about 4 miles northwest of the north end of the pipeline route, north of Mist, Oregon.

State wildlife areas are located 15 miles east and 15 miles west of the Project site. The state wildlife area west of the pipeline is Jewell Wildlife Area. Saddle Mountain State Park is located about 20 miles west of the pipeline route. A state estuarine sanctuary on the Columbia River is located about 15 miles from the Project site.

The Nehalem Fish Hatchery is located more than 20 miles from the project area along the Nehalem River. Several other state hatcheries are located over 20 miles north of the project area along the Columbia River.

Twenty-three state natural heritage areas are located in the northwestern portion of Oregon, in Clatsop, Multnomah, Tillamook, Clackamas, and Columbia Counties. Skull and Little Wallace Islands, located in the Columbia River, are approximately 10 miles north of Miller Station and

Nehalem Bay is over 20 miles west of the project area. The Blind Slough Swamp, established to protect an old growth Sitka spruce (*Picea sitchensis*) swamp, bald eagle (*Haliaeetus leucocephalus*) nests, and Columbian white-tailed deer (*Odocoileus virginianus leucurus*), is located near the mouth of the Columbia River, over 20 miles northwest of the project area (Stolzenburg 1998). All other heritage areas are also located over 10 miles away from the project area.

National protected areas within the study range include Mt Rainier National Park and Goat Rocks Wilderness at more than 90 miles, Mt. Hood Wilderness at 90 miles, Mt. St. Helens National Monument at 40 miles, and the Columbia Gorge National Scenic Area at 50 miles from the site. Several national wildlife refuges are located along the Columbia River over 20 miles from the project site.

The following types of protected areas were not identified within the range of the study: national coordination areas, national fish hatcheries, experimental range areas, scenic waterways, and agricultural experiment stations.

The design, construction, and operation of the pipeline will not have any adverse impact on any of the listed protected areas. Miller station and Bruer Flora Storage Area (including the gathering lines) are not located in any protected area. The closest protected area is the OSU research forest about 4 miles from the project area. Other protected areas are found from 10 to over 20 miles from the project area.

None of the new facilities will have off-site impacts on these protected areas. The gathering lines will be buried and not visible. Temporary construction impacts for the gathering lines, such as ground disturbance, construction activity and noise are not expected to impact the closest protected area resource.

3.0 FISH AND WILDLIFE HABITAT

URS wetland, wildlife, and fisheries biologists conducted a site-specific biological resource investigation on March 27, 2007. Using aerial photography for reference, they conducted a brief field reconnaissance of the project features and a surrounding 200-foot-wide study area. URS mapped the habitats within the study corridor using aerial photographs, field observations, and professional judgment.

3.1 Habitat Identification

For the purposes of this analysis, habitat is described only in areas of the project that would be disturbed during construction or operation: the 200-foot-long connecting pipeline between the well at St. Helens Pool and existing pipe on the other side of Mainline Road, and the 1,300-foot long pipeline that would be placed directly in Main Line haul road (Figure 2).

The project would pass through several ecological communities or habitat types. The proposed project traverses privately owned timber reserves dominated by commercial Douglas-fir forest and commercial mixed conifer/deciduous forest. The proposed project also crosses developed areas consisting of a roadway and existing natural gas well sites. Detailed descriptions and categorical ratings of all habitats are available in the "Habitat Category Ratings" section.

The Pearl Phase II 12-inch pipeline is proposed to begin and terminate at Miller Station, however, most of the pipe will be installed in the roadway immediately adjacent to, and west of, Miller Station in Section 11 of Township 6 North, Range 5 West. The 1,300-foot-long bidirectional pipeline will be installed in a 24-inch wide and 5- to 6-foot deep trench, primarily within the existing Longview Fiber Main Line haul road. Habitat in the impact area is developed, with surrounding habitat characterized by second-growth Douglas-fir forest.

The well at the St. Helens Pool will be connected to an existing pipeline along the east side of the Main Line Road with two 8-inch diameter pieces of pipe extending approximately 200 feet in length. The new pipe would be located in Sections 2 and 3 of Township 6 North, Range 5 West .

3.2 Habitat Definitions

3.2.1 Terrestrial Habitat

Conifer (Douglas-Fir) Forest

The conifer forests found in the Pearl Phase project area are second or third generation stands (20-50 years old) dominated by Douglas-fir (*Pseudotsuga menziesii*). Private forest resources companies manage these stands for timber production. Other trees in Oregon Coast Range conifer forests include western red cedar (*Thuja plicata*), western hemlock (*Tsuga heterophylla*), and red alder (*Alnus rubra*). The single story canopy is closed with little to no understory. The habitat is basically two layered with a tree canopy layer and a low shrub / herb layer. Dominant understory plants include sword fern (*Polystichum munitum*), salal (*Gaultheria shallon*), Oregon grape (*Mahonia nervosa*), deer fern (*Blechnum spicant*), red huckleberry (*Vaccinium parvifolium*), and trailing blackberry (*Rubus ursinus*). Salmonberry (*Rubus spectabilis*) and vine maple (*Acer circinatum*) are found in scattered patches.

Mixed Conifer/Deciduous Forest

Mixed forest stands in the Oregon Coast Range are typically second or third generation stands (20-50 years old) dominated by Douglas-fir and red alder. A small percentage of western hemlock and western red cedar are present in mixed stands. The canopy is closed with little understory development. The shrub and herb layers common to mixed forests include wood sorrel (*Oxalis oregana*), vine maple, red huckleberry, salal, Oregon grape, and sword fern. Private timber companies manage these forests for timber production.

Developed Lands

Developed lands include existing maintained natural gas well sites, the Miller Station compressor facility, and a cross country utilities corridor directly west and south of Miller Station. The well sites and Miller Station contain structures, gravel surfaces, and a minimum of vegetation. Vegetation present consists of grasses and other small herbaceous species. The utility corridor is actively managed to discourage tree and tall shrub growth that would disrupt overhead and/or underground utilities. This corridor is maintained with a cover of low shrubs and herbaceous vegetation.

3.3 Habitat Category Ratings

As part of the site certification amendment process, habitats that will be impacted must be categorized. The Energy Facility Siting Council's (Council) Fish and Wildlife habitat standard (OAR 345-022-0060) states:

“To issue a site certificate, the Council must find that the design, construction, operation and retirement of the facility, taking into account mitigation, is consistent with the fish and wildlife habitat mitigation goals and standards of OAR 635-415-0025 in effect as of September 1, 2000.” (Oregon Secretary Of State 2005a)

OAR 635-415-0025 (Oregon Secretary Of State, 2005b) describes six categories of habitat based on their importance to fish and wildlife. The rule establishes mitigation goals and corresponding implementation standards for each habitat category. Project area habitats fall into Categories 4 and 6. Category 4 habitat is defined in OAR 635-415-0025 as “important habitat for fish and wildlife species.” No net loss of habitat quality or quantity, avoidance of impacts, and reliable in-kind or out-of-kind replacement are priorities in Category 4 habitat. Category 6 habitat “has low potential to become essential or important” for fish and wildlife species. Minimization of impacts is the priority in Category 6 habitats. The rationale for categorizing the various affected habitats is described below.

The habitat categories assigned are based on the habitat descriptions in OAR 635-415-0025 and best professional judgment, considering the common wildlife and fish species likely to use those habitats. The habitat categories are described more fully in the following sections.

3.3.1 Conifer (Douglas-fir) Forest, Category 4

This habitat is considered Category 4 because these forest stands provide habitat for a variety of forest-dwelling wildlife species, but are maintained as commercial timberland and undergo intensive management and periodic harvest. The approximately 25 to 40 year old stands are in the mid-seral stem exclusion stage and will not be allowed to approach late-seral or old-growth conditions.

Tree species present throughout the project area's conifer forests include Douglas fir, grand fir (*Abies grandis*), and red cedar to between 35 and 50 feet tall. Tree diameters range from three to nine inches in some stands and eight to thirteen inches in other stands. Common ground cover and shrub species include sword fern, salal, Oregon grape, vine maple, and ocean spray (*Holodiscus discolor*). Near the bottom of the slopes, just uphill of the riparian forest, were western trillium

(*Trillium ovatum*), wood sorrel, maidenhair fern (*Adiantum pedatum*, infrequent), and Scouler corydalis (*Corydalis scouleri*). False-lily-of-the-valley (*Maianthemum dilatatum*), cascara (*Rhamnus purshiana*), western trillium, and Himalayan blackberry (*Rubus armeniacus*, infrequent) were found scattered throughout the project area on southeast facing slopes.

Habitat structures like snags and woody debris are sparse in these second growth stands. None of the stands provide locations of special importance for deer fawning or elk calving. Certain species such as deer and elk and forest birds (chickadees, thrushes, jays, woodpeckers, etc.) are abundant, but overall plant and wildlife species diversity is relatively low. Future timber harvesting will continue to affect the habitat value of these stands.

3.3.2 Mixed Conifer/Deciduous Forest, Category 4

Although these forests, in most cases, are also managed as commercial timberland, they generally have greater habitat value than the less diverse conifer forests. Species diversity is higher, snags and woody debris are more abundant, and forage and cover are available to a greater number of wildlife species. Most of these forests are in the mid-seral stem exclusion stage but are not allowed to approach late-seral or old-growth conditions. These forests do not receive a higher category rating because they exist in managed industrial forest that receives periodic harvests, limiting its potential importance to wildlife species.

Tree species present throughout the project area's mixed conifer /deciduous forests include Douglas fir, red alder, and vine maple to between 30 and 50 feet tall. Tree diameters range from three to twelve inches. Common ground cover and shrub species include sword fern, red huckleberry, salal, Oregon grape, vine maple, ocean spray, and Indian plum (*Oemleria cerasiformis*). Red-flowering current (*Ribes sanguineum*), miners lettuce (*Claytonia* sp.), trailing blackberry, and devils club were found in moist forest east of and uphill from the riparian corridor along the south alternative gathering line route.

None of the stands in the project area provide locations of special importance for deer fawning or elk calving. Certain species such as deer and elk and forest birds (chickadees, thrushes, crossbills, jays, woodpeckers, etc.) are abundant, but overall plant and wildlife species diversity is relatively low. Future timber harvesting will continue to affect the habitat value of these stands.

3.3.3 Developed Lands, Category 6

Developed lands are classified as Category 6 due to the extent and permanence of human-induced impacts and the limited habitat opportunity for most species. These areas include buildings, well

pads, utility corridors, and other actively managed landscapes. The lack of vegetation or structural component offers very limited habitat for most wildlife. It provides no support to forest streams or the surrounding forest. Most wildlife species do not seek out these spaces to fulfill their life history requirements.

4.0 FISH AND WILDLIFE SPECIES

Wildlife species that use the surrounding habitats are common to the coastal region of Oregon. Large mammals like Roosevelt elk (*Cervus elaphus nannodes*) and Columbia black-tailed deer (*Odocoileus hemionus*) may use the older conifer forests for forage and cover. Common mammal predators are coyote (*Canus latrans*), black bear (*Ursus americanus*), cougar (*Felis concolor*), weasels (*Mustela* spp.), and mink (*Mustela vison*). Small mammals include Douglas squirrels (*Tamiasciurus douglasii*), mountain beaver (*Aplodontia rufa*), bats (*Myotis* spp., *Lasionycteris noctivagans*, *Corynorhinus townsendii townsendii*), deer mice (*Peromyscus* spp.), jumping mice (*Zapus trinotatus*), shrews (*Microsorex hoyi* and *Sorex* spp.), moles (*Scapanus* spp.), voles (*Microtus* spp.), and other small rodents.

Birds common to northwestern Oregon forest lands include the American robin (*Turdus migratorius*), varied thrush (*Ixoreus naevius*), song sparrow (*Melospiza melodia*), western tanager (*Piranga ludoviciana*), Steller's jay (*Cyanocitta stelleri*), black-capped chickadee (*Poecile atricapilla*), and red-breasted nuthatch (*Sitta canadensis*). Red-tailed hawks (*Buteo jamaicensis*) and turkey vultures (*Cathartes aura*) may be observed soaring overhead. Pileated woodpecker (*Picoides pubescens*), Swainson's thrush (*Catharus ustulatus*), winter wren (*Troglodytes troglodytes*), Townsend's warbler (*Dendroica townsendi*) and various neotropical migrants are common in the older conifer forests.

Northwestern garter snakes (*Thamnophis ordinoides*) and common garter snakes (*T. sirtalis*) are common in early-seral and clearcut forest, where openings exist for foraging and basking. Pacific chorus frog (*Pseudacris regilla*), and Northern red-legged frog (*Rana aurora aurora*) are common in the forest understory near streams, ponds, and other waters where they breed.

4.1 Special Status Species

A URS biologist conducted a field reconnaissance on March 27, 2007. Prior to the field work, lists of state and federally listed species expected to occur in the vicinity of the proposed project were obtained. Using those lists along with mapped information on the species, previous reports and studies for the area as points of reference, the biologist conducted a field reconnaissance of the proposed pipeline segments and a 200-foot-wide study area surrounding the segments.

A list of federally listed threatened species and species of concern in Columbia County, Oregon with potential to occur in the project area (Table 1) was generated from the USFWS web site based on existing habitat conditions. This table also provides information about state-listed and sensitive species [under ORS 564.105(2) and ORS 496.172(2)] with potential to occur in the project area

(Table 2) was generated from the Oregon Natural Heritage Information Center (ORNHIC), which covers state-listed plants for the Oregon Department of Agriculture and state-listed animals for the Oregon Department of Fish and Wildlife.

After reviewing current literature on the distribution, habitats, identification and background for each of the special status species, a brief field reconnaissance was conducted on March 27, 2007. A wildlife biologist assessed the existing habitat conditions for evidence of suitability for any of the special status species identified during the information review phase. Incidental observations of special status species were noted. The survey findings for each listed or candidate species are covered under the “Populations in the project area” for each species discussed below.

Table 1. Special Status Species that Potentially Occur in the Vicinity of the Pearl Phase II Project

Common name	Scientific name	Status		Likelihood of occurrence/ present of habitat requirements
		USFWS ¹	ODFW/ ODA ²	
MAMMALS				
Columbian white-tailed deer	<i>Odocoileus virginianus leucurus</i>	E	SV	Low / no riparian bottomland habitat
Townsend’s big-eared bat	<i>Corynorhinus townsendii townsendii</i>	SOC	SC	Moderate / some opportunities for nesting around little-used buildings
Silver-haired bat	<i>Lasionycteris noctivagans</i>	SOC	SU	Moderate / some opportunities for nesting around little-used buildings
Long-eared myotis	<i>Myotis evotis</i>	SOC	SU	Moderate / some opportunities for nesting around little-used buildings

Common name	Scientific name	Status		Likelihood of occurrence/ present of habitat requirements
		USFWS ¹	ODFW/ ODA ²	
Fringed myotis	<i>Myotis thysanodes</i>	SOC	SV	Moderate / some opportunities for nesting around little-used buildings
Long-legged myotis	<i>Myotis volans</i>	SOC	SU	Moderate / some opportunities for nesting around little-used buildings
Yuma bat	<i>Myotis yumanensis</i>	SOC	SU	Moderate / some opportunities for nesting around little-used buildings
Red tree vole	<i>Arborimus longicaudus</i>	SOC	SU	Low / lack of late-successional forest characteristics
White-footed vole	<i>A. albipes</i>	SOC	SU	Low / lack of riparian habitat
BIRDS				
Bald eagle	<i>Haliaeetus leucocephalus</i>	T	T	Low / potentially suitable roosting trees, but no water present. Nearest nest is >1 mile south of the project.
Northern spotted owl	<i>Strix occidentalis caurina</i>	T	T	Low / lack of habitat with late-successional components.

Common name	Scientific name	Status		Likelihood of occurrence/ present of habitat requirements
		USFWS ¹	ODFW/ ODA ²	
Band-tailed pigeon	<i>Patagioenas fasciata</i>	SOC	N/A	High / presence of open areas adjacent to dense conifer stands.
Olive-sided flycatcher	<i>Contopus cooperi</i>	SOC	SV	High / presence of recently logged and early seral forests
Mountain quail	<i>Oreortyx pictus</i>	SOC	N/A	High / presence of early seral habitats
Purple martin	<i>Progne subis arboricola</i>	SOC	SC	Low / no water located within project vicinity
AMPHIBIANS				
Northern red-legged frog	<i>Rana aurora aurora</i>	SOC	SU	Low / lack of water features in project vicinity.
PLANTS				
Nelson's checker-mallow	<i>Sidalcea nelsoniana</i>	T	T	Moderate / lack of prairie habitats in project area.

¹U.S. Fish and Wildlife Service

²Oregon Dept. of Fish and Wildlife / Oregon Dept. of Agriculture

Key to status codes:

T = state or federal threatened E = state or federal endangered SOC = federal species of concern

SV = state sensitive vulnerable SC = state sensitive critical

SU = state sensitive undetermined (further study needed)

4.1.1 Federally-listed Species

Bald Eagle

Status: The bald eagle is listed as threatened under the Oregon and federal Endangered Species Acts. The Oregon Natural Heritage Program (ORNHP) also lists it as a conservation concern in Oregon (List 4).

Background Information: The bald eagle population has been steadily increasing since the species received federal protection (endangered status) under the ESA in 1978. It has been protected much longer under the Bald and Golden Eagle Protection Act. The federal ESA status of bald eagles was downgraded from endangered to threatened in 1995 (USFWS 1995). The USFWS proposes to remove the bald eagle in the lower 48 states from the list of Endangered and Threatened Wildlife by June 29, 2007, but to date the species remains listed as threatened under the federal ESA. Protection under the Oregon ESA dates from 1987.

Bald eagles are large birds of prey that nest and forage along fish-bearing waters. They primarily consume fish, but will also feed on waterfowl and carrion. Bald eagles build large stick nests in conifer trees and occasionally in deciduous trees or on cliffs. Nests are most common near marine shorelines, but also occur on rivers and lakes. Nesting activity usually occurs in January and February with hatching occurring in April and May. Fledglings will typically leave the nest in mid-July, but usually remain at or near the nest until mid-August. Nests are often located near the top of the largest tree with an unobstructed view of open water.

Populations in the Project Area: One bald eagle nest is known to occur in the Calvin Creek drainage approximately 1.25 miles south of Miller Station and along the Nehalem River. This nest successfully produced two fledglings in 2005, but failed to produce young in 2006 (Isaacs and Anthony 2007). Other known bald eagle nests in the vicinity are located near the Columbia River, over 5 miles from the project area (Isaacs and Anthony 2007). None were observed during the field reconnaissance.

Northern Spotted Owl

Status: The northern spotted owl is listed as threatened under the Oregon and federal Endangered Species Acts. The USFWS has designated critical habitat for the northern spotted owl under the federal ESA. It is also listed as threatened with extinction (List 1) by the Oregon Natural Heritage Program (ORNHP).

Background Information: Northern spotted owls occur in mountainous and humid coastal forests from southwestern British Columbia, south through western Washington and western Oregon, to northern California (AOU 1983).

This subspecies is dependent on stands of mature and old-growth forest with a multi-layered canopy (Johnsgard 1988). Northern spotted owls occupy northern interior forests with a moderate to high canopy closure, a multi-layered multi-species canopy with large trees, a high degree of deformities in large trees, large snags, fallen trees and other debris on the ground, and open space below the canopy (Jackson et al. 1995). Northern spotted owls prey on other forest species such as wood rats, deer mice, voles, rabbits, flying squirrels, bats, birds, and some reptiles and invertebrates (Johnsgard 1988) (Terres 1991).

Northern spotted owls generally nest in tree cavities, on stick platforms, or on other debris in old growth conifer trees. Resident owls start roosting near nesting territories in February or early March with actual egg laying occurring March to May (Terres 1991). Generally two eggs are laid and hatch about a month after being laid.

The primary threat to this subspecies is the loss of habitat from forest management practices (Johnsgard 1988).

Populations in the Project Area: There are no known northern spotted owl nests in the vicinity of the project area and the USFWS has not designated any critical habitat in Columbia County. Suitable habitat for northern spotted owls is extremely limited in the Oregon Coast Range due to extensive timber harvesting, forest fragmentation, and catastrophic fires followed by salvage of live and dead trees (USFWS 1992). The ORNHIC database does not contain any records of northern spotted owl nests or populations within 2 miles of the project area. None were observed during the field reconnaissance.

The proposed natural gas pipeline passes through nearly homogenous, single-story, second growth Douglas-fir stands. Stands in the project area are up to 40 years old and lack a multi-layered canopy and other habitat features found in mature or old-growth stands preferred by northern spotted owls.

Columbian white-tailed deer

Status: The Columbia River distinct population segment (DPS) of the Columbian white-tailed deer is listed as endangered under the federal ESA. Until recently the entire species was listed as endangered under the federal ESA. On July 24, 2003, the USFWS identified the Douglas County and Columbia River distinct population segments (DPS) of the deer and removed the Douglas

County DPS from the list of threatened and endangered species. The Columbia River DPS remains listed as endangered (68 Federal Register 43647, July 24, 2003). It is also listed as threatened with extinction (List 1) by the Oregon Natural Heritage Program (ORNHP) and as sensitive on the Oregon State Department of Fish and Wildlife (ODFW) list of sensitive species.

Background Information: This white-tailed deer subspecies was federally listed in 1967 and state listed in 1987 as endangered. In 1995 the Oregon Fish and Wildlife Commission determined that the species has recovered and removed it from the state endangered list.

Their preferred habitat includes open riparian zones of lowlands where the deer forage on herbs and grasses. They will also forage along edges of habitat dominated by shrubs. Populations have decreased due to habitat destruction in riparian areas through the conversion of shrub and forest habitats to agricultural lands.

Populations in the Project Area: A small population (<1000 animals) occurs in riparian habitat along the Columbia River and islands of the Columbia River, north of the project. No suitable riparian habitat occurs within the project area, and Columbian white-tailed deer are not known to occur within the area where the project is located. None were observed during the field reconnaissance.

Nelson's checker-mallow

Status: Nelson's checker-mallow is listed as threatened under the Oregon and federal Endangered Species Acts. It is also listed as threatened with extinction (List 1) by the Oregon Natural Heritage Program (ORNHP).

Background Information: Nelson's checker-mallow is a regional endemic with a range from Lewis County, Washington south to Benton County, Oregon. This species was federally listed in 1993 and added to the Oregon list soon thereafter. Nelson's checker-mallow is generally found in areas where prairie or grassland remnants persist. Examples of such habitat include fencerows, drainage swales and at the edges of plowed fields adjacent to wooded areas. Fire suppression has facilitated the encroachment of woody species into the grasslands that Nelson's checker-mallow inhabits, while roadside herbicide spraying and untimely mowing may also contribute to this species' decline.

Populations in the Project Area: The ORNHIC database had no records of Nelson's checker-mallow within 2 miles of the project area. The absence of native prairie habitat in the project area makes the likelihood of an occurrence extremely low. Nelson's checker-mallow was not observed during the field reconnaissance.

4.1.2 Federal Species of Concern

The U.S. Fish and Wildlife Service (USFWS) and NOAA Fisheries noted 14 federal species of concern that may occur in the project vicinity. Those species with preferred habitat occurring in the project vicinity, or those that have a likelihood of occurring in the project area are discussed below. Many of these species are also classified as sensitive by ODFW.

4.1.3 Birds

Band-tailed Pigeon

Status: The band-tailed pigeon is a federal species of concern.

Background Information: Band-tailed pigeons prefer to forage in open sites bordered by tall conifers, such as managed forests, city parks, or neighborhoods. In western Oregon, they prefer to nest in dense coniferous forests. They nest in small colonies near the tops of trees within thick conifer forest.

Populations in the Project Area: This species is found along much of the Pacific Coast. Band-tailed pigeons are likely to occur in the project area, although none were observed during the field reconnaissance.

Olive-sided Flycatcher

Status: The olive-sided flycatcher is a federal species of concern. It is also listed as a sensitive (vulnerable) species in Oregon.

Background Information: Olive-sided flycatchers utilize recently logged forests, shrub dominated areas, and early-seral conifer forests. They commonly perch at tops of trees, conducting occasional flights to capture large insects, especially bees. The cause of species decline is unknown, but habitat loss on the wintering grounds (South America) is a possible threat. The most significant decrease in olive-sided flycatcher populations has occurred in eastern North America.

Populations in the Project Area: Olive-sided flycatchers are likely found throughout the project area during the breeding season; from mid-May to mid-August. None were observed during the field reconnaissance.

Mountain Quail

Status: The mountain quail is a federal species of concern.

Background Information: Mountain quail prefer densely vegetated slopes often resulting from disturbance or logging activities. They require a source of water for breeding activities and often prefer alder thickets along streams and steep shrubby early-seral forest clearcuts. Development, agriculture, and overgrazing are major threats to this species.

Populations in the Project Area: The status of many mountain quail populations are not well known due to the species' elusive and secretive nature. Known Oregon populations exist in the Coast Range, Cascade Mountains, near the Columbia River Gorge, and in the Blue Mountains. While mountain quail are still common in western Oregon, interior populations east of the Cascade Mountain crest have almost completely disappeared due to overgrazing in riparian areas and the spread of agriculture. This species is likely to occur in the project area. No mountain quail were observed during the field reconnaissance.

Purple Martin

Status: The purple martin is a federal species of concern. It is also listed as critical on the ODFW list of sensitive species.

Background Information: This swallow nests in abandoned woodpecker holes (cavities within snags) or in artificial nest boxes. Cavities in pilings near bays and along the lower Columbia River also provide habitat for nesting pairs. Nesting pairs in western populations primarily nest singly, rather than in colonies (Csuti et al. 2001). Purple martins are summer breeding residents in western Oregon. Purple martins require the juxtaposition of appropriate nesting habitat with open areas for foraging, usually near the shores of lakes, large rivers, or saltwater bays (Csuti et al. 2001). Most existing nesting pairs in Oregon utilize artificial nest boxes for a number of reasons. The removal of large dead snags trees has reduced the availability of natural nesting sites. Also, introduced European starlings and house sparrows (*Passer domesticus*) tend to outcompete martins for the limited number of natural nest cavities available. Artificial nest boxes can be designed and maintained to prevent their use by introduced birds (Horvath 1999). Purple martins feed on flying insects and catch most of their food on the wing. A 1998 statewide population survey (Horvath 1999) of 784 pairs of purple martins in Oregon estimated the statewide populations as less than 1,000 pairs. Purple martins were uncommon and local, but were locally common along the Columbia River and in some coastal estuaries. Purple martin require an average distance of 160 yards between nest cavities and large canopy trees and will not nest closer than 20 feet from the edge of the canopy of large trees (Horvath 1999).

Populations in the Project Area: The nearest known nesting pairs were located at Nehalem Bay (Kostka 2000) and along the Columbia River (where they are locally abundant) (Horvath 1999, Kostka 2000, Csuti et al. 2001). No nesting habitat exists in the vicinity of the Pearl Phase gathering systems project. The surrounding habitat is composed of closed canopy forest throughout the project area, which is unsuitable for nesting purple martin. None were observed during the field reconnaissance.

4.1.4 4.2.2 Mammals

Townsend's big-eared bat
Fringed myotis
Long-eared myotis
Long-legged myotis
Yuma bat
Silver-haired bat

Status: The Townsend's big-eared bat, silver-haired bat, and myotis bats are federal species of concern. Due to their dependence on caves and cave-like habitat for hibernation and sensitivity to the disturbance of hibernation caves, Townsend's big-eared bat is considered a critical (listing as threatened or endangered is pending or for which listing as threatened or endangered may be appropriate if immediate conservation actions are not taken) state sensitive species. Fringed myotis are considered a vulnerable state sensitive species, while the silver-haired bat, long-eared myotis, and long-legged myotis are considered state sensitive species of undetermined status (status is unclear, may be susceptible to population decline, but scientific study needed to determine if decline is of sufficient magnitude that they could qualify for listing as endangered, threatened, critical sensitive, or vulnerable sensitive species).

Background Information: Townsend's big-eared bats in western Oregon are associated with coniferous forests and are scattered in distribution. Caves and abandoned mines are considered critical habitat (Verts and Carraway 1998) for roosting and hibernation. They will also use buildings if caves or mines are absent. This species is extremely sensitive to human disturbance while roosting or hibernating.

Silver-haired bats are also found in conifer forests and occasionally roost in caves and mines. For summer roosting, they use old growth snags. Similarly, myotis species are associated with conifer forests and were probably cave dwellers historically, but have adapted to using mines, buildings, and other man made structures.

Populations in the Project Area: The ORNHIC database does not contain any records of colonies or roosting areas within 2 miles of the project area. None have been reported in the project vicinity and suitable roosting, breeding, and hibernation habitat is not present in the project vicinity. Incidental use of the existing habitats by foraging animals is possible with each bat species. None were observed during the field reconnaissance.

Red Tree Vole

Status: The red tree vole is a federal species of concern. It is also listed as a species for which more information is needed before status can be determined. It is listed as a sensitive species of undetermined status (status is unclear, may be susceptible to population decline, but scientific study is needed to determine if decline is of sufficient magnitude that they could qualify for listing as endangered, threatened, critical sensitive, or vulnerable sensitive species) on the ODFW list of sensitive species.

Background Information: Red tree voles are endemic to Oregon and are found in the coastal and interior mountain ranges. They prefer dense, moist conifer forests and nest in large trees typically 50 feet above ground. Similar to its major predator the northern spotted owl, loss of preferred habitat due to timber harvest has had a significant effect on populations.

Populations in the Project Area: The ORNHIC database does not contain any records of red tree vole populations within 2 miles of the project area. The range of the red tree vole in the northern portion of the Oregon Coast Range appears to be primarily in moister forest habitat west of Columbia County (Csuti et al. 2001). Because of the lack of mature conifer trees it is possible, but unlikely that red tree voles occur in the project area. None were observed during the field reconnaissance.

White-footed vole

Status: The white-footed vole is a federal species of concern. It is also listed as a sensitive species of undetermined status (status is unclear, may be susceptible to population decline, but scientific study needed to determine if decline is of sufficient magnitude that they could qualify for listing as endangered, threatened, critical sensitive, or vulnerable sensitive species) on the ODFW list of sensitive species.

Background Information: This species once competed with the spotted bat (*Euderma maculatum*) for the title of “rarest mammal in North America” (Csuti et al. 2001). It has been observed more frequently in recent years, but still is uncommon. Some feel it may benefit from timber harvest practices that create early successional conditions (Csuti et al. 2001). The white-footed vole is

found in a variety of habitats, but most frequently in riparian (especially red alder stands) areas in coniferous forests (Csuti et al. 2001, Verts and Carraway 1998). Small clearings supporting a growth of forbs may also be an important habitat component. This species is presumed to be a burrowing rodent, nocturnal, and active throughout the year (Csuti et al. 2001).

Populations in the Project Area: The ORNHIC database does not contain any records of white-foot voles within 2 miles of the project area. Because of the lack of riparian habitat within the project area and low occurrence levels of this species, it is unlikely that white-footed tree voles occur in the project area. None were observed during the field reconnaissance.

4.1.5 Amphibians

Northern Red-legged Frog

Status: The northern red-legged frog is a federal species of concern. Outside of the Willamette Valley, this species is listed as a sensitive species of undetermined status (status is unclear, may be susceptible to population decline, but scientific study needed to determine if decline is of sufficient magnitude that they could qualify for listing as endangered, threatened, critical sensitive, or vulnerable sensitive species) on the ODFW list of sensitive species.

Background Information: In western Washington and Oregon northern red-legged frogs range from sea level up to 4,680 feet in the Umpqua National Forest of Oregon. Red-legged frogs are also found in the Columbia Gorge (Leonard et al. 1993).

Northern red-legged frogs breed in fresh water marshes, ponds, lakes, and slow-moving streams. Eggs are laid in water on emergent vegetation or submerged branches in late winter or early spring (January or February near sea level). The embryos take about four weeks to develop into tadpoles, and tadpoles develop into frogs in about four to five months, in May, June, or July. Adult frogs are often found in upland forests near streams and wetlands (Leonard et al. 1993).

Populations in the Project Area: Northern red-legged frogs may occur in conifer and early-seral forested habitat within the project area, but are generally found in riparian forest in the vicinity of streams and ponds, which are not present in the project area. The ORNHIC database does not contain any records of northern red-legged frog populations within 2 miles of the project area. None were observed during the field reconnaissance.

5.0 CONCLUSIONS

5.1 Potential Impacts to Habitat

5.1.1 Compliance with Goals and Standards

The 12-inch pipeline adjacent to Miller Station will be trenched within the existing road corridor. The 8-inch pipelines connecting the well at St. Helens Pool to an existing pipeline will be partially constructed through mixed conifer/deciduous forest, thus requiring removal of some trees. The construction corridor will be 40 feet (or less) wide. These impact areas are applicable to the habitat categories discussed below.

Category 4 includes:

- Conifer (Douglas fir) Forest
- Mixed Conifer/Deciduous Forest

Category 6 includes:

- Developed Lands

The removal of vegetation will be minimized as much as practicable, and best management practices (BMPs) will be used to prevent erosion of soil into ephemeral drainage pathways and to prevent the spread of weeds. Impacts to these habitats include the removal of vegetative cover and temporary disturbance of the soil in the trench and of the adjacent surface from movement of construction equipment. The vegetation cover will be allowed/encouraged to grow back in the construction corridor with the exception of trees and large shrubs in the area directly over the pipe. This maintenance corridor must be kept clear of tall vegetation to allow for visual inspections and to avoid deep root interference with the pipe.

The impact to forest habitat in the part of the corridor not containing the pipe will be temporary, and the habitat value would be restored to the level allowed in the surrounding tree farm operation. In the area directly over the pipe (typically 20 feet) trees will be discouraged, but other vegetation will be encouraged to prevent erosion and provide habitat value. The tree spacing in the tree farms is controlled to maximize growth, and the maintained pipeline corridor will be narrow enough that the overall spacing of trees in the stand will be unchanged. Therefore, the habitat value will not be diminished except for the temporary impact from construction activities. The restoration of vegetation in place is therefore the mitigation, and the result is no net loss of habitat value.

For these reasons, the design, construction, operation, and retirement of the project, taking mitigation into account, is consistent with the habitat mitigation goals and standards of OAR 635-415-030.

5.2 Potential Impacts to Special Status Species

This section provides a discussion of potential effects to special status species. Table 2 summarizes the impacts to each species.

Table 2. Potential Impacts to Special Status Species

Species	Impacts and Justification
MAMMALS	
Columbian white-tailed deer	Not likely / not documented to occur and no suitable habitat in the project area.
Townsend's big-eared bat	Not likely / not documented to occur and no suitable habitat in the project area.
Silver-haired bat	Not likely / not documented to occur and no suitable habitat in the project area.
Long-eared myotis	Not likely / not documented to occur and no suitable habitat in the project area.
Fringed myotis	Not likely / not documented to occur and no suitable habitat in the project area.
Long-legged myotis	Not likely / not documented to occur and no suitable habitat in the project area.
Yuma bat	Not likely / not documented to occur and no suitable habitat in the project area.
Red tree vole	Not likely / not documented to occur and no suitable habitat in the project area.
White-footed vole	Not likely / not documented to occur and no suitable habitat in the project area.
BIRDS	
Bald Eagle	Not likely / not documented to occur and no suitable habitat in the project area.
Northern Spotted Owl	Not likely / not documented to occur and no suitable habitat in the project area.
Band-tailed pigeon	Not likely, conifer woodland impacts are limited to a very narrow corridor of permanent tree exclusion directly over the pipeline.
Olive-sided flycatcher	Not likely / not documented to occur and no suitable habitat in the project area.
Mountain quail	Not likely / not documented to occur and no suitable habitat in the project area.
Purple Martin	Not likely / not documented to occur and no suitable habitat in the project area.
AMPHIBIANS	

Species	Impacts and Justification
Northern red-legged Frog	Not likely / not documented to occur and no suitable habitat in the project area.
PLANTS	
Nelson's checker-mallow	Not likely / not documented to occur and no suitable habitat in the project area.

5.2.1 Federal Threatened and Endangered Species

Bald Eagle

USFWS timing restrictions for construction activities are meant to protect the bald eagle during critical periods of their annual cycle. Construction activities during the breeding season, designated by USFWS as January 1st to August 30th, have the following restrictions: 1) 300-foot no-touch buffer, 2) ¼ mile from nest tree if construction activities are not visible from nest (due to topography or other features), and 3) ½ mile from nest tree if construction activities are visible from nest. The Oregon Forest Practices Act has the same restrictions. Construction activities outside the nesting period (between September 1 and December 31) would not have the ¼-mile or ½-mile restrictions.

Activities associated with Pearl phase of the Interstate Storage Project will have limited to no impact on bald eagles. The proposed project is located approximately 1.25 miles from the nearest known eagle nest to the southwest. Presence of eagle nesting or other activity will be determined before construction begins to preclude unnecessary disturbance to nesting activities.

Northern Spotted Owl

Northern spotted owls will not be affected by project construction. The proposed pipeline segments pass through a patchwork of second-growth stands (20-40 years old) that are not suitable for northern spotted owl nesting. These forest patches are small, surrounded by clearcuts and lack the diversity of vegetation, snags, and other late-successional forest habitat features preferred by northern spotted owls. The small number of trees removed, to accommodate the 8-inch connectors the well at St. Helens Pool, do not provide suitable habitat for northern spotted owls. Their removal will not affect the species.

Columbian white-tailed deer

Columbian white-tailed deer will not be affected by construction activities. There are no riparian areas in the project area, and the project is over 7 miles from the closest known population of Columbia white-tailed deer occurring near the Columbia River.

Nelson's checker-mallow

Nelson's checker-mallow will not be affected. There is no habitat for this species in the project area.

5.2.2 Federal Species of Concern

Project-related effects to federal species of concern, many of which are also state sensitive, are summarized in Table 2.

6.0 RECREATION

Under its Recreation standard, the EFSC council determines whether the “design, construction and operation” of a facility will result in “significant adverse impact to important recreational opportunities in the impact area.” OAR 345-022-0100.

Within the recommended analysis area of 1 mile beyond the proposed corridors, there are no recreation facilities. There is some seasonal light recreation use in the area by hunters and fisherman. The proposed project is determined to have no effect on recreational opportunities or uses within or near the project area consistent with the standards of OAR 345-022-0100.

7.0 HISTORIC, CULTURAL, AND ARCHAEOLOGICAL RESOURCES

Under this standard, the Council considers whether the construction, operation, and retirement of a facility, taking into account mitigation, is likely to result in significant adverse impacts to:

1. Historic, cultural, or archaeological resources that have been listed on, or would likely be listed on, the National Register of Historic Places
2. For a facility on private land, archaeological objects, as defined in ORS 358.905(1)(a), or archaeological sites, as defined in ORS 358.905(1)(c)
3. For a facility on public land, archaeological sites, as defined in ORS 358.905(1)(c)

ORS 358.905(1)(a) defines an archaeological object as an object that (1) is at least 50 years old, (2) comprises the physical record of any culture, and (3) is material remains of past human life or activity that are of archaeological significance.

ORS 358.905(1)(c)(A) defines archaeological site as any location that contains archaeological objects and the contextual associations of the archaeological objects with each other of biotic or geological remains or deposits.

7.1 Pre-field Investigation

To determine the extent of previous research in the project area, a record search was conducted at the State Historic Preservation Office, Salem, Oregon, on July 8, 2003 during an earlier phase of this project. This review indicated that excluding previous studies conducted for Northwest Natural, few archaeological investigations have been conducted in this region of Oregon. Studies conducted for Northwest Natural include an archaeological inventory conducted by Dames & Moore in 1997, in conjunction with previous gas storage operations in the Miller Station vicinity (Dames & Moore 1997) and a series of studies conducted in conjunction with the construction and expansion of the Mist pipeline, south of Miller Station. These latter investigations include the 1987-1988 studies conducted in prior to initial pipeline construction (Gaddis 1987; Hibbs and Ellis 1988a, 1988b), and more limited studies along portions of the same route (Dames & Moore 1998). More recently, a cultural resources survey was conducted within 0.25 miles of the current project area for the Northwest Natural Interstate Storage Project (URS 2004). No additional archaeological inventories have been conducted within a one-mile radius of the project area and no previously recorded archaeological sites are known in the immediate area.

A number of archaeological sites, however, including both historic and prehistoric resources, were recorded in conjunction with the surveys conducted for the Mist pipeline construction (Hibbs and Ellis 1988a). These were largely confined to the floor of the Nehalem Valley and other areas to the south of the current project, primarily along Dairy Creek. Twenty-three sites were recorded along the South Mist pipeline route; several were found in the Nehalem River Valley or along the East Fork of Dairy Creek, and consist of prehistoric artifact scatters and historic structures or homesteads. Limited subsurface testing was conducted at these sites, indicating the presence of some subsurface deposits at the sites in the Nehalem Valley. In addition, numerous cultural observations were made, including isolated artifacts, roads, fences, bridges, and logging railroad grades and trestles. These findings indicate that cultural resources, particularly those related to

historic logging practices, are present in the broader vicinity of the project and may also be anticipated in the project area.

A search of historic General Land Office (GLO) maps with coverage of the project area was conducted prior to the field survey. Historic homesteads were noted on an 1872 map including the project area, however, all were located along the Nehalem River Valley and not in the upland location of the current project area. An historic road, the "Trail from the Columbia to the Nehalem Valley," was also noted on an 1870 GLO map and would have been located within two miles of the current project area. A portion of the current maintained roadway presumably followed this historic trail, however no evidence of the 1870s transportation corridor was noted during a previous inventory, and it was determined that extensive logging activities and road construction throughout the twentieth century likely obscured any evidence of the original trail in this area (URS 2004).

The components of the current project are sited along an existing roadway and existing well pad and surrounded by thick, second-growth coniferous forest or mixed forest intersected by numerous logging roads and skid trails. In general, given the terrain and environment of the project area, as well as the results of previous inventories in the immediate vicinity, overall archaeological sensitivity along the project corridor may be considered relatively low.

7.2 Field Investigation

URS archaeologist Michael S. Kelly visited the Project's area of potential effect on March 22, 2007 and completed a reconnaissance-level survey. Intensive pedestrian survey did not occur because the Project includes (1) areas previously surveyed (URS 2004), and (2) areas already developed such that the native soil surface is no longer visible.

7.3 Results and Recommendations

No previously recorded or newly recognized cultural resources were identified during inventory of the proposed project area. The proposed Project is situated within an area of low archaeological sensitivity, and has little ability to impact potential significant, buried resources. No additional investigation is recommended. Should any potential archaeological resources be encountered during project construction, however, all work in the immediate vicinity should cease until a qualified archaeologist can evaluate the find and recommend an appropriate course of action.

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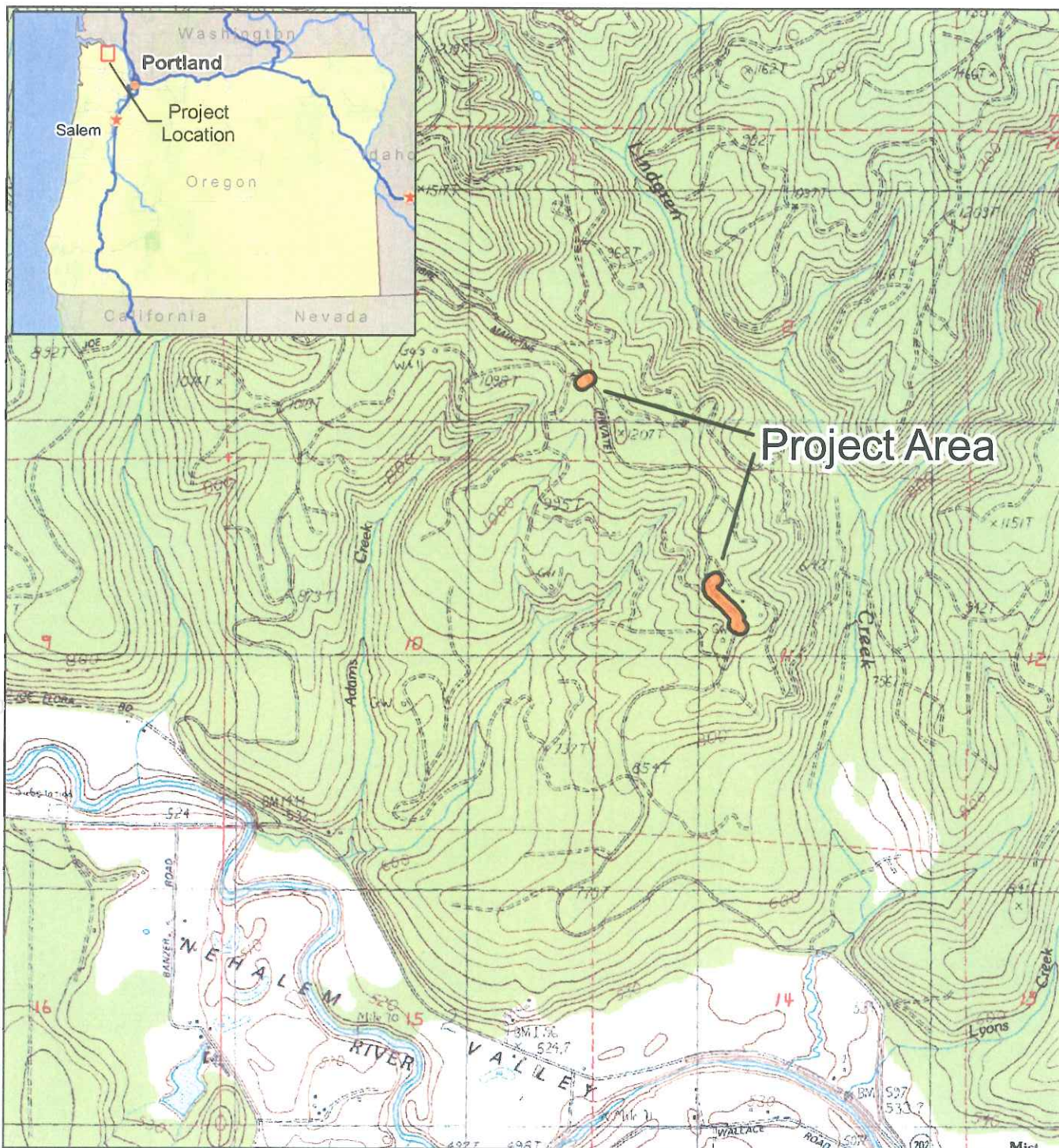
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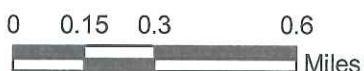
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SOURCE: USGS 7.5-minute topographic map, Marshland, Oregon, 1985



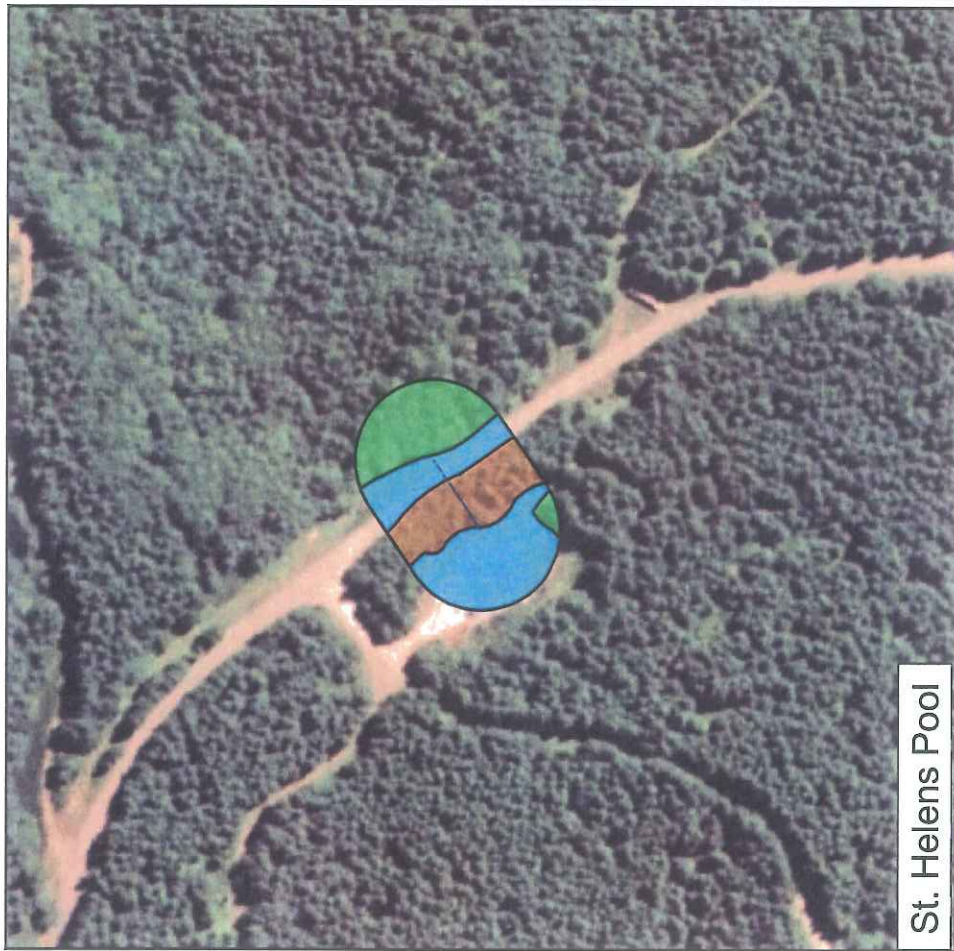
Scale in Miles

Figure 1
Project Vicinity

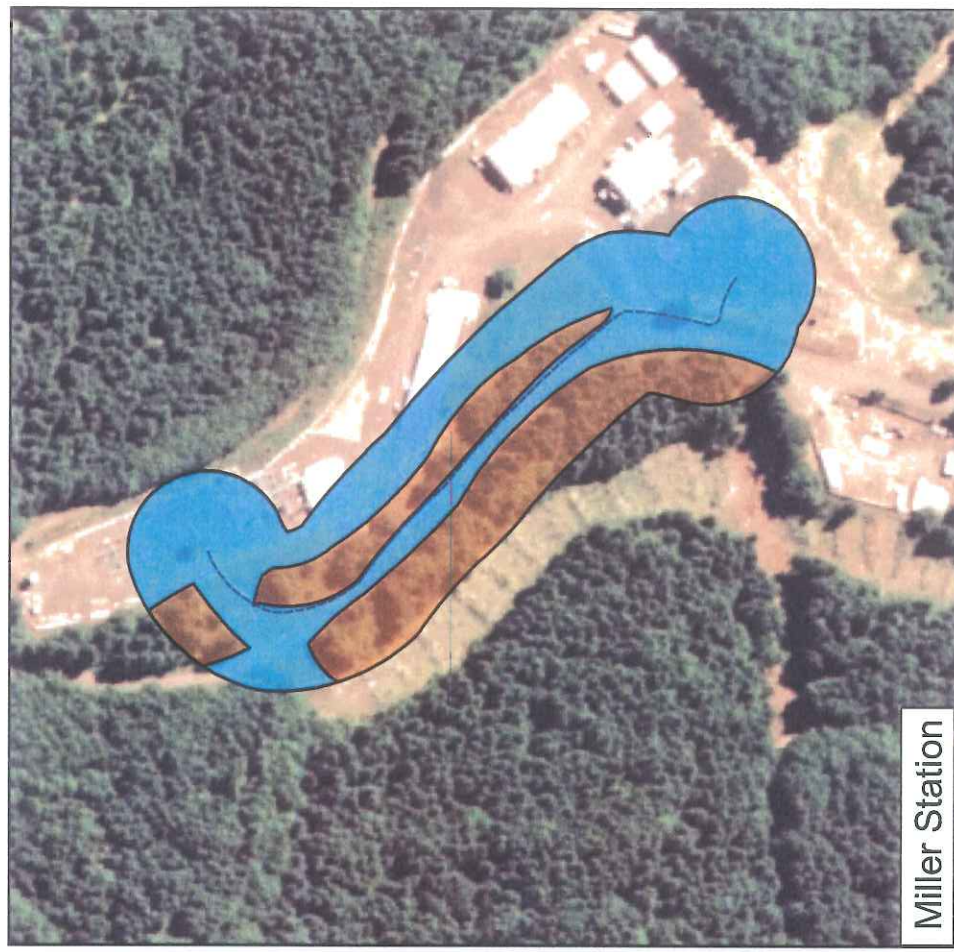
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Interstate Storage Project - Pearl Phase II
Environmental Studies Report
Northwest Natural



St. Helens Pool



Miller Station

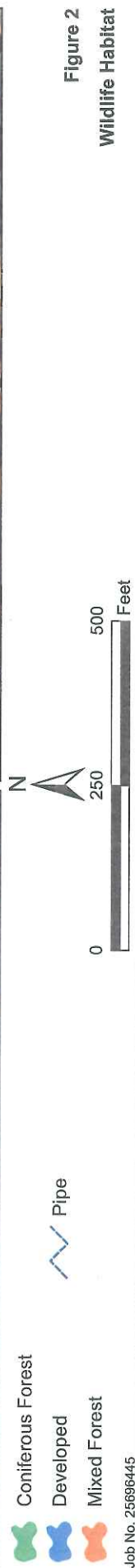


Figure 2
Wildlife Habitat



May 19, 2005

Northwest Natural
220 Northwest Second Avenue
Portland, Oregon 97209

Attention: Mr. Todd Thomas

Subject: Geotechnical and Geologic Hazard Evaluation
Proposed Injection Well and Gathering Line
Pearl Phase I – Bruer Pool Development
File No. 6024-076-00

GeoEngineers is pleased to submit four copies of our report titled "Geotechnical and Geologic Hazard Evaluation, Northwest Natural, Proposed Injection Well & Gathering Line, Pearl Phase I – Bruer Pool Development, Columbia County, Oregon." Our services have been provided in accordance with our proposal dated April 1, 2005.

We appreciate the opportunity to be of continuing service to Northwest Natural (NWN). Please call if you have questions regarding this report or if we can be of further assistance.

Yours very truly,

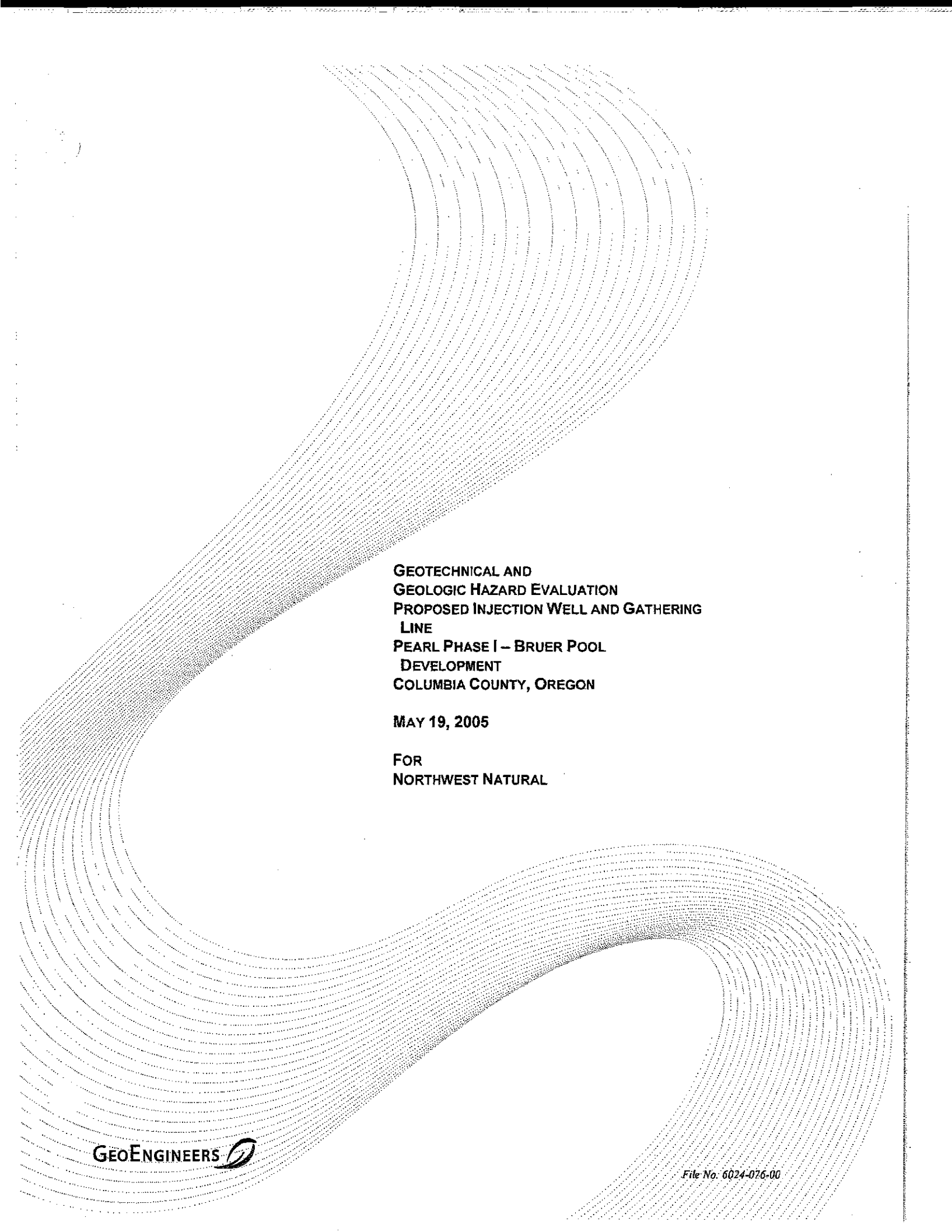
GeoEngineers, Inc.

A handwritten signature in black ink, appearing to read "T. W. Blackwood".

Timothy W. Blackwood, P.E.
Associate

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c. Mr. Jack Meyer



**GEOTECHNICAL AND
GEOLOGIC HAZARD EVALUATION
PROPOSED INJECTION WELL AND GATHERING
LINE
PEARL PHASE I – BRUER POOL
DEVELOPMENT
COLUMBIA COUNTY, OREGON**

MAY 19, 2005

**FOR
NORTHWEST NATURAL**

**Geotechnical and Geologic Hazard Evaluation
Proposed Injection Well and Gathering Line
Pearl Phase 1 – Bruer Pool Development
File No. 6024-076-00**

May 19, 2005

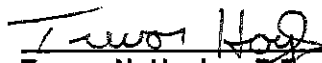
Prepared for:

**Northwest Natural
220 Northwest Second Avenue
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Attention: Mr. Jack Meyer

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EXPIRES: 6/30/05

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**GEOTECHNICAL AND GEOLOGIC HAZARD EVALUATION
PROPOSED INJECTION WELL AND GATHERING LINE
PEARL PHASE I – BRUER POOL DEVELOPMENT
COLUMBIA COUNTY, OREGON
FOR
NORTHWEST NATURAL**

1.0 INTRODUCTION

This report presents the results of our geologic hazard evaluation and geotechnical investigation for the gathering line and proposed injection well planned for the Pearl Phase I of the Interstate Storage Program (ISP) located near Mist, Oregon.

The information used in this evaluation is based on available geologic maps, geologic and geotechnical reports pertinent to the alignment, historical aerial photographs and geologic surface reconnaissance of the planned alignment. Figure 1 shows the project area with respect to surrounding topography.

2.0 PROJECT DESCRIPTION

Northwest Natural (NWN) operates an underground natural gas storage and delivery system in rugged terrain near Mist, Oregon. The system consists of a series of underground gas/storage reservoirs (“pools”), injection/extraction wells, a compressor station (Miller Station), and approximately 20 miles of pipeline. As part of NWN’s plan to increase the system’s capacity, a new injection well will be drilled and a new gathering line will be constructed to connect a series of existing injection wells and the new injection well to Miller Station.

The new gathering line will be constructed from Well 22d10 east to Miller Station. The proposed gathering line will be approximately 6,000 feet long, of which 1,500 feet may be directionally drilled across a canyon.

The proposed injection well pad will include two well heads, a gas/water separator, a 2,000 gallon Methanol tank and a small ancillary equipment shed. NWN proposes to construct the project under the existing Energy Facility Siting Council (EFSC) Mist underground storage site certificate.

3.0 SURFACE CONDITIONS

3.1 GENERAL

The project area is located about 2 to 3 miles northwest of Mist, in Columbia County, Oregon. The site extends across a broad drainage basin located between Adams Creek to the west and Lindgren Creek to the east, all tributaries to the Nehalem River. The approximate existing and proposed gathering line alignments, well pad and general topography of the area are shown on Figure 1.

Landforming processes in the project area have mainly involved stream erosion and mass wasting in the uplifted Coast Range, producing the current dissected topography. In general, relatively weak rocks have been eroded into mostly moderate-gradient slopes by stream incision, soil creep and sliding. More resistant rocks, however, appear to hold up the highlands of Clatskanie Mountain and the ridges to the south. The weaker rocks can form steeper slopes below stronger capping rocks, and where deeply incised by streams. Faulting can also affect landforms: a straight valley segment of Lindgren Creek is thought to

be controlled by a fault trace where rocks are more fractured and susceptible to greater erosion. This is probably the case in other stream valleys in the region, as well.

We have identified large, ancient landslide complexes in the region through our review of stereoscopic aerial photographs and our field reconnaissance as shown in Figure 3. Many of the slides we identified appear to involve the failure of weaker rock layers under caps of more resistant rocks, as erosion initiated by stream downcutting triggered mass wasting that advanced into the ridges. Although these large landslides are widespread near the project area, they are generally inactive and we find no evidence that landsliding poses a significant risk to the proposed gathering line or injection well. Section 5.2 provides a discussion of landslide hazard in the project area.

The following sections describe the topography at the proposed facilities.

3.2 PROPOSED GATHERING LINE SYSTEM

The east end of the proposed gathering system alignment begins at the Longview Fibre Mainline Road at the south end of Miller Station as shown in Figure 2. The alignment follows an existing gathering line and logging road west across generally gentle (less than 15 percent), west facing slopes descending from elevation 1,040 feet mean sea level (MSL) to about 860 feet MSL at the proposed location of the new injection well pad.

From the new injection well site, the alignment continues west along gentle to moderate slopes to the end of the road at the existing Well 42d10 pad. West of Well 42d10 the alignment descends steeply cross country into and across the canyon of an unnamed tributary of Adams Creek to existing Well 32-10. Both east and west side slopes of the tributary drainage canyon range from 50 to 65 percent gradient.

West of the steep canyon slopes the alignment continues west from well 32-10 along generally gentle slopes on an existing gravel road to the termination of the proposed line at well 22d10.

3.3 PROPOSED INJECTION WELL PAD

The proposed injection well site is located on a forested, gently sloping ridgetop with a gradient of approximately 10 percent. The site is bounded to the north by the existing pipeline road, to the east by the pad of Well 13b11 and by timber land to the west and south. No surface water features were observed within or adjacent to the injection well site. The approximate location of the proposed well site is shown on Figure 2.

4.0 SUBSURFACE CONDITIONS

4.1 GEOLOGIC SETTING

The project area is located within mountainous terrain of the Oregon Coast Range. In Oregon, the Coast Range is a belt of moderately high mountains, extending along a north-south axis between the Columbia River and the Klamath Mountains. This anticlinal structural chain is underlain by early Tertiary pillow basalts, lavas, and basalt breccias, erupted underwater and as oceanic islands, and later accreted onto the western edge of the North American continent by the subduction of the Juan de Fuca tectonic plate.

Because of the presence of natural gas in economic quantities, Columbia County has been subject to several generations of geologic research. The understanding of rock units and structures has progressed from the earlier work of Warren and Norbistrath (1946); to more intensive study in the 1970s by Van Atta

(1971), Niem and Van Atta (1973), and Newton and Van Atta (1976); through the master's theses of Kelty (1981), Kadri (1982), and Ketrenos (1986); and most recently to the compilations of Niem and others (1990, 1994). Geologic mapping has been aided by the large number of wells drilled and geophysical surveys conducted in support of natural gas exploration.

4.2 STRATIGRAPHY

In the Mist area, basement rocks of the Tillamook Volcanics (upper to middle Eocene), remnants of a large mid-ocean volcanic complex, are overlain by several thousand feet of marine sedimentary rocks deposited on the emerging continental shelf. Deep in that sequence, shallow-marine to deltaic sandstones of the Cowlitz Formation (upper Eocene) are the primary hydrocarbon reservoir rocks. Fine-grained sediment layers in the upper Cowlitz and the overlying Keasey Formation form the cap to the reservoir rocks.

Surface rock exposures in the highlands between the Columbia River floodplain near Marshland, the Nehalem Valley around Mist, and south to Calvin Creek are assigned to one of five major geologic units:

- Keasey Formation (upper Eocene)
- Sager Creek Formation (informal, upper Eocene)
- Pittsburg Bluff Formation (upper Eocene to Oligocene)
- Columbia River Basalt Group (Miocene) including Grande Ronde Basalt and Wanapum Basalt (Frenchman Springs Member)
- Scappoose Formation (middle Miocene)

The Site Area Geologic Map (Figure 3) shows the distribution of the formational units across the project site. The Keasey Formation and the Sager Creek formation are exposed in the lower Lindgren Creek valley, southeast of the Bruer-Flora area, and especially south of the Nehalem River some distance from the project site. As it is unlikely to encounter these geologic units in the project area they will not be discussed further.

Marine sedimentary rocks of the Pittsburg Bluff Formation form the stratigraphic and topographic base around the project site. The higher parts of these uplands are composed of Columbia River Basalt Group (CRBG) volcanics, and mostly terrestrial sediments of the Scappoose Formation.

Rocks of the Pittsburg Bluff Formation (East Fork Member) are mapped as underlying the project site and are exposed over most of the Bruer-Flora storage area, and the southwestern part of the Adams area. These rocks are typically tuffaceous and arkosic sandstones, locally glauconitic and fossiliferous, with lesser tuffaceous siltstone, claystone, and coal. They were deposited in marine to deltaic waters that appear to have been becoming shallower with time; ultimately, the area rose above sea level, and there is an erosional unconformity between the top of the Pittsburg Bluff Formation and overlying strata.

4.3 GEOLOGIC STRUCTURE

The Mist area is located on the Nehalem Arch, a high area formed in the basement Tillamook Volcanics connecting the Willapa Hills and Northern Coast Range uplifts (north and south, respectively), and separating the sediment-filled Nehalem and Astoria forearc basins (east and west, respectively; Niem and others, 1994). The Mist area is a relatively low saddle in the Nehalem Arch. In the Miocene, flood basalts of the CRBG and sediments of the Scappoose Formation were transported west and the Mist

Saddle area was still low enough to receive these Scappoose sediments and flood basalts. The latest uplift of the Coast Range occurred in the late Neogene.

Many faults have been identified in the Mist area, because of the intense drilling and geophysical work related to gas exploration; many are older faults dating from a late Eocene (pre-Keasey Formation) period of tectonism and not exposed at the surface. A series of mostly NW-SE and W-E normal faults cuts across the Nehalem Arch, forming the Nehalem graben, generally coincident with the Nehalem River valley between Mist and Birkenfeld (Niem and others, 1990). Disruption of rock layers along faults causes zones of weakness that are exploited by erosion, commonly becoming stream valleys; a fault seems to be responsible for the valley of Lindgren Creek (Ketrenos, 1986).

In general, major strata in the area are only gently deformed. Ketrenos (1986) stated that dips in bedding planes in the younger rocks are generally about 5 to 10 degrees to the northwest, whereas mapped dips in the older strata can be up to about 30 degrees (e.g., Newton and Van Atta, 1976; Kelty, 1981). But attitudes can change within short distances, particularly around faults. The extensive old faulting in the area has also probably contributed to local fault-zone deformation.

4.4 SHALLOW SUBSURFACE CONDITIONS – GATHERING LINE

Near-surface soil conditions along the gathering line alignment were investigated by reviewing U.S. Department of Agriculture, Soil Conservation Service (SCS) soil surveys and by observing road cuts. Most of the soils in the study area consist of silty loam formed in colluvium derived from sandstone. The dominant soil groups are the Tolke, Braun, and Scaponia (Smythe, 1988).

The following paragraphs describe the surficial soil materials that exist along the planned alignment.

4.4.1 Tolke silt loam

Tolke silt loam occurs on broad stable ridge-tops and on gentle to moderate side slopes. The soil unit, typically about 5 feet thick, is formed in volcanic ash and colluvium derived from siltstone and shale. Permeability of the Tolke soil is moderate, runoff is medium to rapid, and the hazard of water erosion is moderate to high.

4.4.2 Braun-Scaponia silt loam

Braun-Scaponia silt loam occurs on gentle to moderate, stable, convex slopes within the project area. The soil unit, typically about 2 feet thick, is formed in colluvium derived from siltstone. Permeability of the Braun-Scaponia soil is moderate, runoff is medium to rapid, and the hazard of water erosion is high.

4.4.3 Scaponia-Braun silt loam

Scaponia-Braun silt loam is on moderate to steep, active, convex slopes within the project area. Most of the pipeline alignment portion of the project area mapped by Smythe (1988) as mantled by Scaponia-Braun soils will be constructed using horizontal directional drilling (HDD) techniques, and therefore the exposure of this soil unit during construction should be limited. Where encountered, the soil unit, typically about 3 feet thick, is formed in colluvium derived from siltstone. Permeability of the Braun-Scaponia soil is moderate, runoff is very rapid, and the hazard of water erosion is high.

4.5 SHALLOW SUBSURFACE CONDITIONS – INJECTION WELL PAD

Subsurface conditions at the proposed injection well site were explored for this phase of the work by drilling one hand-auger boring and advancing one Wildcat Dynamic cone exploration to depths up to 12.5 feet below the current site grades. Figure 2 shows the approximate boring and cone locations. Our subsurface exploration program is summarized in Appendix A. Subsurface conditions across the well pad site consists of up to 1-foot of organic duff and topsoil overlying brown to gray, lean clay with silt and occasional sand to a depth of 12.5 feet, the maximum depth explored due to practical auger refusal on weathered sandstone. Based on the penetration resistance of the cone exploration, the clay consistency generally ranges from medium stiff to stiff. Laboratory analyses indicate that the moisture content at the time of our exploration ranged from 31 to 62 percent.

4.6 GROUNDWATER

A regional groundwater table was not encountered in borings previously drilled for another project at Miller Station (GeoEngineers, 2003). However, perched groundwater was encountered locally at a depth of 12 feet in our hand auger boring completed in the location of the proposed injection well. Groundwater along the ridgetop pipeline segments likely consists of isolated seeps and springs.

5.0 GEOLOGIC AND SOIL HAZARD ASSESSMENT

This section summarizes the non-seismic geologic hazards, which could affect the planned construction.

5.1 GROUND SURFACE EROSION

Erosion can be caused by air or water. Wind erosion is not a significant concern because of the fine-grained surface soils, tree cover along and adjacent to most of the alignments, post construction revegetation of the pipeline trench strip, and the subgrade protection measures that will be implemented to provide equipment access.

The soils at the project area are moderately susceptible to water erosion. However, where the alignment follows the existing roadways, water erosion will be minimal because of existing surface water drainage systems and crushed rock road surfacing. Horizontal directional drilling (HDD) is being considered for the unnamed stream drainage crossing, which would eliminate surface soil disturbance in and around the steep canyon slopes. The proposed injection well pad will be relatively small and will be protected from erosion using current erosion control best management practices (BMPs). A detailed erosion and sediment control plan is being completed to fulfill requirements of the National Pollutant Discharge Elimination System (NPDES) permit 1200-C. Erosion control measures to be employed during construction include:

- Installing sediment fence/straw bale barriers at downslope side of excavations and disturbed areas;
- Straw mulching and discing at locations adjacent to the road that have been affected; and
- Planting designated seed mixes at affected areas adjacent to the road.

Exposed soil areas that are affected by the construction will be seeded when there is adequate soil moisture. They will be reseeded in the spring if a healthy cover crop does not grow. The sediment fences and check dams will remain in place until the affected areas are well vegetated.

Whenever feasible, overland corridors will be constructed with waterbars so that surface drainage continues to natural drainage patterns, with minimal diversions through ditches and culverts. Regular maintenance of drainage facilities will ensure continued proper operation.

5.2 SLOPE STABILITY

5.2.1 Landslides

GeoEngineers evaluated the presence of landslides in the project area based on historical aerial photograph interpretation and a site reconnaissance of the entire alignment. As discussed in Section 4.1, landsliding is a dominant landforming process in the region. However, the proposed pipeline corridor has been sited to avoid known active landslides and/or unstable slopes. Figure 3 shows the landslides we identified during our aerial photograph review and geologic reconnaissance.

We classified the landslides based on our observations in general accordance with the Unified Landslide Classification System (modified from Wieczorek, 1984). The following summarizes GeoEngineers' general criteria for assigning risk to the proposed facilities/structures from landslide movement.

5.2.2 High Risk

- Alignment crosses landslide mass or is within 100 feet of slide margin or unstable slope; and
- Surficial, geomorphic and vegetative features suggest that the landslide is active.

5.2.3 Moderate Risk

- Alignment crosses landslide mass or is within 100 feet of margin; and
- Surficial, geomorphic and vegetative features suggest that the landslide is dormant-young.

5.2.4 Low Risk

- Alignment is greater than 100 feet from margin of potentially active landslide; or
- Alignment crosses landslide that has a low potential for reactivation based on one of the following criteria:
 - Surficial, geomorphic and vegetative features suggest the landslide is dormant-mature; or
 - The apparent cause of the landslide has been removed or the landslide has been stabilized (i.e., drainage improvements, grading).

As discussed above, and shown in Figure 3, the landslides identified in the area of the proposed pipeline corridor appear to pose a low risk of damage to the pipeline from ground movement. Based on this study, we consider the entire project site to be at low risk from landslide hazard.

5.2.5 Potentially Unstable Slopes

Although during our field reconnaissance we did not identify any natural slopes that would pose a high risk of potential for mass movement damage to the pipeline, road cuts and fills in sloping terrain tend to be marginally stable. In general, road cuts along the proposed alignment are low and do not present a significant stability hazard. Road fills (inclined at gradients typically from 65 to 80 percent) exist along the existing pipeline road east of the unnamed drainage. While we did not observe slumping or sliding from the fill slopes along this road, there is potential for future failures from the fills. Because of the

geometry of typical cut/fill failures, the inside edge of roads are usually not affected. To minimize the potential for shallow fill failures to affect the proposed pipeline, the gathering line should be constructed within the inside edge of the road where practical.

5.2.6 Potential Adverse Impacts to Slope Stability

Although the steep slopes along the planned alignment are anticipated to be directionally bored, the following measures should be considered if construction occurs on or near steep slopes to minimize the potential to adversely affect slope stability:

- Permanent cut and fill slopes should be inclined at a maximum gradient of 2H:1V (Horizontal:Vertical).
- Fill slopes (if required) should be keyed into undisturbed, firm native material.
- Roads and pipeline corridors on sloping ground should be constructed with waterbars to prevent capturing, concentrating and rerouting surface water runoff. Waterbar spacing can be based on the slope gradient of the corridor as outlined in Northwest Naturals standard construction procedures.

6.0 CONCLUSIONS

Based on the results of our map and aerial photograph review, visual reconnaissance, subsurface explorations and analyses, it is our opinion that the site is suitable for the proposed construction provided the recommendations of this report are incorporated into the project design and implemented during construction. The following conditions are expected to have the greatest affect on the proposed construction:

1. The moisture content of the native soils is approximately 15 to 20 percent above optimum. The on-site soils will be unsuitable for use as structural fill unless the soils can be dried to near-optimum conditions. Drying operations will require a relatively large layout area, persistent dry weather, and tilling equipment to turn the moist soil to the surface.
2. Excavations within the clay and underlying weathered sandstone may be accomplished with conventional earthwork equipment.
3. Most of the site access roads are covered with gravel surfacing which will generally provide adequate support for construction traffic. If construction is performed during wet weather, exposed soils should be protected from construction traffic.

7.0 SITE DEVELOPMENT AND EARTHWORK RECOMMENDATIONS

The following sections present specific geotechnical recommendations for design and construction of the proposed injection well pad.

7.1 SITE PREPARATION

The approximately 20,000 square foot area proposed for construction is heavily wooded with mature conifer trees. The ground surface across the site is covered by up to 24 inches of duff and organic topsoil.

We recommend that the primary root systems for trees and other vegetation be completely removed. Trees designated for preservation should be clearly marked prior to site clearing. We recommend that all vegetation and organic material be removed from structural areas. Stripped material should be

transported off site for disposal or used as fill in non-structural areas. We anticipate stripping depths of 6 to 24 inches, depending on the location. Greater depths may necessary to remove localized zones of organic material. Any voids created during stripping operations should be backfilled as described in the "Structural Fill" and "Fill Placement and Compaction" section of this report.

7.2 WET WEATHER CONSIDERATIONS

Trafficability of the near surface clayey and silty soils will be difficult during periods of rainfall or when the moisture content is more than a few percentage points above optimum moisture content. When wet, this material is highly susceptible to disturbance and will not provide adequate support for construction equipment.

If construction occurs during the wet season, site preparation activities may need to be accomplished using track-mounted equipment, loading excavated material into trucks operating on granular haul roads, or other special procedures to protect the subgrade. Wet soil that has been disturbed during site preparation activities, or soft or loose zones identified during probing, should be removed and replaced with structural fill.

7.3 HAUL ROAD GUIDELINES

The use of granular fill staging areas will be necessary to support construction equipment outside of existing gravel roads during the rainy season or when the moisture content of the surficial soil is a few percentage points above optimum. A 12-inch-thick layer of imported granular material should generally be sufficient for light staging areas but is generally not expected to be adequate to support heavy equipment or truck traffic. Haul roads and areas with repeated heavy construction traffic should be constructed with 18 inches of imported granular material. We recommend that a geotextile be placed to separate the subgrade and imported fill in areas of repeated construction traffic. The geotextile should have a minimum Mullen burst strength of 225 pounds per square inch (psi) for puncture resistance and a minimum apparent opening size (AOS) of a U.S. Standard No. 70 Sieve to minimize migration of fines into the rock. Mirafi 140N meets these requirements.

Imported granular material used for haul roads and staging areas should consist of crushed rock that is well-graded between coarse and fine sizes, contains no organic matter or unsuitable materials, has a maximum particle size between 1 1/2 and 3 inches, and has less than 5 percent by weight passing the U.S. Standard No. 200 Sieve. The imported granular material should be placed in one lift over the prepared, undisturbed subgrade and compacted using a smooth-drum roller without the use of vibratory action. If the imported granular material remains uncontaminated by fines and meets the appropriate fill specifications, it can be used elsewhere on the site as structural fill.

7.4 EXCAVATION

Excavations should stand vertical to a depth of approximately 4 feet, provided no groundwater seepage occurs in the sidewalls. Excavations deeper than 4 feet should be shored or laid back at an inclination of 1.5H:1V (horizontal to vertical) or flatter if workers are required to enter. All trench excavations should be made in accordance with applicable Occupational Safety and Health Administration (OSHA) and state regulations.

Depending on the depth of excavation and the season of construction, groundwater may be encountered in the utility trenches. Pumping from a sump located within the trench likely will be effective in removing

water resulting from seepage. The sidewalls of the trench may have to be flattened or shored if seepage is encountered.

While we have provided suggestions for trench dewatering and shoring, it is the contractor's responsibility to select the excavation and dewatering methods, to monitor the trench excavations for safety and to provide any shoring required to protect personnel and adjacent improvements.

7.5 CUT AND FILL SLOPES

Permanent cut and fill slopes should not exceed 2H:1V. Buildings, access roads and pavements should be set back a minimum of 5 feet from any slope crest. We do not anticipate cuts or fills greater than 5 feet high. If higher cuts or fills are planned, we should be contacted to make further recommendations.

7.6 SITE DRAINAGE

Pavement surfaces and open space areas should be sloped such that surface water runoff is collected and routed to suitable discharge points. We recommend that ground and paved surfaces adjacent to any buildings be sloped to drain away from the buildings. Drainage should not be directed onto or near slopes such that saturation or instability of the slopes occurs.

7.7 EROSION CONTROL

Soils at the site are moderately susceptible to erosion by surface water. Erosion should be controlled through use of best management practices in accordance with the Erosion Control Plan submitted for the NPDES 1200-C permit for the project.

7.8 STRUCTURAL FILL

Structural areas include areas beneath foundation mats, pavements or any other areas intended to support structures or within the influence zones of structures. Suitable fill for structural areas may consist of on-site soils or imported granular fill. Recommendations for suitable fill materials are provided in the following sections.

7.8.1 On-site Soils

The on-site clay soils will be difficult if not impossible to compact during wet weather periods. Laboratory results indicate that natural moisture content at the time of exploration was approximately 20 percent to 40 percent above optimum. These silty and clayey soils are highly sensitive to small changes in moisture content and will be suitable for use as structural fill only if they can be dried to near optimum. This will only be possible during extended periods of dry weather and will require a relatively large layout area.

If the soil cannot be properly moisture conditioned, we recommend using imported granular material. On-site soils used as structural fill should be free of clay balls, roots, organic matter and other deleterious materials and particles larger than 3 inches in diameter.

7.8.2 Select Granular Fill

Granular material for structural fill should be pit or quarry run rock, crushed rock, or crushed gravel and sand that is fairly well-graded between coarse and fine, contain no deleterious materials, have a maximum

particle size of 1 1/2 inches, and have less than 5 percent by weight passing the U.S. No. 200 Sieve. Organic matter, debris, frozen particles or other deleterious material should not be present. Granular fill used during periods of prolonged dry weather may have up to 12 percent passing the U.S. No. 200 Sieve provided it is properly moisture-conditioned.

7.8.3 Pipe Bedding

We understand that Northwest Natural typically uses fine to medium sand in the pipe zone. This material is acceptable provided it contains less than 5 percent passing the U.S. No. 200 Sieve.

7.9 FILL PLACEMENT AND COMPACTION

Fill soils should be compacted at a moisture content that is near optimum. The maximum allowable moisture content varies with the soil gradation, and should be evaluated during construction. The on-site silty and clayey soils may be difficult or impossible to compact during persistent wet conditions.

Fill and backfill material should be placed in uniform, horizontal lifts, and densified with appropriate compaction equipment. The maximum lift thickness will vary depending on the material and compaction equipment used, but should generally not exceed the loose thicknesses provided in Table 1. Fill material should be compacted in accordance with the compaction criteria provided in Table 2.

Table 1. Recommended Uncompacted Lift Thickness

Compaction Equipment	Recommended Uncompacted Fill Thickness (inches)		
	Silty Soils	Granular and Crushed Rock Maximum Particle Size ≤ 1 1/2 inch	Crushed Rock Maximum Particle Size > 1 1/2 inch
Hand Tools: Plate Compactors and Jumping Jacks	4 – 8	4 – 8	Not Recommended
Rubber-tire Equipment	6 – 8	10 – 12	6 – 8
Light Roller	8 – 10	10 – 12	8 – 10
Heavy Roller	10 – 12	18 – 24	12 – 16
Hoe Pack Equipment	12 – 16	18 – 24	12 – 16

Note: The above table is based on our experience and is intended to serve as a guideline. The information provided in this table should not be included in the project specifications.

Table 2. Compaction Criteria

Fill Type	Compaction Requirements in Structural Zones Percent Maximum Dry Density Determined by ASTM Test Method D 1557		
	0 to 2 Feet Below Subgrade	> 2 Feet Below Subgrade	Pipe Zone
Area Fills and Bases	95% ¹	92% ²	-----
Aggregate Bases	95%	95%	-----
Trench Backfill ³	95% ¹	92% ²	90% ⁴
Retaining Wall Backfill	95% ¹	92% ²	-----

Notes:

¹ May be reduced to 92 percent if on-site silty or clayey soils are used.

² May be reduced to 90 percent if on-site silty or clayey soils are used.

³ Trench backfill above the pipe zone in nonstructural areas should be compacted to at least 85 percent of the maximum dry density as determined by ASTM Test Method D 1557.

⁴ Or as recommended by the pipe manufacturer.

7.9.1 Area Fills and Bases

Fill placed to raise site grades should be placed on a suitable subgrade that consists of firm, inorganic site soils prepared in accordance with the "Site Preparation" section of this report, or on compacted fill. Fill material should be placed in uniform horizontal lifts as outlined in Table 1 and compacted to the recommended minimum density provided in Table 2.

7.9.2 Aggregate Bases

Aggregate base materials under foundations and pavements should be placed on a suitable subgrade that consists of firm, inorganic native soils prepared in accordance with the "Site Preparation" section of this report, or on compacted fill. Aggregate base material should be placed in uniform horizontal lifts as outlined in Table 1 and compacted to the recommended minimum density provided in Table 2.

7.9.3 Trench Backfill

Trench backfill in structural areas should consist of select granular fill or crushed rock as described in the "Structural Fill" section of this report, be placed in uniform horizontal lifts as recommended in Table 1, and compacted to the minimum density provided in Table 2. Pipe bedding and fill in the pipe zone should be compacted to the minimum density presented in Table 2 or as recommended by the pipe manufacturer.

8.0 FOUNDATION SUPPORT RECOMMENDATIONS

We anticipate that the well heads, gas/water separator, methanol tank and equipment shed can be supported on mat foundations. Specific building and equipment loads were not available at the time of this report, but we anticipate that loads will be relatively light and typical for these structures. We have provided geotechnical recommendations for use in design and construction of the anticipated mat foundations.

8.1 MAT FOUNDATIONS

Mat foundations should be established on the undisturbed firm native soils or on structural fill overlying firm native soils at least 18 inches beneath the surrounding ground surface. The clayey soils are easily disturbed when at a moisture content that is above optimum. If excavation takes place during a period of wet weather we recommend that a 4-inch layer of compacted crushed rock be placed over the subgrade to avoid subgrade disturbance due to foot traffic.

8.1.1 Bearing Capacity

The appropriate subgrade reaction modulus for use in design of shallow mat foundations depends on the mat dimensions, the duration and magnitude of the load, and the stiffness of the mat relative to the supporting soil. We recommend that stiff mats supporting short-duration loads be designed using the coefficient of subgrade reaction modulus relationship shown in Figure 4.

We recommend that an allowable bearing capacity of 2,000 pounds per square foot (psf) be used when designing for short-term loads such as wind and seismic forces. The weight of the footing and any overlying backfill can be ignored in calculating footing loads.

8.1.2 Foundation Settlement

Settlement rather than bearing capacity will control the design when considering long-term loads. A settlement of less than 1-inch should be expected provide the real long term loads are less than 1,000 psf. This value assumes that plan dimension of the mat foundation is less than 15 feet by 15 feet and that the subgrade has been prepared in accordance with the recommendations provided in this report. The upper soils are overconsolidated, so minor stress increases will result in small settlements while high foundation stresses will result in disproportionately larger settlements.

8.1.3 Lateral Resistance

Lateral loads can be resisted by passive earth pressure on the sides of the mat and by friction on the base. We recommend a friction coefficient of 0.35 for computing the friction capacity of the mat foundations that bear on native soil. A friction coefficient of 0.60 on should be used for foundations in contact with crushed rock that is at least 4 inches thick.

An equivalent fluid unit weight of 350 pounds per cubic foot (pcf) is recommended to compute passive earth pressures acting on footings constructed in direct contact with compacted structural fill or undisturbed silt. This value is based on the assumptions that the adjacent confining structural fill or native soils are level and that static groundwater remains below the base of the footing throughout the year. The top 1-foot of soil should be neglected when calculating passive lateral earth pressures unless the adjacent area is covered with asphalt or concrete pavement.

The passive and friction resistance may be combined provided that the passive component does not exceed two-thirds of the total. These values do not include safety factors.

9.0 OBSERVATION OF CONSTRUCTION

Satisfactory foundation and earthwork performance depends, to a large degree, on the quality of construction. Sufficient monitoring of the contractor's activities is a key part of determining that the work is completed in accordance with the construction drawings and specifications. We recommend that

the geotechnical engineer or their representative be retained to monitor and test excavation and fill compaction.

Subsurface conditions observed during construction should be compared with those encountered during the subsurface exploration. Recognition of changed conditions often requires experience; therefore, qualified personnel should visit the site with sufficient frequency to detect whether subsurface conditions change significantly from those anticipated.

10.0 LIMITATIONS

We have prepared this report for the exclusive use of the NWN and their authorized agents for The Pearl Phase I – Bruer Pool Development Project.

Our services were provided to assist in the design of foundations and pipelines to be located on sloping property. Our recommendations are intended to reduce the potential for future property damage related to earth movements, drainage or erosion. However, all construction on slopes involves risk, only part of which can be mitigated through qualified engineering and construction practices. Favorable performance of structures in the near term does not imply a certainty of long-term performance, especially under conditions of adverse weather or seismic activity.

Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices in the field of geotechnical engineering in this area at the time this report was prepared. No warranty or other conditions, express or implied, should be understood.

Any electronic form, facsimile or hard copy of the original document (email, text, table, and/or figure), if provided, and any attachments are only a copy of the original document. The original document is stored by GeoEngineers, Inc. and will serve as the official document of record.

Please refer to the appendix titled Report Limitations and Guidelines for Use for additional information pertaining to use of this report.

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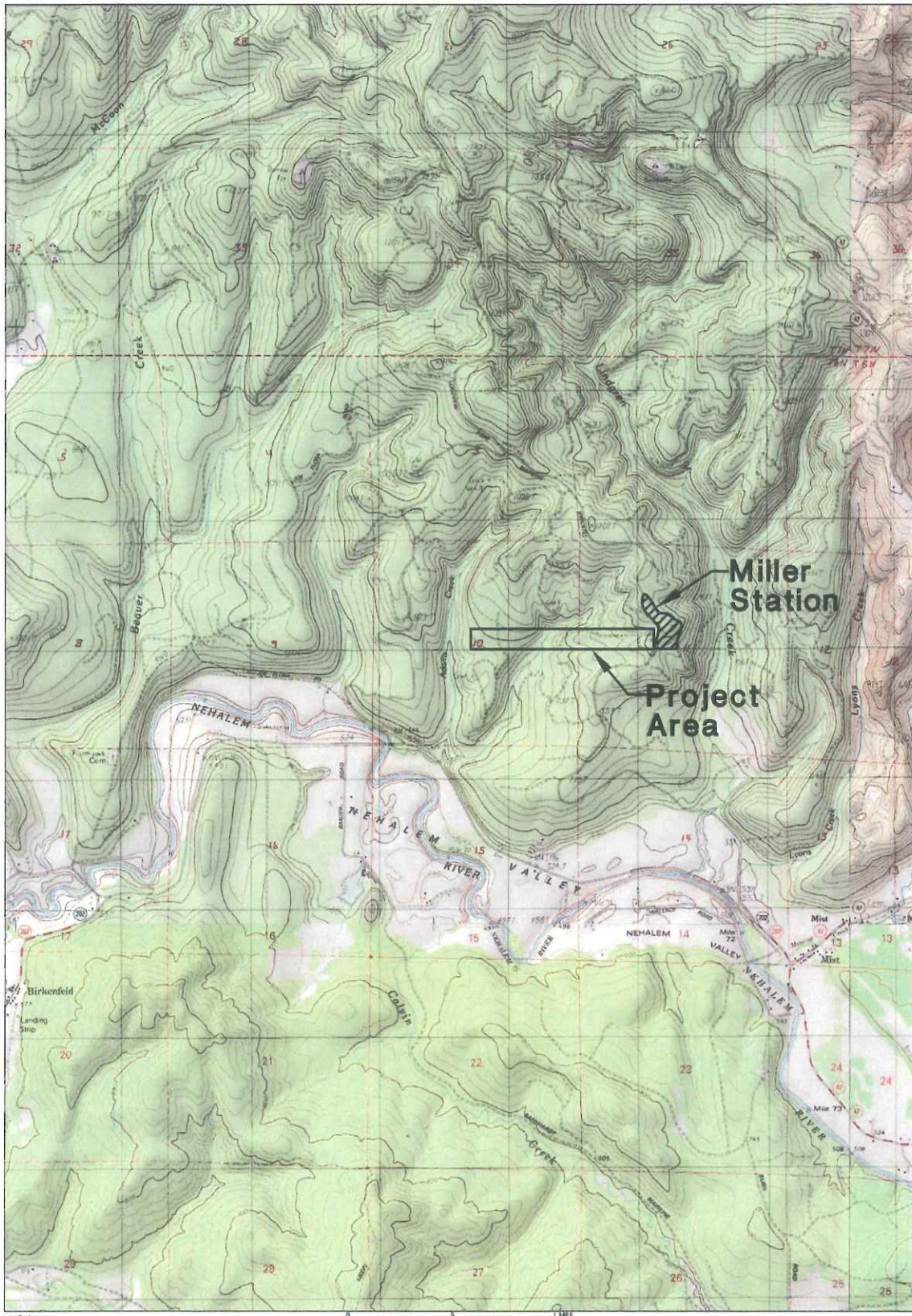
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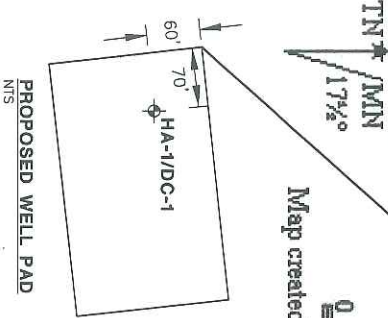
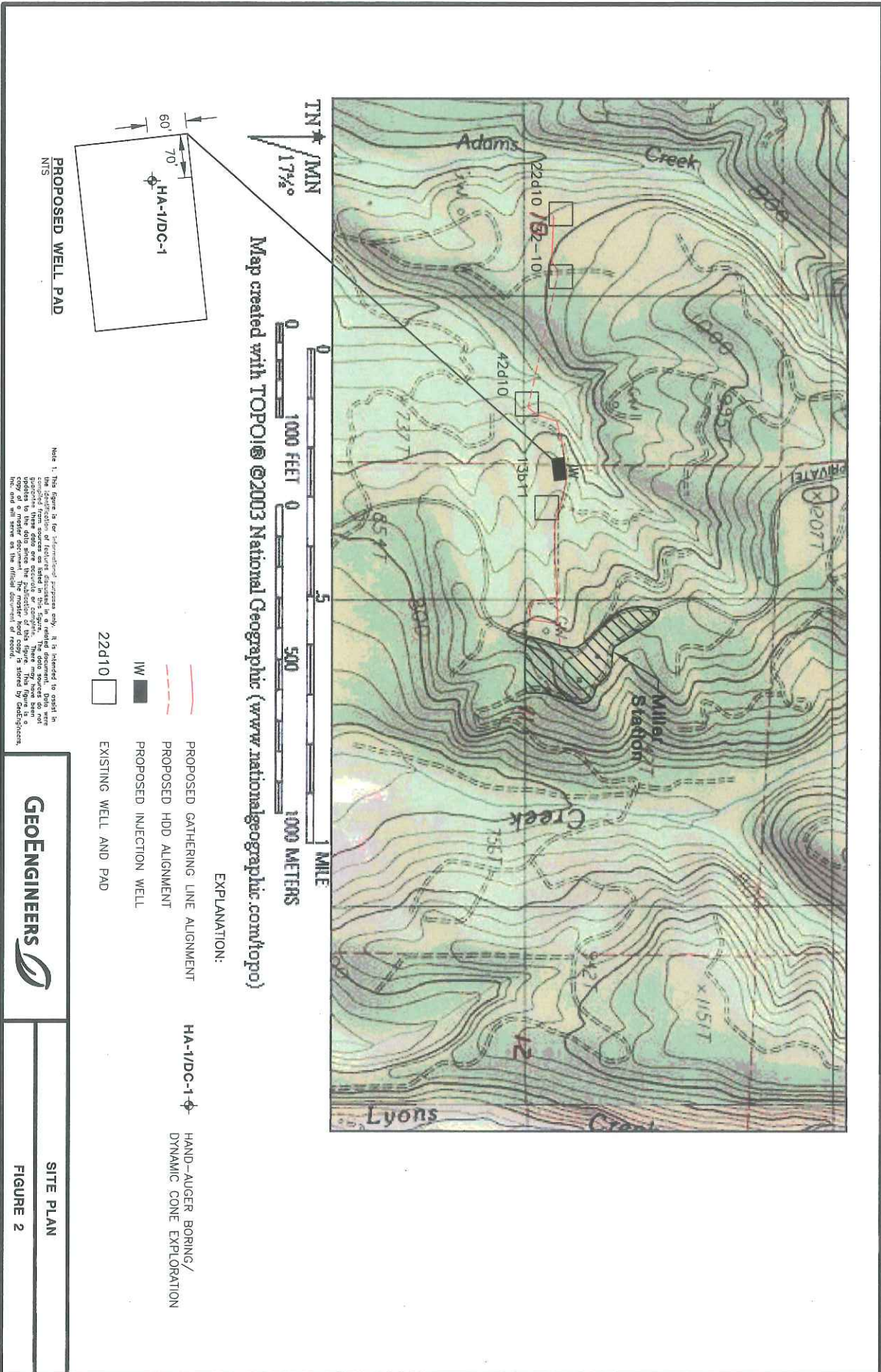
TN MN
13°

0 500 1000 FEET 0 500 1000 METERS
Map created with TOPO! © 2003 National Geographic (www.nationalgeographic.com/topo)

GEOENGINEERS

VICINITY MAP

FIGURE 1



PROPOSED WELL PAD
N15

Note 1: This figure is for informational purposes only. It is intended to assist in the identification of features, not to be used as a legal document. Data were prepared by the contractor and are not guaranteed by the engineer. There may have been a change in the location of the features since the master plan was prepared. The master plan copy is stored by GeoEngineers Inc. and will serve as the official document of record.

- PROPOSED GATHERING LINE ALIGNMENT
- PROPOSED HDD ALIGNMENT
- PROPOSED INJECTION WELL
- EXISTING WELL AND PAD



SITE PLAN
FIGURE 2

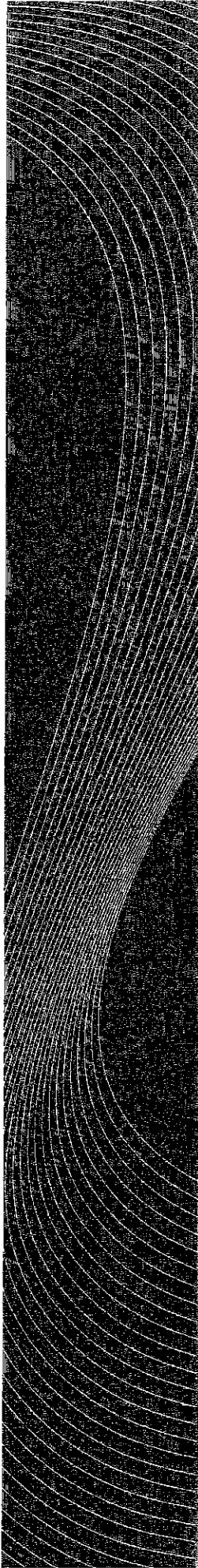
EXPLANATION:

- HA-1/DC-1
- HAND-AUGER BORING/
DYNAMIC CONE EXPLORATION



APPENDIX A
FIELD EXPLORATION

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APPENDIX A FIELD EXPLORATION

We evaluated subsurface soil and groundwater conditions at the injection well pad location by advancing one hand auger boring and one Wildcat Dynamic Cone at the locations shown in Figure 2. The boring and cone exploration locations were approximately located by pacing from survey stakes found at the site. Exploration locations should be considered accurate only to the degree implied by the methods used.

The dynamic cone penetration test was performed using a Wildcat dynamic cone penetrometer manufactured by Triggs Technologies, Inc. The Wildcat penetrometer test consists of driving a 90-degree, 10 cm² steel cone into the soil using a 35-pound safety hammer falling 15 inches. The number of hammer blows required to drive the cone each 10 cm into the soil is recorded. Water and polymer slurry is periodically injected through the cone rods and out two ports located just above the cone. The slurry fills the annulus between the cone's path and the smaller diameter rods, and reducing skin friction along the rods so that the hammer energy is directed into the cone. The hammer blows per 10 cm of driving is related to tip bearing pressure and is correlated with standard penetration test N-values so that the relative density of sands and the relative consistency of silts and clays can be estimated.

The field explorations were performed by a representative from our staff, who located the boring and cone exploration, classified the various soil units encountered, obtained representative soil samples for geotechnical testing, observed and recorded groundwater conditions, and maintained a detailed log of the boring and driving log of the cone exploration.

We visually classified the soils in accordance with the system summarized in Figure A-1. Our boring log and cone driving log are provided as figures A-2 and A-3, respectively.

Samples of the subsurface soils were obtained from the hand auger for laboratory testing and further classification. Results of the testing are indicated on the boring log.

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% RETAINED ON NO. 200 SIEVE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES
		CLEAN SANDS (LITTLE OR NO FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SP	POORLY-GRADED SANDS, GRAVELLY SAND
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% PASSING NO. 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50	SILTY SILTS		ML	INORGANIC SILTS, ROCK FLOUR, CLAYEY SILTS WITH SLIGHT PLASTICITY
		CLAYEY SILTS		CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
		ORGANIC SILTS		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50	SILTY CLAYS		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS SILTY SOILS
		CLAYEY SILTS		CH	INORGANIC CLAYS OF HIGH PLASTICITY
		ORGANIC CLAYS		OH	ORGANIC CLAYS AND SILTS OF MEDIUM TO HIGH PLASTICITY
HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS	

NOTE: Multiple symbols are used to indicate borderline or dual soil classifications

Sampler Symbol Descriptions

- 2.4-inch I.D. split barrel
- Standard Penetration Test (SPT)
- Shelby tube
- Piston
- Direct-Push
- Bulk or grab

Blowcount is recorded for driven samplers as the number of blows required to advance sampler 12 inches (or distance noted). See exploration log for hammer weight and drop.

A "P" indicates sampler pushed using the weight of the drill rig.

ADDITIONAL MATERIAL SYMBOLS

SYMBOLS		TYPICAL DESCRIPTIONS
GRAPH	LETTER	
	CC	Cement Concrete
	AC	Asphalt Concrete
	CR	Crushed Rock/ Quarry Spalls
	TS	Topsoil/ Forest Duff/Sod

- Measured groundwater level in exploration, well, or piezometer
- Groundwater observed at time of exploration
- Perched water observed at time of exploration
- Measured free product in well or piezometer

Stratigraphic Contact

- Distinct contact between soil strata or geologic units
- Gradual change between soil strata or geologic units
- Approximate location of soil strata change within a geologic soil unit

Laboratory / Field Tests

- %F Percent fines
- AL Atterberg limits
- CA Chemical analysis
- CP Laboratory compaction test
- CS Consolidation test
- DS Direct shear
- HA Hydrometer analysis
- MC Moisture content
- MD Moisture content and dry density
- OC Organic content
- PM Permeability or hydraulic conductivity
- PP Pocket penetrometer
- SA Sieve analysis
- TX Triaxial compression
- UC Unconfined compression
- VS Vane shear

Sheen Classification

- NS No Visible Sheen
- SS Slight Sheen
- MS Moderate Sheen
- HS Heavy Sheen
- NT Not Tested

NOTE: The reader must refer to the discussion in the report text and the logs of explorations for a proper understanding of subsurface conditions. Descriptions on the logs apply only at the specific exploration locations and at the time the explorations were made; they are not warranted to be representative of subsurface conditions at other locations or times.

KEY TO EXPLORATION LOGS

GEOENGINEERS

FIGURE A-1

Date Excavated: 04/21/05
 Equipment: Hand Auger

Logged by: JLL
 Surface Elevation (ft): _____

Depth feet	Sample Number	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	OTHER TESTS AND NOTES
0			OL	Black to dark brown organic silt topsoil (loose, moist)		
			CL	Brown lean clay (medium stiff, moist) Trace fine sand and angular claystone fragments		
	1			Becomes yellowish-brown, stiff	31.3%	
	2			Yellow with brown and reddish brown lamination (stiff to very stiff, moist)	42.8%	
5						
	3				49.4%	
	4				52.7%	
10			CL	Light yellowish lean clay; low plasticity with a trace of fine sand (stiff, moist)	40.7%	
	5					
	6				42.9%	
	7		RX	Yellow decomposed siltstone drilled with maximum effort into 1 to 2 inch angular fragments Hand auger completed at 12.5 feet on 04/21/05 Perched groundwater seepage observed at 12.5 feet Practical refusal on weathered siltstone	62.4%	
15						

Notes: See Figure A-1 for explanation of symbols.
 The depths on the hand auger logs are based on an average of measurements across the hand auger and should be considered accurate to 0.5 foot.

LOG OF HAND AUGER HA-1



Project: Northwest Natural
 Project Location: Mist, Oregon
 Project Number: 6024-076-00

Figure A-2
 Sheet 1 of 1

V6-GTTPIT P.16...-J76100F\NALS1602407600.GPJ GEIV6 1.GDT 5/2/05

WILDCAT DYNAMIC CONE LOG

GeoEngineers, Inc.
 15055 S.W. Sequoia Parkway
 Portland, Oregon, 97224

PROJECT NUMBER: 6024076-00
 DATE STARTED: 04-21-2005
 DATE COMPLETED: 04-21-2005

HOLE #: DC-1
 CREW: John Lawes
 PROJECT: Pearl Ph. 1
 ADDRESS: Bruer Pool
 LOCATION: Mist, Oregon

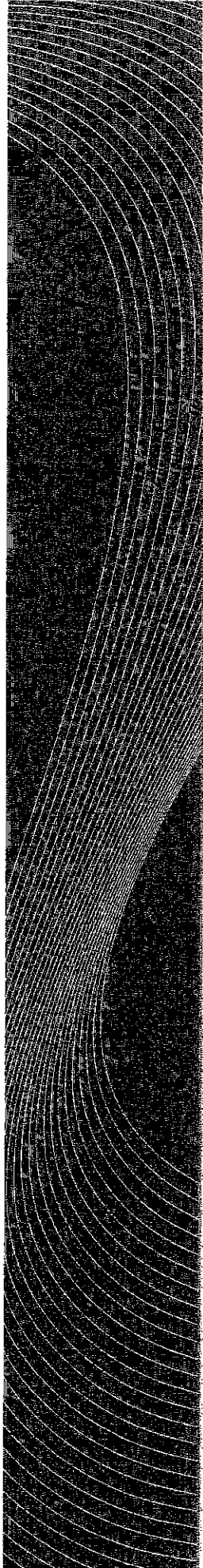
SURFACE ELEVATION: not determined
 WATER ON COMPLETION: 12'
 HAMMER WEIGHT: 35 lbs.
 CONE AREA: 10 sq. cm

DEPTH	BLOWS PER 10 cm	RESISTANCE Kg/cm ²	GRAPH OF CONE RESISTANCE				N'	TESTED CONSISTENCY	
			0	50	100	150		SAND & SILT	CLAY
	2	8.9	..				2	VERY LOOSE	SOFT
	6	26.6	.....				7	LOOSE	MEDIUM STIFF
1 ft	6	26.6	.....				7	LOOSE	MEDIUM STIFF
	5	22.2	.....				6	LOOSE	MEDIUM STIFF
	3	13.3	...				3	VERY LOOSE	SOFT
2 ft	4	17.8	.....				5	LOOSE	MEDIUM STIFF
	3	13.3	...				3	VERY LOOSE	SOFT
	3	13.3	...				3	VERY LOOSE	SOFT
3 ft	3	13.3	...				3	VERY LOOSE	SOFT
1 m	5	22.2	.....				6	LOOSE	MEDIUM STIFF
	6	23.2	.....				6	LOOSE	MEDIUM STIFF
4 ft	7	27.0	.....				7	LOOSE	MEDIUM STIFF
	9	34.7	.....				9	LOOSE	STIFF
	10	38.6	.....				11	MEDIUM DENSE	STIFF
5 ft	10	38.6	.....				11	MEDIUM DENSE	STIFF
	11	42.5	.....				12	MEDIUM DENSE	STIFF
	10	38.6	.....				11	MEDIUM DENSE	STIFF
6 ft	9	34.7	.....				9	LOOSE	STIFF
	10	38.6	.....				11	MEDIUM DENSE	STIFF
2 m	11	42.5	.....				12	MEDIUM DENSE	STIFF
7 ft	9	30.8	.....				8	LOOSE	MEDIUM STIFF
	8	27.4	.....				7	LOOSE	MEDIUM STIFF
	8	27.4	.....				7	LOOSE	MEDIUM STIFF
8 ft	5	17.1	....				4	VERY LOOSE	SOFT
	7	23.9	.....				6	LOOSE	MEDIUM STIFF
	10	34.2	.....				9	LOOSE	STIFF
9 ft	9	30.8	.....				8	LOOSE	MEDIUM STIFF
	7	23.9	.....				6	LOOSE	MEDIUM STIFF
	8	27.4	.....				7	LOOSE	MEDIUM STIFF
3 m	10 ft	30.8	.....				8	LOOSE	MEDIUM STIFF
	7	21.4	.....				6	LOOSE	MEDIUM STIFF
	9	27.5	.....				7	LOOSE	MEDIUM STIFF
	6	18.4	.....				5	LOOSE	MEDIUM STIFF
11 ft	6	18.4	.....				5	LOOSE	MEDIUM STIFF
	5	15.3	....				4	VERY LOOSE	SOFT
	3	9.2	..				2	VERY LOOSE	SOFT
12 ft	3	9.2	..				2	VERY LOOSE	SOFT
	17	52.0	.....				14	MEDIUM DENSE	STIFF
4 m	13 ft	64.3	.....				18	MEDIUM DENSE	VERY STIFF

WILDCAT.XLS



APPENDIX B
REPORT LIMITATIONS AND GUIDELINES FOR USE



APPENDIX B REPORT LIMITATIONS AND GUIDELINES FOR USE¹

This appendix provides information to help you manage your risks with respect to the use of this report.

GEOTECHNICAL SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES, PERSONS AND PROJECTS

This report has been prepared for the exclusive use of NWN and their authorized agents. This report may be made available to for review. This report is not intended for use by others, and the information contained herein is not applicable to other sites.

GeoEngineers structures our services to meet the specific needs of our clients. For example, a geotechnical or geologic study conducted for a civil engineer or architect may not fulfill the needs of a construction contractor or even another civil engineer or architect that are involved in the same project. Because each geotechnical or geologic study is unique, each geotechnical engineering or geologic report is unique, prepared solely for the specific client and project site. Our report is prepared for the exclusive use of our Client. No other party may rely on the product of our services unless we agree in advance to such reliance in writing. This is to provide our firm with reasonable protection against open-ended liability claims by third parties with whom there would otherwise be no contractual limits to their actions. Within the limitations of scope, schedule and budget, our services have been executed in accordance with our Agreement with the Client and generally accepted geotechnical practices in this area at the time this report was prepared.. This report should not be applied for any purpose or project except the one originally contemplated.

A GEOTECHNICAL ENGINEERING OR GEOLOGIC REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

This report has been prepared for the Pearl Phase -- I, Bruer Pool Development Project. GeoEngineers considered a number of unique, project-specific factors when establishing the scope of services for this project and report. Unless GeoEngineers specifically indicates otherwise, do not rely on this report if it was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

For example, changes that can affect the applicability of this report include those that affect:

- the function of the proposed structure;
- elevation, configuration, location, orientation or weight of the proposed structure;
- composition of the design team; or
- project ownership.

If important changes are made after the date of this report, GeoEngineers should be given the opportunity

¹ Developed based on material provided by ASFE, Professional Firms Practicing in the Geosciences; www.asfe.org

to review our interpretations and recommendations and provide written modifications or confirmation, as appropriate.

SUBSURFACE CONDITIONS CAN CHANGE

This geotechnical or geologic report is based on conditions that existed at the time the study was performed. The findings and conclusions of this report may be affected by the passage of time, by manmade events such as construction on or adjacent to the site, or by natural events such as floods, earthquakes, slope instability or groundwater fluctuations. Always contact GeoEngineers before applying a report to determine if it remains applicable.

MOST GEOTECHNICAL AND GEOLOGIC FINDINGS ARE PROFESSIONAL OPINIONS

Our interpretations of subsurface conditions are based on field observations from widely spaced sampling locations at the site. Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. GeoEngineers reviewed field and laboratory data and then applied our professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ, sometimes significantly, from those indicated in this report. Our report, conclusions and interpretations should not be construed as a warranty of the subsurface conditions.

GEOTECHNICAL ENGINEERING REPORT RECOMMENDATIONS ARE NOT FINAL

Do not over-rely on the preliminary construction recommendations included in this report. These recommendations are not final, because they were developed principally from GeoEngineers' professional judgment and opinion. GeoEngineers' recommendations can be finalized only by observing actual subsurface conditions revealed during construction. GeoEngineers cannot assume responsibility or liability for this report's recommendations if we do not perform construction observation.

Sufficient monitoring, testing and consultation by GeoEngineers should be provided during construction to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes should the conditions revealed during the work differ from those anticipated, and to evaluate whether or not earthwork activities are completed in accordance with our recommendations. Retaining GeoEngineers for construction observation for this project is the most effective method of managing the risks associated with unanticipated conditions.

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GIVE CONTRACTORS A COMPLETE REPORT AND GUIDANCE

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CONTRACTORS ARE RESPONSIBLE FOR SITE SAFETY ON THEIR OWN CONSTRUCTION PROJECTS

Our geotechnical recommendations are not intended to direct the contractor's procedures, methods, schedule or management of the work site. The contractor is solely responsible for job site safety and for managing construction operations to minimize risks to on-site personnel and to adjacent properties.

READ THESE PROVISIONS CLOSELY

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BIOLOGICAL POLLUTANTS

GeoEngineers' Scope of Work specifically excludes the investigation, detection, prevention or assessment of the presence of Biological Pollutants. Accordingly, this report does not include any interpretations, recommendations, findings, or conclusions regarding the detecting, assessing, preventing or abating of Biological Pollutants and no conclusions or inferences should be drawn regarding Biological Pollutants,

as they may relate to this project. The term "Biological Pollutants" includes, but is not limited to, molds, fungi, spores, bacteria, and viruses, and/or any of their byproducts.

If Client desires these specialized services, they should be obtained from a consultant who offers services in this specialized field.

April 27, 2007

Northwest Natural
220 Northwest Second Avenue
Portland, Oregon 97209

Attention: Mr. Todd Thomas

Subject: Addendum Geotechnical and Geologic Hazard Evaluation
Proposed Well Development and Gathering Line
Pearl Phase II – Bruer Pool Development
File No. 6024-076-01

1.0 INTRODUCTION

This addendum report presents the results of our supplemental evaluation for Pearl Phase II of the Interstate Storage Project (ISP) located near Mist, Oregon. GeoEngineers performed a geotechnical and geologic hazards evaluation of Pearl Phase I, and presented our conclusions and recommendations in a report dated May 19, 2005.

The information used in this evaluation is based on available geologic maps, geologic and geotechnical reports pertinent to the alignment, historical aerial photographs and geologic surface reconnaissance of the planned improvements. This report is not intended to be a stand-alone document. But rather, used in conjunction with the May 19, 2005 report. Figure 1 shows the project area with respect to surrounding topography.

2.0 PROJECT DESCRIPTION

Northwest Natural (NW Natural) operates an underground natural gas storage and delivery system in rugged terrain near Mist, Oregon. The system consists of a series of underground gas/storage reservoirs (“pools”), injection/withdrawal wells, a compressor station (Miller Station), and approximately 20 miles of pipeline. As part of NW Natural’s plan to increase the system’s capacity, The “Pearl Phase II” project will add storage capacity and deliverability to serve the Interstate Storage Services business need and meet contract obligations. This Phase of the Interstate Storage Project will further develop and possibly add to the existing underground storage resources and in the Mist Field. The project scope of work includes improvements to the Flora Pool, the Miller Station facilities, and gathering line enhancements and interconnect improvements.

Approximately 1,200 feet of new gathering line will be installed along the west side of Miller Station. Two new injection/withdrawal wells (23adH-3-65, 23acH-3-65) will be drilled at existing well pads 23b3 and 33c3, respectively. The existing well 33-d-3 will be modified to become the new Observation/Monitoring well (OM 33d-3-65) for the Flora Pool. The project also includes testing the St. Helens pool with a new well (44-3-65).

The proposed injection/withdrawal well pads will include a gas/water separator, a 2,000 gallon methanol tank and a small ancillary equipment shed. NW Natural proposes to construct the project under the existing Energy Facility Siting Council (EFSC) Mist underground storage site certificate.

3.0 SURFACE CONDITIONS

3.1 GENERAL

The project area is located about 2 to 3 miles northwest of Mist, in Columbia County, Oregon. The site is situated at the headwaters of Adams Creek and an adjacent stream to the west, both tributaries to the Nehalem River. The proposed gathering line alignment, well pads and general topography of the area are shown on Figure 1.

Landforming processes in the project area have mainly involved stream erosion and mass wasting in the uplifted Coast Range, producing the current dissected topography. In general, relatively weak rocks have been eroded into mostly moderate-gradient slopes by stream incision, soil creep and sliding. More resistant rocks, however, appear to hold up the highlands of Clatskanie Mountain and the ridges to the south. The weaker rocks can form steeper slopes below stronger capping rocks, and where deeply incised by streams. Faulting can also affect landforms: a straight valley segment of Lindgren Creek is thought to be controlled by a fault trace where rocks are more fractured and susceptible to greater erosion. This is probably the case in other stream valleys in the region, as well.

We have identified large, ancient landslide complexes in the region through our review of stereoscopic aerial photographs and our field reconnaissance as shown in Figure 2. Many of the slides we identified appear to involve the failure of weaker rock layers under caps of more resistant rocks, as erosion initiated by stream downcutting triggered mass wasting that advanced into the ridges. Although these large landslides are widespread near the project area, they are generally inactive and we find no evidence that landsliding poses a significant risk to the proposed gathering line or well sites. The following sections describe the topography at the proposed facilities.

3.2 PROPOSED GATHERING LINE SYSTEM

The proposed new gathering line extends approximately 1,200 feet along the west side of Miller Station, roughly parallel and along the Longview Fibre Mainline Road. The alignment and Mainline road are situated on gentle, west facing slopes near the top of the regional ridgeline.

3.3 PROPOSED INJECTION/WITHDRAWAL WELL PADS

The proposed injection well sites are located within the headwaters of tributary streams to the Nehalem River. The sites have been previously graded flat and developed for existing well pads. The existing 23b3 well pad site is situated on moderate south facing slopes. The well pad was constructed by cutting and filling. The cutslope is about 10 feet in height and exposed stiff sandy silt. No surface water features were observed within or adjacent to the 23b3 well site.

The existing well pad site 33c3 is situated on gentle south facing slopes as shown in Figure 1. Because of the gentle nature of the slope, only minor cutting and filling was required for construction of the well pad. Drainage improvements have been previously constructed at the site to improve surface drainage. Specifically, a ditch was excavated along the inside edge of the pad to direct surface water from an ephemeral stream around and downslope of the well pad.

4.0 SUBSURFACE CONDITIONS

Please refer to the Subsurface Conditions Section of the May 19, 2005 original report for a description of the geologic setting, stratigraphy, and geologic structure of the project area. Based on our review of the US Department of Agriculture, Soil Conservation Service (SCS) soil surveys, geologic maps, and our site reconnaissance, we expect similar shallow subsurface soil conditions for the proposed Pearl Phase 2 project areas as those described in our May 19, 2005 report for the Pearl Phase 1 project.

5.0 GEOLOGIC AND SOIL HAZARD ASSESSMENT

This section summarizes the non-seismic geologic hazards, which could affect the planned construction.

5.1 GROUND SURFACE EROSION

Please refer to the May 19, 2005 report for a discussion of appropriate erosion control measures for the site.

5.2 SLOPE STABILITY

GeoEngineers initially performed a slope stability evaluation of the well sites of the Flora and Bruer Gas Pools and presented our findings in a January 6, 1999 report. Since that report, we have performed several additional landslide and slope stability studies of the area including the most recent May 19, 2005 report. Landslides we have identified at the project area are shown in Figure 2. The following summarizes our conclusions regarding slope stability at the project area.

5.2.1 23b3 Well site (Proposed 23adH-3-65)

Based on our previous studies and most recent site reconnaissance, we did not identify indications of landslides at the 23b3 Well Site. Our January 6, 1999 slope stability evaluation of the site concluded that risk to the well site is low.

5.2.2 33c3 Well site (proposed 23acH-3-65)

Our January 6, 1999 study, identified a deep-seated landslide at the 33c3 well site and concluded that there was moderate risk of future slide movement at the site. In accordance with our recommendations, an inclinometer was installed in 1999 to monitor potential slope movement at the site. We have monitored the inclinometer casing now for 7 years and have not measured significant movement of the casing, indicating that the mapped landslide is dormant. Based on the monitoring data, it is our opinion that the landslide hazard risk at the 33c3 site is low.

5.2.3 OM Well sites 33d, 44a3 (proposed 44-3, 33d-3-65)

Based on our previous studies and most recent site reconnaissance, we did not identify indications of landslides at the 33d or 44a3 Well Sites. Our January 6, 1999 slope stability evaluation of the sites concluded that the risk to the well sites is low.

5.2.4 Gathering Line Site

We have not identified landslides along the proposed gathering line following the Longview-Fibre Mainline at the western side of Miller Station and this area appears to be at a low risk of being affected by landslide movement.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the results of our map and aerial photograph review, visual reconnaissance, and previous work at the project area, it is our opinion that the site is suitable for the proposed construction. The conclusions and geotechnical recommendations provided in the May 19, 2005 report are generally appropriate for the Pearl Phase 2 improvements. However, our recommendations assume that the proposed well sites are underlain by medium stiff to stiff silt or clay. Locally, soft and/or wet areas may exist at the well sites. Subsurface conditions may be confirmed by test pit excavations and or borings completed to a depth of 10 to 20 feet below site grades, depending on conditions encountered.

If the subsurface conditions cannot be confirmed prior to construction, we recommend that all shallow foundations be underlain by a minimum of 18 inches of crushed rock structural fill meeting the specifications in Section 7.8 of our original report. The crushed rock should also extend a minimum of 18-inches beyond the perimeter of the foundations. Our recommendations should be incorporated into the project design and implemented during construction.

7.0 LIMITATIONS

We have prepared this report for the exclusive use of the NW Natural and their authorized agents for the Pearl Phase II Project.

Our services were provided to assist in the design of foundations and pipelines to be located on sloping property. Our recommendations are intended to reduce the potential for future property damage related to earth movements, drainage or erosion. However, all construction on slopes involves risk, only part of which can be mitigated through qualified engineering and construction practices. Favorable performance of structures in the near term does not imply a certainty of long-term performance, especially under conditions of adverse weather or seismic activity.

Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices in the field of geotechnical engineering in this area at the time this report was prepared. No warranty or other conditions, express or implied, should be understood.

Any electronic form, facsimile or hard copy of the original document (email, text, table, and/or figure), if provided, and any attachments are only a copy of the original document. The original document is stored by GeoEngineers, Inc. and will serve as the official document of record.

Please refer to the appendix titled Report Limitations and Guidelines for Use for additional information pertaining to use of this report.

8.0 REFERENCES

Dames & Moore. January 24, 1997. Geotechnical Investigation, Miller Station Expansion and Calvin Creek Pipeline Alignment, Mist Underground Storage Project.

GeoEngineers, January 6, 1999, Slope Stability Evaluation, Existing Well Sites, Flora/Bruer Gas Pool.
Prepared for Northwest Natural.

GeoEngineers, May 19, 2005, Geotechnical and Geologic Hazard Evaluation, Proposed Injection Well
and Gathering Line Pearl Phase I, Bruer Pool Development, Prepared for Northwest Natural.

Sincerely,

GeoEngineers, Inc.




Trevor N. Hoyles, PE
Associate

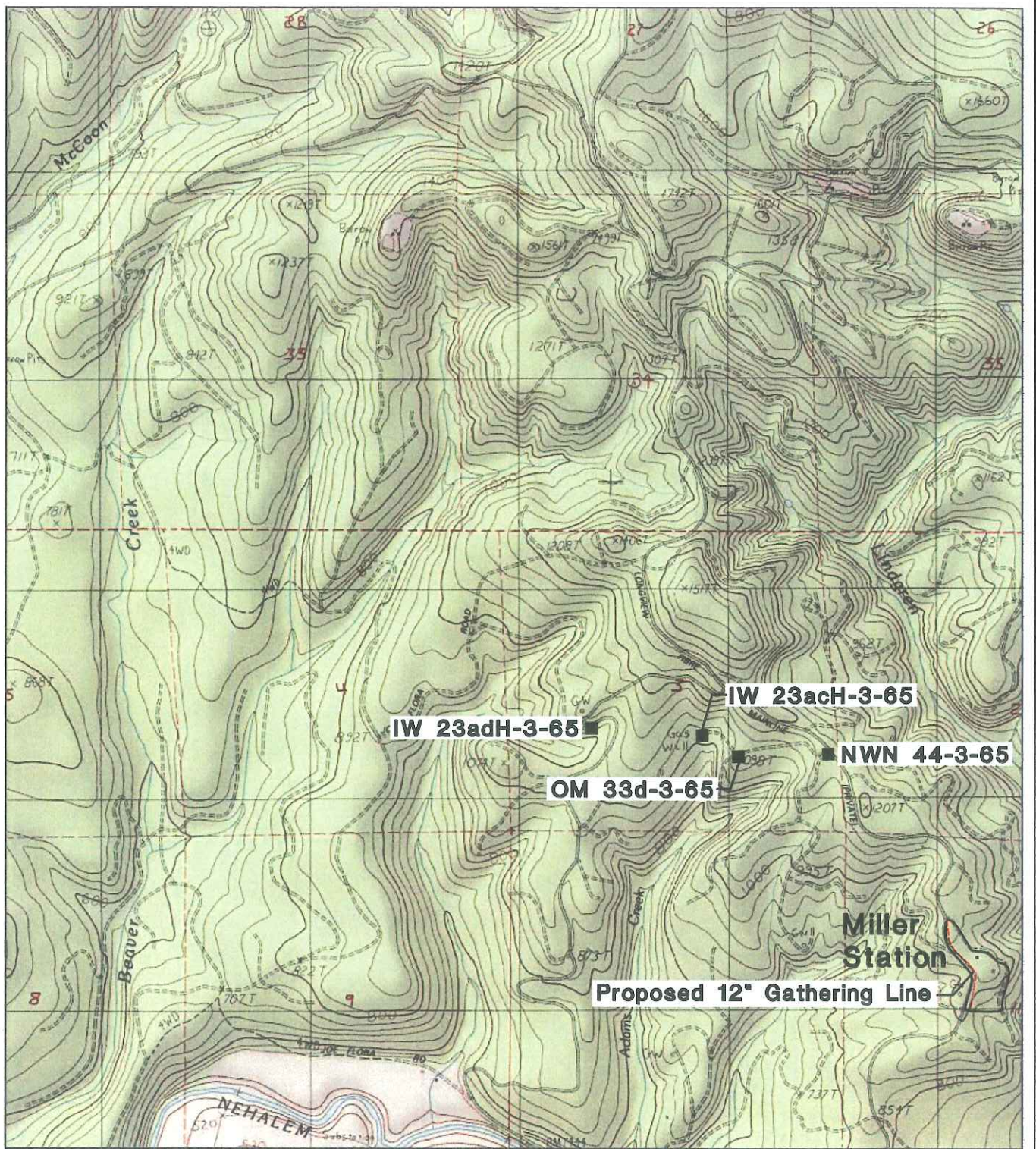
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Attachments: Figure 1. Vicinity Map
Figure 2. Landslide Hazards Map
Attachment A – Report Limitations and Guidelines For Use

Two copies submitted

Disclaimer: Any electronic form, facsimile or hard copy of the original document (email, text, table, and/or figure), if provided, and any attachments are only a copy of the original document. The original document is stored by GeoEngineers, Inc. and will serve as the official document of record.



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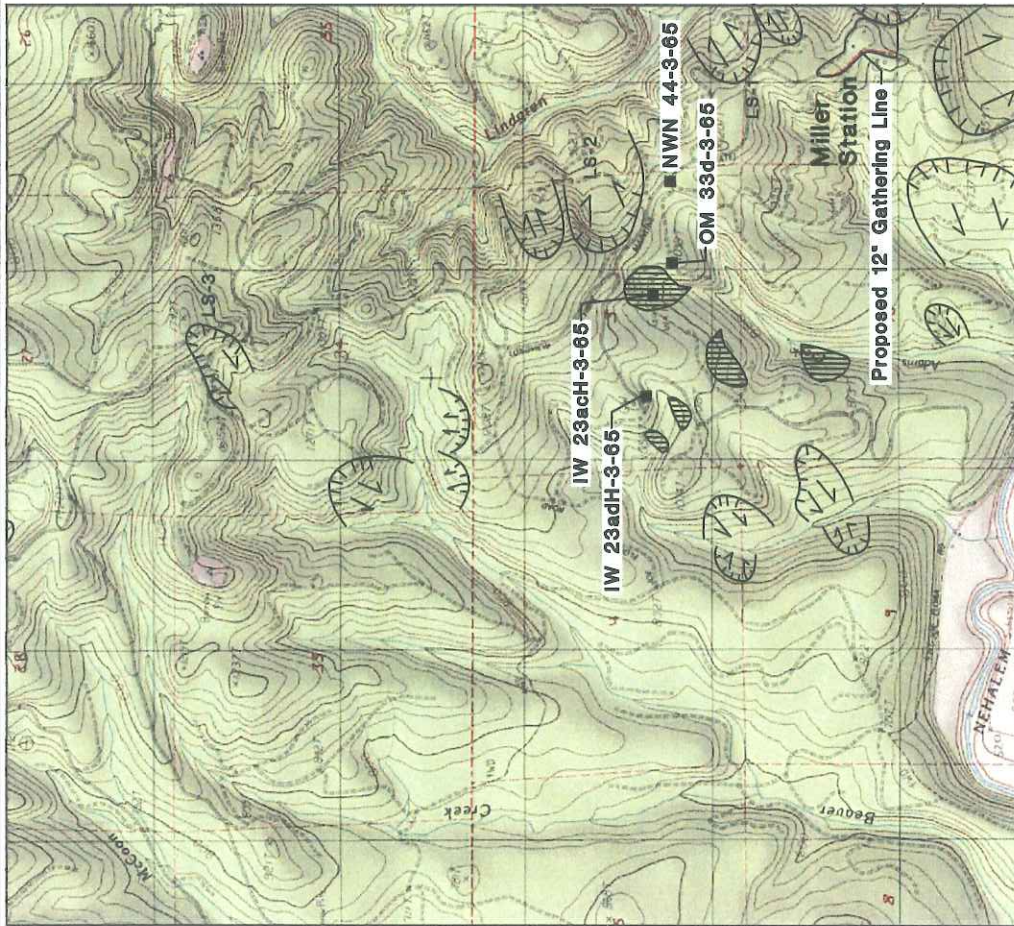
0 5 1 MILE
0 1000 FEET 0 500 1000 METERS

Map created with TOPO!® ©2003 National Geographic (www.nationalgeographic.com/topo)



Vicinity Map
Miller Station
Marshland, Oregon

Figure 1



EXPLANATION:

- LS-1 DORMANT LANDSLIDE AND SITE IDENTIFICATION NUMBER (SEE TEXT FOR DESCRIPTION) FROM GEOENGINEERS MAY 2005 REPORT
- DORMANT LANDSLIDE FROM GEOENGINEERS JANUARY 1999 REPORT
- NWN 44-3-65 PROPOSED WELL PAD

Notes:
 1. The locations of all features shown are approximate.
 2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. can not guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.



Landslide Hazards Map

Miller Station
 Marshland, Oregon

Figure 2



ATTACHMENT A
REPORT LIMITATIONS AND GUIDELINES FOR USE

THIS DOCUMENT IS THE PROPERTY OF THE U.S. GEOLOGICAL SURVEY AND IS LOANED TO YOUR AGENCY OR INDIVIDUAL. IT IS TO BE USED ONLY FOR THE PURPOSES AUTHORIZED BY THE U.S. GEOLOGICAL SURVEY. IT IS TO BE RETURNED TO THE U.S. GEOLOGICAL SURVEY WHEN NO LONGER NEEDED.



ATTACHMENT A

REPORT LIMITATIONS AND GUIDELINES FOR USE¹

This attachment provides information to help you manage your risks with respect to the use of this report.

GEOTECHNICAL SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES, PERSONS AND PROJECTS

This report has been prepared for the exclusive use of NW Natural and their authorized agents. This report may be made available to for review. This report is not intended for use by others, and the information contained herein is not applicable to other sites.

GeoEngineers structures our services to meet the specific needs of our clients. For example, a geotechnical or geologic study conducted for a civil engineer or architect may not fulfill the needs of a construction contractor or even another civil engineer or architect that are involved in the same project. Because each geotechnical or geologic study is unique, each geotechnical engineering or geologic report is unique, prepared solely for the specific client and project site. Our report is prepared for the exclusive use of our Client. No other party may rely on the product of our services unless we agree in advance to such reliance in writing. This is to provide our firm with reasonable protection against open-ended liability claims by third parties with whom there would otherwise be no contractual limits to their actions. Within the limitations of scope, schedule and budget, our services have been executed in accordance with our Agreement with the Client and generally accepted geotechnical practices in this area at the time this report was prepared.. This report should not be applied for any purpose or project except the one originally contemplated.

A GEOTECHNICAL ENGINEERING OR GEOLOGIC REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

This report has been prepared for the Pearl Phase II Project. GeoEngineers considered a number of unique, project-specific factors when establishing the scope of services for this project and report. Unless GeoEngineers specifically indicates otherwise, do not rely on this report if it was:

- not prepared for you.
- not prepared for your project.
- not prepared for the specific site explored.
- completed before important project changes were made.

For example, changes that can affect the applicability of this report include those that affect:

- the function of the proposed structure.
- elevation, configuration, location, orientation or weight of the proposed structure.
- composition of the design team.
- project ownership.

¹ Developed based on material provided by ASFE, Professional Firms Practicing in the Geosciences; www.asfe.org.

If important changes are made after the date of this report, GeoEngineers should be given the opportunity to review our interpretations and recommendations and provide written modifications or confirmation, as appropriate.

SUBSURFACE CONDITIONS CAN CHANGE

This geotechnical or geologic report is based on conditions that existed at the time the study was performed. The findings and conclusions of this report may be affected by the passage of time, by manmade events such as construction on or adjacent to the site, or by natural events such as floods, earthquakes, slope instability or groundwater fluctuations. Always contact GeoEngineers before applying a report to determine if it remains applicable.

MOST GEOTECHNICAL AND GEOLOGIC FINDINGS ARE PROFESSIONAL OPINIONS

Our interpretations of subsurface conditions are based on field observations from widely spaced sampling locations at the site. Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. GeoEngineers reviewed field and laboratory data and then applied our professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ, sometimes significantly, from those indicated in this report. Our report, conclusions and interpretations should not be construed as a warranty of the subsurface conditions.

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If Client desires these specialized services, they should be obtained from a consultant who offers services in this specialized field.

BEFORE THE
COLUMBIA COUNTY PLANNING COMMISSION
ST. HELENS, OREGON

In the Matter of the Application of Enerfin Resources)
request for a Conditional Use Permit for natural gas)
production activities in a Primary Forest Zone (PF-76))

-44 a-3
Final Order CU 06-21

This matter came before the Columbia County Planning Commission on the application of Enerfin Resources for natural gas production activities in a Primary Forest (PF-76) Zone . The subject property is located within commercial timberlands, owned by Bascom Pacific, LLC., that have access to Highway 202, approximately 2 ½ miles northwest of Mist. The parcel is described on the Columbia County Assessor's records as Tax Account # 6500-000-00300 (Section 3).

Notice of the land use application was provided to the Mist-Birkenfeld CPAC, affected agencies and surrounding property owners. A public hearing was held on May 1, 2006. The Planning Commission heard testimony from the applicant and interested parties and considered written materials including the Staff Report.

After due consideration the Columbia County Planning Commission hereby adopts the findings of the Staff Report dated April 20, 2006(Amended May 1, 2006), and orders this application (CU 06-21 for a Conditional Use Permit for natural gas production activities in the Primary Forest (PF-76) Zone, **APPROVED**, with the following conditions:

Conditions of Approval:

1. This permit shall become void 4 years from the date of the final decision if drilling has not begun on the property. Extensions of time may be granted by the Planning Director if requested in writing before the expiration date and if the applicant was not responsible for the failure to develop.
2. Prior to operations, the applicant shall notify and obtain proper permits from DOGAMI.
3. Prior to operations, the applicant shall provide notification to the Mist-Birkenfeld Fire District a minimum of 5 days in advance of drilling activity. The applicant shall arrange inspection by Fire Department personnel prior to start of drilling activity. The applicant shall notify the Mist-Birkenfeld Fire District when the drilling activity is completed. This permit will not be valid unless the applicant meets the requirements of the Mist-Birkenfeld Fire District.
4. Prior to operations, the applicant shall obtain documentation from West Oregon Electric that the proposed activities will not create a life safety issue regarding their powerlines and infrastructure.

COLUMBIA COUNTY PLANNING COMMISSION

David A. Middle
DAVID MIDDLE, VICE CHAIRMAN

5-5-06
DATE

BEFORE THE
COLUMBIA COUNTY PLANNING COMMISSION
ST. HELENS, OREGON

In the Matter of the Application of)
NW Natural Gas for a Conditional)
Use Permit to drill two Injection/)
Withdrawal Wells and rework one)
existing I/W Well into an observation)
well in a Primary Forest (PF-76) Zone.)

23-024-3-65
- 330-2-65
- 3324-3-65

FINAL ORDER CU 06-41, CU06-42, CU 06-44

This matter came before the Columbia County Planning Commission on the application of NW Natural Gas for a Conditional Use Permit (modification of prior approval) to drill two Injection/Withdrawal Wells and rework one existing I/W Well into an observation well in the existing Bruer/Flora Storage Area on a 160.0 acre parcel, owned by Bascom Pacific LLC, in the Primary Forest (PF-76) Zone. The subject property is located approximately 2 1/2 miles northwest of Mist. The parcel is described on the Columbia County Assessor's records as Tax Account Number 6500-000-00300.


Notice of the land use application was provided to the Mist-Birkenfeld CPAC, affected agencies and surrounding property owners. A public hearing was held on July 3, 2006. The Planning Commission heard testimony from the applicant and interested parties and considered written materials including the Staff Report.

After due consideration, the Columbia County Planning Commission hereby adopts the findings in the Staff Report dated June 9, 2006, and orders this application (CU 06-41, CU 06-42, CU 06-44) for a Conditional Use Permit to drill two Injection/Withdrawal Wells and rework one existing I/W Well into an observation well on a 160.0 acre parcel in the Primary Forest (PF-76) Zone, **APPROVED**, with the following conditions:

Conditions of Approval:

1. This permit shall become void 4 years from the date of the final decision if drilling has not begun on the property. Extensions of time may be granted by the Planning Director if requested in writing before the expiration date and if the applicant was not responsible for the failure to develop.
2. Prior to operations, the applicant shall notify and obtain proper permits from DOGAMI.
3. The applicants shall satisfy the permit requirements of the Mist-Birkenfeld Rural Fire Protection District which include: a minimum of one access road be maintained for emergency vehicles at all times, the site shall be subject to inspection at any time and the fire department must be notified 3 working days prior to beginning drilling activities.

COLUMBIA COUNTY PLANNING COMMISSION



GUY LETOURNEAU, VICE CHAIRMAN
David A. Middle

7-7-06

DATE

BEFORE THE
COLUMBIA COUNTY PLANNING COMMISSION
ST. HELENS, OREGON

In the Matter of the Application of)
NW Natural Gas for a Conditional)
Use Permit to drill two Injection/)
Withdrawal Wells in a Primary Forest)
(PF-76) Zone.)

203 22-3-18
33 D-3-6
FINAL ORDER CU 06-40, CU06-43

This matter came before the Columbia County Planning Commission on the application of NW Natural Gas for a Conditional Use Permit (modification of prior approval) to drill two Injection/Withdrawal Wells in the existing Bruer/Flora Storage Area on a 915.14 acre parcel, owned by Longview Fibre Company, in the Primary Forest (PF-76) Zone. The subject property is located approximately 2 1/2 miles northwest of Mist. The parcel is described on the Columbia County Assessor's records as Tax Account Number 6500-000-00700.

Notice of the land use application was provided to the Mist-Birkenfeld CPAC, affected agencies and surrounding property owners. A public hearing was held on July 3, 2006. The Planning Commission heard testimony from the applicant and interested parties and considered written materials including the Staff Report.

After due consideration, the Columbia County Planning Commission hereby adopts the findings in the Staff Report dated June 9, 2006, and orders this application (CU 06-40, CU 06-43) for a Conditional Use Permit to drill two Injection/Withdrawal Wells on a 915.14 acre parcel in the Primary Forest (PF-76) Zone, **APPROVED**, with the following conditions:

Conditions of Approval:

1. This permit shall become void 4 years from the date of the final decision if drilling has not begun on the property. Extensions of time may be granted by the Planning Director if requested in writing before the expiration date and if the applicant was not responsible for the failure to develop.
2. Prior to operations, the applicant shall notify and obtain proper permits from DOGAMI.
3. The applicants shall satisfy the permit requirements of the Mist-Birkenfeld Rural Fire Protection District which include: a minimum of one access road be maintained for emergency vehicles at all times, the site shall be subject to inspection at any time and the fire department must be notified 3 working days prior to beginning drilling activities.

COLUMBIA COUNTY PLANNING COMMISSION



GUY LETOURNEAU, VICE CHAIRMAN
David A. Middle

7-7-06

DATE



Oregon

Theodore R. Kulongoski, Governor

Department of Geology & Mineral Industries

Mineral Land Regulation and Reclamation

229 Broadalbin Street SW

Albany, OR 97321-2246

541-967-2039

FAX 541-967-2075

November 21, 2006

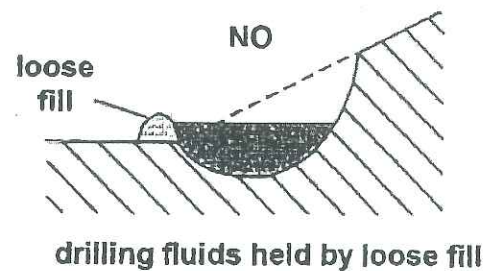
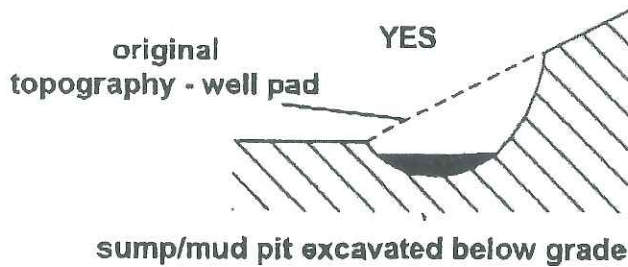
NW Natural
220 NW 2nd Avenue
Portland OR 97209

Permit to Drill Gas Well

The application to drill a gas well, IW 23ACH-03-65, located in Section 3, Township 6N, Range 5W, Columbia County, Mist Storage - Flora Pool, DOGAMI ID No. 580, API No. 36-009-00364, has been approved with the following conditions:

The permittee shall:

1. Construct all sumps/mud pits by excavating below grade with a design and size for holding the drill cuttings and fluid removed from the well. Loose fill material will not be allowed to be used in the construction of the sumps/mud pits for the purposes of water retention.



2. Contact DOGAMI two weeks prior to spud.
3. Provide DOGAMI with a 2-week, a 3 day, and a 24-hour notice to schedule an inspection to witness all BOPE tests conducted prior to drilling out each casing shoe.
4. Per 632-010-0014(C) & (D), the BOPE shall be pressure tested: when installed, prior to drilling out casing shoes, following repairs or reassembly of the preventers that require disconnection a pressure seal in the assembly, and shall be actuated to test proper functioning once each trip or once each week, whichever is more frequent.

Issued on 11.21.06, 2006

by

Gary W. Lynch
Assistant Director
Department of Geology

c: Columbia County



Oregon

Theodore R. Kulongoski, Governor

Department of Geology & Mineral Industries

Mineral Land Regulation and Reclamation

229 Broadalbin Street SW

Albany, OR 97321-2246

541-967-2039

FAX 541-967-2075

November 21, 2006

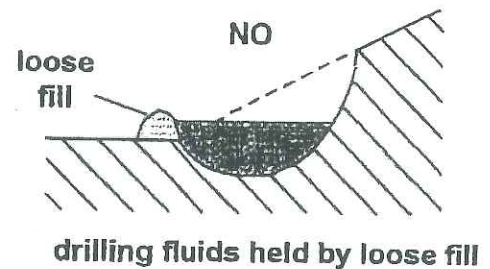
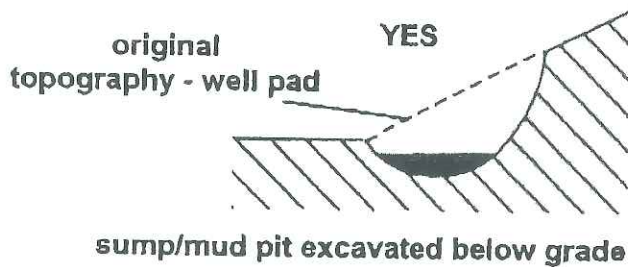
NW Natural
220 NW 2nd Avenue
Portland OR 97209

Permit to Drill Gas Well

The application to drill a gas well, IW 23ADH-03-65, located in Section 3, Township 6N, Range 5W, Columbia County, Mist Storage - Flora Pool, DOGAMI ID No. 581, API No. 36-009-00365, has been approved with the following conditions:

The permittee shall:

1. Construct all sumps/mud pits by excavating below grade with a design and size for holding the drill cuttings and fluid removed from the well. Loose fill material will not be allowed to be used in the construction of the sumps/mud pits for the purposes of water retention.



2. Contact DOGAMI two weeks prior to spud.
3. Provide DOGAMI with a 2-week, a 3 day, and a 24-hour notice to schedule an inspection to witness all BOPE tests conducted prior to drilling out each casing shoe.
4. Per 632-010-0014(C) & (D), the BOPE shall be pressure tested: when installed, prior to drilling out casing shoes, following repairs or reassembly of the preventers that require disconnection a pressure seal in the assembly, and shall be actuated to test proper functioning once each trip or once each week, whichever is more frequent.

Issued on 11.21, 2006

by

Gary W. Lynch

 Gary W. Lynch
 Assistant Director
 Department of Geology

c: Columbia County

well file



Oregon

Theodore R. Kulongoski, Governor

Department of Geology & Mineral Industries

Mineral Land Regulation and Reclamation

229 Broadalbin Street SW

Albany, OR 97321-2246

541-967-2039

FAX 541-967-2075

January 5, 2007

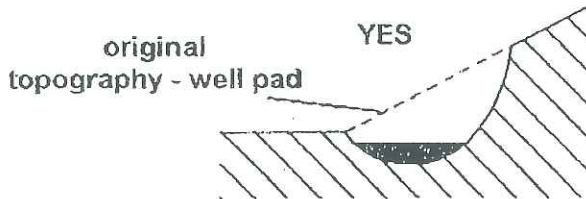
Enerfin Resources Northwest Ltd Partnership
2500 City West Blvd Suite 400
Houston TX 77042

Permit to Drill Gas Well

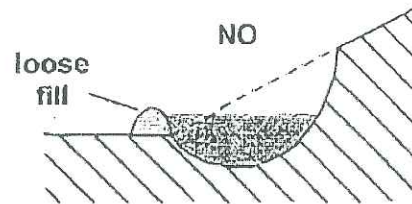
The application to drill a gas well, CC 44-03-65, located in Section 3, Township 6N, Range 5W, Columbia County, Mist Gas Field, DOGAMI ID No. 582, API No. 36-009-00366, has been approved with the following conditions:

The permittee shall:

1. Construct all sumps/mud pits by excavating below grade with a design and size for holding the drill cuttings and fluid removed from the well. Loose fill material will not be allowed to be used in the construction of the sumps/mud pits for the purposes of water retention



sump/mud pit excavated below grade



drilling fluids held by loose fill

2. Contact DOGAMI two weeks prior to spud
3. Provide DOGAMI with a 2-week, a 3 day, and a 24-hour notice to schedule an inspection to witness all BOPE tests conducted prior to drilling out each casing shoe.
4. Per 632-010-0014(C) & (D), the BOPE shall be pressure tested: when installed, prior to drilling out casing shoes, following repairs or reassembly of the preventers that require disconnection a pressure seal in the assembly, and shall be actuated to test proper functioning once each trip or once each week, whichever is more frequent.

Issued on 1-8 2007

by

G. Lynch
Gary W. Lynch
Assistant Director

Department of Geology

c: Columbia County

March 19, 2007

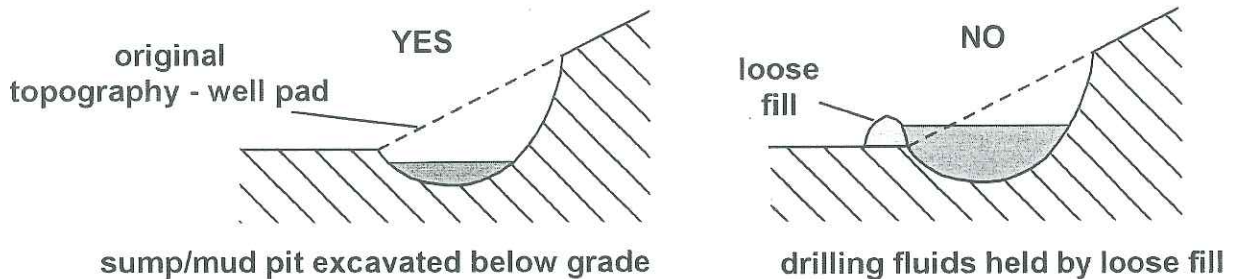
NW Natural
220 NW Second Avenue
Portland OR 97209

Permit to Drill Gas Well

The application to drill a gas well, NWN 44-03-65 (formerly CC 44-03-65), located in Section 3, Township 6N, Range 5W, Columbia County, Mist Gas Field, DOGAMI ID No. 582, API No. 36-009-00366, has been approved with the following conditions:

The permittee shall:

1. Construct all sumps/mud pits by excavating below grade with a design and size for holding the drill cuttings and fluid removed from the well. Loose fill material will not be allowed to be used in the construction of the sumps/mud pits for the purposes of water retention.



2. Contact DOGAMI two weeks prior to spud.
3. Provide DOGAMI with a 2-week, a 3 day, and a 24-hour notice to schedule an inspection to witness all BOPE tests conducted prior to drilling out each casing shoe.
4. Per 632-010-0014(C) & (D), the BOPE shall be pressure tested: when installed, prior to drilling out casing shoes, following repairs or reassembly of the preventers that require disconnection a pressure seal in the assembly, and shall be actuated to test proper functioning once each trip or once each week, whichever is more frequent.

Issued on March 19, 2007

by Robert A. Houston
Gary W. Lynch
Assistant Director
Department of Geology

c: Columbia County

March 19, 2007

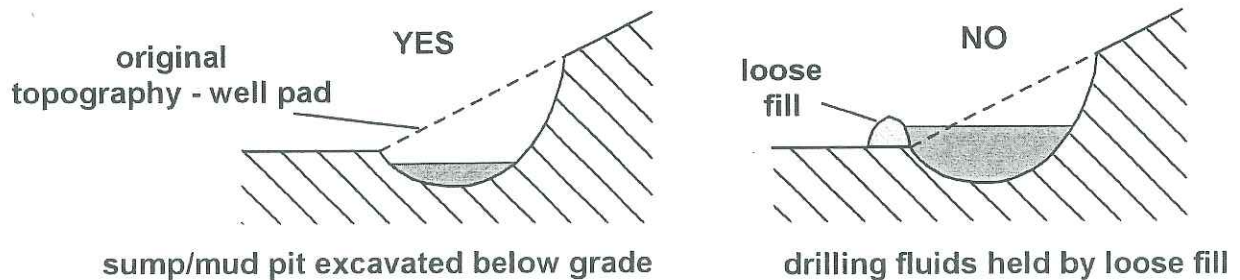
NW Natural
220 NW 2nd Avenue
Portland OR 97209

Miscellaneous Permit

The application to rework IW 33D-03-65, located in Section 3, Township 6N, Range 5W, Mist Storage - Flora Pool, DOGAMI ID No. 404, has been approved with the following conditions.

The permittee shall:

1. Construct all sumps/mud pits by excavating below grade with a design and size for holding the drill cuttings and fluid removed from the well. Loose fill material will not be allowed to be used in the construction of the sumps/mud pits for the purposes of water retention.



2. Contact DOGAMI two weeks prior to spud.
3. Provide DOGAMI with a 2-week, a 3 day, and a 24-hour notice to schedule an inspection to witness all BOPE tests conducted prior to drilling out each casing shoe.
4. Per 632-010-0014(C) & (D), the BOPE shall be pressure tested: when installed, prior to drilling out casing shoes, following repairs or reassembly of the preventers that require disconnection a pressure seal in the assembly, and shall be actuated to test proper functioning once each trip or once each week, whichever is more frequent.

Issued on March 19, 2007

by Robert A. Houston

Bob Houston
Petroleum - Geothermal Geologist
Natural Resource Specialist
Mineral Land Regulation and Reclamation

c: Columbia County

June 11, 2007

Todd Thomas
NW Natural
220 NW 2nd Ave.
Portland OR 97209

Re: Concurrence under OAR 345-027-0050(5) for Pearl Project Phase 2

Dear Todd,

On May 16, 2007 you sent an evaluation of need for a site certificate amendment to the Oregon Department of Energy. In the evaluation, you described some proposed changes to the Mist Underground Storage Facility. The proposed changes to the Mist storage facility are called the Pearl Project Phase (2).

You included an analysis of need for a site certificate amendment, and concluded that these changes do not require a site certificate under the threshold criteria of OAR 345-027-0050(1) or (2). You asked ODOE to review and concur with this analysis under OAR 345-027-0050(5).

ODOE has reviewed the request for concurrence, and we agree that these changes can be made without a site certificate amendment.

Proposed Changes as Miller Station

The Pearl Project Phase (2) includes equipment upgrades at Miller Station. The upgrades include replacement of pipes and valves within Miller Station, and expanded metering and flow control equipment at the Flora Pool gathering area.

The equipment upgrades will increase the design day compressed throughput to 515 million cubic feet per day (MMcfd). Currently, the site certificate allows a maximum throughput of 515 MMcfd, but this is only possible under free flow conditions. With the proposed modifications, the facility will be able to reach 515 MMcfd under compressed conditions. However, the site certificate does not specify the conditions under which the 515 MMcfd rate can be achieved. It simply allows a maximum of 515. Therefore, the equipment upgrades do not require a change in the site certificate condition.

All equipment upgrades are proposed on land within the site, and are similar to other equipment already at the site.

The upgrades will result in greater use of compressors and more CO2 emissions. However, under the current site certificate, NWN maintains a fund payable to the Oregon Climate Trust to account for CO2 emissions from the Mist Storage Facility, and replenishes the fund as needed. With the proposed upgrades, NWN would replenish the account more often, but the current conditions in the site certificate allow for this. Therefore no change is needed to the site certificate.

The analysis includes information showing that the proposed upgrades do not have any impacts that are not previously accounted for in Council orders approving the site certificate or amendments 1 through 9.

ODOE agrees that the proposed upgrades to Miller Station do not require a site certificate amendment.

Upgrade to Flora storage area

NWN proposes to drill new injection wells into the Flora Pool. The new wells would be within the site boundaries. The wells are under DOGAMI jurisdiction, but will require approximately 200 feet of new gathering line. The new gathering line will be in existing Right of Way and does not require an expansion of the site boundary. Construction impacts for this new gathering line are the same as impacts previously described in Council orders approving amendments 1 through 9. Construction conditions requiring use of Best Management Practices and described in the order approving amendment 9 would apply to pipelines constructed for the Pearl project.

NWN has submitted an analysis of compliance with EFSC standards in OAR 345 Divisions 22 and 24 and concluded that the new pipelines would comply with all standards. NWN provided studies to support this conclusion, under OAR 345-027-0050(3).

Conclusion

ODOE agrees that the upgrades to Miller station and the Breuer/Flora storage areas included in the Pearl project and described in the evaluation that NWN submitted on May 16, 2007 do not require a site certificate amendment.

Sincerely,

Adam Bless
Oregon Department of Energy