3.0 ALTERNATIVES

Several alternatives to Northwest's Capacity Replacement Project were evaluated to determine whether they would be reasonable and environmentally preferable to the proposed action. These alternatives included the no action or postponed action alternative; system alternatives, including other existing or alternative pipeline systems, new pipeline corridors, and alternative configurations of Northwest's system; route variations and non-standard parallel offsets; abandonment alternatives; and construction method alternatives.

The evaluation criteria for selecting potentially reasonable and environmentally preferable alternatives include whether they:

- are technically and economically feasible and practical;
- offer significant environmental advantage over the proposed project; and
- meet the project objectives of replacing the required delivery capacity of Northwest's existing 268-mile-long, 26-inch-diameter pipeline between Sumas and Washougal, Washington.

In conducting a reasonable analysis, it is important to recognize the environmental advantages and disadvantages of the proposed action to be able to focus the analysis on those alternatives that may reduce impacts and offer a significant environmental advantage. A detailed discussion of the environmental consequences of the project (both positive and negative) is included in section 4.0.

Using the evaluation criteria discussed above and subsequent environmental comparisons, each alternative was considered to the point where it was either clear that the alternative was not reasonable, would result in substantially greater environmental impacts that could not be readily mitigated, offered no potential environmental advantages over the proposed project, or could not meet the project's objectives. Those alternatives that appeared to offer environmental advantages or that would result in less than or similar levels of environmental impact were reviewed in greater detail.

The analysis was based on information provided by Northwest, field reconnaissance, aerial photographs, U.S. Geological Survey (USGS) topographic maps, other publicly available environmental data, agency consultations, and public scoping comments.

3.1 NO ACTION OR POSTPONED ACTION

The action triggering this environmental review was Northwest's application to the FERC for a Certificate. This environmental review will also satisfy the COE's NEPA responsibilities in considering issuance of section 404 and section 10 permits for activities associated with the project and the WDOE's responsibilities to consider alternatives under SEPA. The FERC, the COE, the WDOE, and the WDFW have three alternative courses of action in considering proposed projects. They may: 1) grant the approval with or without conditions; 2) deny the approval; or 3) postpone action pending further study.

If the FERC were to deny or postpone action on Northwest's application, Northwest would not be able to comply with the DOT's CAO unless it were to replace the entire existing 26-inch-diameter pipeline with a new 26-inch-diameter pipeline according to the phased schedule outlined in the CAO (see section 1.1). The entire 26-inch-diameter pipeline could be replaced without obtaining a FERC Certificate if Northwest were to either phase its construction into multiple, small projects that would

remain within the provisions of Title 18 CFR Part 2.55[1] of the FERC's regulations or replace the entire 268 miles under those provisions.

However, if Northwest were to replace the 26-inch-diameter pipeline under Title 18 CFR Part 2.55 of the FERC's regulations, it would still need to obtain other federal, state, and local approvals. The cumulative environmental impact of a phased replacement of the entire 268 miles of 26-inch-diameter pipeline over a 10-year period would be greater than the impact of the 79.5-mile-long Capacity Replacement Project because it would involve more than three times the length of right-of-way and would be constructed in more than 1 year. Therefore, the likely outcome of the FERC, the COE, the WDOE, and the WDFW denying or postponing action on Northwest's applications for the Capacity Replacement Project would be the replacement of the entire 26-inch-diameter pipeline causing greater environmental impacts. Alternatively, if Northwest were to abandon the 26-inch-diameter pipeline without replacing its capacity, Northwest would not be able to meet its contractual obligations and Washington would lose a significant amount of its natural gas supply.

Northwest is currently the sole provider of interstate natural gas in the Interstate 5 corridor in western Washington. If Northwest could not meet its delivery contracts, its customers would likely seek natural gas from other sources. This could necessitate the construction of additional and/or new pipeline facilities in other locations (system alternatives) to transport natural gas to the markets Northwest serves. If other new natural gas pipeline facilities are approved and constructed, each project would result in specific environmental impacts that could be less than, similar to, or greater than those associated with the current proposal. Use of alternative pipeline systems to supply natural gas to Northwest's customers is discussed in section 3.2.1.

An insufficient supply of natural gas could cause many of Northwest's customers to use other fossil fuels, such as coal or oil, for its energy supplies. Many natural gas power plants have the option of switching to fuel oil if natural gas becomes unavailable or prohibitively expensive. However, increased use of other fossil fuels would lead to increased emissions of combustion byproducts, including sulfur oxides (SO_x), nitrogen oxides (NO_x), hydrocarbons, and carbon dioxide (CO_2) (see table 3.1-1).

TABLE 3.1-1

Estimated Air Emissions by Fossil Fuel Type for Electric Power Generation

Fossil Fuel Type	CO_2 (lb/kWh)	SO_X (lb/kWh)	NO_X (lb/kWh)
Coal	2.1	0.013	0.0076
Oil	1.6	0.011	0.0021
Natural Gas	1.0	0.000007	0.0018

Source: Estimated emissions are based on total emissions and total electrical power production for each fossil fuel type, as reported in the U.S. Environmental Protection Agency's Annual Energy Review 2003 (U.S. Department of Energy, 2003).

CO_2 = carbon dioxide
SO_x = sulfur oxides
NO_x = nitrogen oxides
lb/KWh = pounds per kilowatt hour

[1] Title 18 CFR Part 2.55 includes (a) auxiliary installations and (b) replacement of facilities. Auxiliary installations are defined as installations (excluding gas compressors) that are merely auxiliary or appurtenant to an authorized or proposed transmission pipeline system and are installations only for the purpose of obtaining more efficient or more economical operation of the authorized or proposed transmission facilities (e.g., valves; drips; pig launchers and receivers; yard and station piping; cathodic protection equipment; gas cleaning, cooling, and dehydration equipment; residual refining equipment; water pumping, treatment, and cooling equipment; electrical and communication equipment; and buildings). Replacement of facilities is defined as facilities that constitute the replacement of existing facilities that have or will soon become physically deteriorated or obsolete, to the extent that replacement is deemed advisable.

Compared to other fossil fuels, natural gas is a relatively clean and efficient fuel. Combustion of fuels, such as oil or coal, can generate 60 to 110 percent more CO_2 than natural gas. Other emissions from oil or coal combustion, including greenhouse gases, are also significantly higher than those from natural gas. The use of other fossil fuels in place of natural gas would not only increase atmospheric pollution, but would also result in secondary impacts associated with production (e.g., coal mining and oil drilling), transportation (e.g., oil tankers, rail cars, and pipelines), and refining. Under Northwest's proposed project, these increased emissions and secondary impacts would not occur and would actually decrease overall because the proposed project would result in slightly less delivery of natural gas and subsequent emissions, and would rely on the same production and transportation systems as the original (authorized) 26-inch-diameter pipeline system.

The use of renewable energy sources is currently infeasible because solar, wind, hydroelectric, and other energy sources such as geothermal or fuel cells are either not physically or commercially available in the market region or have not been developed to the point where they would be viable substitutes for the volume of natural gas that Northwest is required to provide. Moreover, their use if they were available would require major modifications to end-user facilities.

3.2 SYSTEM ALTERNATIVES

System alternatives are alternatives to the proposed action that would make use of other existing, modified, or proposed pipeline systems to meet the stated objectives of the project. A system alternative would make it unnecessary to construct all or part of the proposed project, although some modifications or additions to another existing pipeline system may be required to increase its capacity, or another entirely new system may need to be constructed. Such modifications or additions would result in environmental impact; however, the impact could be less than, similar to, or greater than that associated with construction of the proposed project.

Under the terms of the DOT's CAO, Northwest is required to replace the capacity of its existing 268-mile-long, 26-inch-diameter pipeline over a 10-year period. A number of system alternatives that could potentially be implemented by Northwest to comply with the CAO were evaluated. The purpose of identifying and evaluating system alternatives is to determine whether potential environmental impacts associated with the construction and operation of the proposed facilities could be avoided or reduced while still allowing the stated objectives of the project to be met.

In order to be viable system alternatives to the Capacity Replacement Project, other systems or modified systems would have to meet two criteria: 1) they would need to provide transportation of natural gas from Sumas to Washougal, Washington from which the gas could then be transported via regional systems to the market delivery points; and 2) they would need to be able to provide the required volumes within the same general time frame as the proposed project.

3.2.1 Other Existing Pipeline Systems

Northwest's existing customers could seek natural gas from other existing pipeline systems if Northwest were released from its contractual obligations or if it were to abrogate its delivery contracts to its existing customers. However, because Northwest is the sole provider of interstate natural gas in the western Washington area, there are no other companies or existing systems that could meet Northwest's contractual delivery requirements without constructing new transmission facilities. In order for an alternative pipeline system to replace the proposed project, new facilities would need to be planned, permitted, constructed, and placed in service by December 18, 2006, and Northwest's existing customers would need to subscribe to the alternative pipeline system to receive the equivalent volumes of natural gas. To serve the same market as the Capacity Replacement Project, a new natural gas transmission

system would likely require the construction of between 260 and 300 miles of new pipeline along with compression and related infrastructure to interconnect with the local distribution companies. Based on length alone, such a project would likely result in significantly greater environmental impact than the proposed action. Therefore, the use of an alternative pipeline system is not considered to be environmentally preferable to the proposed action and it was eliminated from further consideration.

Because no other existing pipeline systems currently exist or are proposed in western Washington that could duplicate the capacity of Northwest's 26-inch-diameter pipeline except for Northwest's own system, this analysis focuses on what appear to be the most reasonable modifications to Northwest's system to meet the project objectives. These system alternatives are evaluated below.

3.2.2 Northwest System Alternatives

3.2.2.1 New Pipeline Corridor Alternatives

Northwest's existing system between Sumas and Washougal, Washington consists of two parallel 26-inch- and 30-inch-diameter pipelines and 27.8 miles of adjacent 36-inch-diameter pipeline. Collocation of facilities is generally preferred by land management agencies, land use planners, and other regulatory agencies, and has several inherent engineering and environmental advantages. While the origin and delivery points of new pipeline corridor alternatives would generally be the same as for corresponding segments of an existing pipeline corridor, the route alternatives would follow different alignments and would impact new landowners and environmental features that are not currently impacted or were not impacted by construction of the original pipelines. In addition, from an engineering standpoint, it is much easier and more efficient to maintain facilities within the same corridor. Northwest has proposed to use its existing corridor to the maximum extent possible and to minimize the amount of additional permanent easement that would be required. Because of the significant advantages afforded by collocating with Northwest's existing corridor, the FERC staff believes that installing the proposed loops within or adjacent to the existing corridor would be environmentally preferable and eliminated an alternative using a new pipeline corridor from further consideration.

3.2.2.2 Alternative Configurations of the Northwest System

A number of potential alternative configurations of Northwest's system were evaluated to determine whether they would be technically and economically feasible and practical, environmentally preferable, and able to meet the project objectives. Some of these alternatives were identified by the public and various agencies during the scoping process. These alternative configurations include:

- permanently returning the existing 26-inch-diameter pipeline to service;
- constructing a new 26-inch-diameter pipeline to replace the existing 26-inch-diameter pipeline;
- using pipeline looping only;
- using compression only;
- installing an alternative pipeline size;
- installing the pipeline loops in alternative locations;
- replacing the existing 26-inch-diameter pipeline with the 36-inch-diameter loops in the same trench;

- maximizing use of the existing 30-inch-diameter pipeline;
- placing a smaller pipeline inside the existing 26-inch-diameter pipeline or using a pipe liner; and
- implementing a no turn back capacity alternative.

These alternatives are discussed below.

Permanently Returning the Existing 26-inch-diameter Pipeline to Service

In June 2004, Northwest was able to temporarily return approximately 111 miles of the existing 26-inch-diameter pipeline to service. The DOT approved the implementation of an integrity management program that involved identification and repair of pipeline anomalies and verification through pressure testing that the pipeline segment could be safely operated at its originally authorized pressure. In authorizing the return of this existing pipeline segment to temporary service, the DOT authorized Northwest to operate that segment of the pipeline only until the replacement dates required in the December 18, 2003 amended CAO. The DOT did not authorize permanent operation of that pipeline segment or provide a mechanism for permanent return to service of any portions of the existing pipeline beyond the mandated replacement dates. Therefore, a permanent return to service of the 26-inch-diameter pipeline is not considered to be a viable alternative and was eliminated from further consideration.

Like-kind Replacement of the 26-inch-diameter Pipeline

Replacing the entire 268 miles of existing 26-inch-diameter pipeline with a new 268-mile-long, 26-inch-diameter pipeline would be possible, and is authorized by the CAO to occur in three phases over 10 years. This alternative would consist of 65.5 miles of DOT Class 3 areas and HCAs in 52 separate sections that must be abandoned within 3 years, 79.0 miles of non-HCA DOT Class 2 areas in 44 separate sections that must be abandoned within 5 years, and the remaining 123.8 miles of non-HCA DOT Class 1 areas that must be abandoned within 10 years. Section 4.12.1 provides additional information on DOT class locations and HCAs. The alternative would involve staged replacements according to the DOT schedule and would require multiple internal inspections, hydrostatic tests, and associated repairs to temporarily restore full service capability as individual segments are abandoned and replaced, along with frequent follow-up testing until abandonment of the entire 268 miles of pipeline is complete. A like-kind replacement, as authorized in the CAO, would disturb 100 percent of the existing pipeline right-of-way over a much longer time frame (10 years) as compared to the proposed action, which would only disturb approximately 30 percent of the right-of-way during a period of less than 1 year. A like-kind replacement would also require significantly greater land disturbance, waterbody crossings, wetland crossings, vegetative clearing, and associated impacts on sensitive environmental resources and landowners compared to the impact of constructing 79.5 miles of 36-inch-diameter loops. In addition, installing 188.5 more miles of pipeline would greatly increase costs for both construction and materials. Therefore, a like-kind replacement alternative is not considered economically practical or environmentally preferable and was eliminated from further consideration.

Pipeline Looping-only Alternative

In the design of pipeline systems to deliver natural gas, there is a trade-off between installing pipeline loops and increasing compression. Pipeline loops are more reliable than compression because pipeline outages are generally predictable and can be planned. A large percentage of compressor outages are unplanned and, therefore, more likely to adversely affect system reliability and service to customers. Pipeline loops also increase service reliability by providing a redundant path for flow, thus allowing continued gas flow if a parallel section of pipe is removed from service. A pipeline also provides

reliability by acting like a long storage bottle. This pipeline storage, or "line pack," not only helps to mitigate the impacts of a compression outage, but can also help meet the non-uniform demands of natural gas customers that can occur near a large market like Seattle. For example, customers typically take a significant amount of gas between 6:00 AM and 11:00 AM when items such as water heaters and furnaces are in heavy use at homes, businesses, and schools. The flexibility provided by pipeline capacity helps to manage daily variation in demand. A pipeline loop enhances this reliability because it can provide an additional source of gas for customers to meet increases in peak demand.

The pipeline looping-only alternative (with minor modifications to some of the existing compressors) could potentially replace all of the necessary delivery capacity associated with the proposed project and would preclude the need for significant additional compression. However, in evaluating system flow hydraulics, approximately 166 miles of 36-inch-diameter loop would be needed to replace the capacity of the existing 26-inch-diameter pipeline without additional compression compared to the 79.5 miles of new 36-inch-diameter loop that would be needed for the proposed action. This alternative would more than double the length of the proposed project and, subsequently, would have greater impacts on the environment and landowners. In addition, installing 86.5 more miles of pipeline would increase costs for both construction and materials. Therefore, a pipeline looping-only alternative is not considered economically practical or environmentally preferable and was eliminated from further consideration.

Compression-only Alternatives

A compression-only alternative would entail increasing compression on the existing pipelines rather than adding loops to replace the capacity of the 26-inch-diameter pipeline. Compression facilities are key components in the hydraulic design of a pipeline system. Their suitability in supplementing pipeline capacity can be affected by a number of factors including concerns for system reliability and flexibility, potential environmental impacts, and technical issues such as pipeline design limitations. Compressor reliability is critical to meet peak flow demand periods. However, because compressors are either running or not running, and have finite upper and lower flow limits, they do not allow the flexibility of operation that is inherently present in pipeline facilities. In order to avoid compression breakdowns at critical times, compressors frequently need to be shut down to service the engines and equipment. Although shut downs are typically planned for low-use periods, compressor stations inherently limit system reliability.

Existing Compressor Station – Several commenters asked that Northwest consider installing additional compression instead of constructing new loops in residential areas. Northwest currently has four existing compressor stations between Sumas and Washougal that are spaced from 44 miles to 62 miles apart and are operating at or near the existing design limitations for the existing 30-inch- and 36-inch-diameter pipelines. The amount of compression that can be added to a pipeline system is limited by a number of technical parameters. For example, all pipelines are designed to withstand a limited amount of pressure; frictional losses in small diameter pipe can limit gas velocities and low suction pressure and volume can limit the discharge pressure that can be added. Pipelines are authorized to operate at an MAOP based on their design limitations and the pipeline integrity as demonstrated through pressure testing. Northwest's existing pipelines are being utilized at or near their MAOP.

Increasing compression using Northwest's existing compressor stations instead of installing pipeline loops is not considered a viable alternative for the following reasons:

- the MAOP of the existing lines would be exceeded;
- gas velocities would be too high without looping;
- compressor station suction pressures would be lower than acceptable;
- fuel usage at the compressor stations would increase significantly; and
- desired operational flexibility and reliability would not be achieved.

Because a compression-only alternative using the existing compressor stations would not be technically feasible or economically practical, it was eliminated from further consideration.

New Compressor Stations – Constructing new compressor stations at the approximate midpoints between the existing stations instead of installing loops would provide a moderate increase in flow capacity on the existing pipeline system and still remain within the MAOP, but would also create landowner, visual, noise, and air quality impacts associated with new permanent aboveground facilities. In addition, the abandonment of the existing 26-inch-diameter pipeline between Sumas and Washougal would create a significant loss of line pack, or storage, in Northwest's system and new intermediate compressor stations would further reduce the line pack on the remaining 30-inch-diameter pipeline by about half. This loss in storage would significantly reduce the system's reliability and Northwest's ability to manage daily variations in pressure and/or flow requirements within the Interstate 5 corridor. The variability in demand on Northwest's gas supplies within the Interstate 5 corridor supports the need for flexibility that would be provided by line pack on the proposed loops. In addition, gas discharge temperatures from each intermediate station would tend to be higher and may require the installation of additional gas coolers at existing stations and equivalently sized coolers at the new compressor stations. Gas coolers contribute to higher noise levels and have a negative impact on efficiency because the coolers themselves would require energy to operate, which would cause an additional pressure drop.

In terms of environmental efficiency, Northwest's proposed action would add 10,760 hp at two of its existing compressor stations to avoid construction, operation, and maintenance of new grassroots compressor stations. The proposed project would be a more compression-intensive design compared to the previously existing 26-inch-diameter pipeline system, make efficient use of existing facilities, and reduce environmental effects. The use of existing compressor stations and equipment would also minimize the long-term impacts on the natural and human environment associated with new facilities, including increased air emissions, noise, and permanent aboveground structures. The proposed pipeline and compression would also require less compressor fuel to transport an equivalent volume of gas because of efficiencies realized from the proposed loops that would reduce the total horsepower requirements for the project.

Because of the environmental and operational issues described above, the construction of new compressor stations instead of additional pipeline loop would not be a viable alternative and it was eliminated from further consideration.

Alternative Pipeline Size

Numerous comments were received regarding the diameter of the proposed loops. Some commenters recommended that there be no change from the existing 26-inch-diameter pipeline size, and some requested justification why larger-diameter pipe could not be used to reduce the total length of the proposed loops. In the evaluation of pipeline size requirements, factors associated with hydraulic requirements, efficiency, constructability, configuration of the existing right-of-way, impacts on landowners, existing pipeline facilities, reliability, accessibility of aboveground facilities, and environmental effects were considered.

Landowners on the Snohomish Loop, principally within the Deer Park Subdivision, commented that larger diameter pipelines should be considered in an effort to avoid certain properties. Based on the assumption that the pipeline would begin at a point immediately downstream of the existing Snohomish Compressor Station, the required delivery capacity on the Snohomish Loop could be achieved with a 42-inch-diameter pipeline that is about 11 miles in length, or 0.9 mile less pipe than the proposed project. This would place the terminus of the loop at about MP 1382.9 between 19th Drive NE and 25th Way NE, which is within residential areas associated with the Deer Park Subdivision. Ending the loop at that location would require the purchase and demolition of one home on the west side of the right-of-way in

order to install the DOT-required MLV and pig receiver within a fenced area about 75 feet wide by 150 feet long. In addition, installation of a 42-inch-diameter pipeline would require a minimum construction right-of-way width of 80 feet to safely accommodate the larger equipment and the deeper and wider trench needed to install larger diameter pipe. Because Northwest only has limited permanent right-of-way in many areas through the subdivision due to encroachment onto its existing easement, extra workspace would have to be purchased and the footprint of disturbance within the subdivision would be greater than that associated with the proposed project. For these reasons, installing a 42-inch-diameter pipeline on the Snohomish Loop is not considered a practical alternative.

If Northwest were to replace the Snohomish Loop with a new 26-inch-diameter pipeline, the loop length would be 15.8 miles versus the currently proposed 11.9 miles of 36-inch-diameter pipeline. Assuming that the same starting point was used immediately downstream of the Snohomish Compressor Station and that Northwest would use its existing easement, the terminus for a new 26-inch-diameter pipeline loop would be at MP 1378.0. This would represent an increase of 3.9 miles, of which 88 percent would be located in a DOT Class 3 area. Installation of a 26-inch-diameter pipeline would not significantly reduce construction impacts. Rather, the increased length of smaller-diameter pipeline would affect more landowners and sensitive environmental areas, such as the Queen's Bog wetland. Given these reasons, incurring an additional 3.9 miles of impact associated with installation of a 26-inch-diameter pipeline would not be environmentally preferable to the proposed action.

In summary, a 36-inch-diameter pipeline would offer advantages over other pipeline diameters for the following reasons:

- a larger diameter pipeline would require a wider construction right-of-way width, potentially greater pipeline offset, and larger construction equipment;
- a smaller diameter pipeline would require a substantially greater length in order to attain the same hydraulic capacity requirements of the 36-inch-diameter pipeline; and
- a 36-inch-diameter pipeline would meet the hydraulic capacity requirements and allow for installation within the existing right-of-way, thereby minimizing the need for new permanent right-of-way.

As a result, the alternative of using a different pipeline diameter was eliminated from further consideration.

Alternative Pipeline Loop Locations

Several comments were received concerning the basis for the proposed loop locations, specifically the Snohomish and Fort Lewis Loops. The majority of comments regarding the Snohomish Loop were from landowners in the Deer Park, Saddleback, and Lake of the Woods Subdivisions. In all pipeline systems, the pressure decreases due to friction as the gas flows down the pipeline. Therefore, the location of the loops affects gas flow and pressure requirements. Hydraulic studies indicate that the proposed loops should generally be located immediately downstream of existing compressor stations to maximize compressor efficiency and should be strategically located to provide adequate line pack for the system to accommodate non-uniform loads. Placement of loops immediately downstream of compressor stations allows the gas to be at the highest pressure with the lowest velocity, thus minimizing the overall length of loop required. The Capacity Replacement Project would place the loops as near as possible to the discharge side of Northwest's existing compressor stations.

The locations of the Sumas and Snohomish Loops would take full advantage of the efficiency realized by constructing loops immediately downstream of compression facilities, as would the Mount

Vernon Loop which is located immediately south of the existing 36-inch-diameter loop installed as part of the Evergreen Expansion Project. Pipeline hydraulics require that the Snohomish Loop be located between the Snohomish and Sumner Compressor Stations. Avoidance of populated areas would not be possible between these two compressor stations. Environmental and landowner impacts would increase if the pipeline loop were moved further from the Snohomish Compressor Station because of the need for additional total pipeline length and compression to compensate for the additional pressure drops. In addition, an alternative segment would not allow for collocation with existing aboveground facilities (e.g., launcher, receivers, MLVs); therefore, new aboveground facilities would need to be established and system operational reliability would be negatively affected. The installation of a loop along an alternative right-of-way that would be hydraulically equivalent to the proposed loop is also not possible without increasing the length of the pipeline and adding associated compression. This alternative would create greater impacts associated with an increased right-of-way and additional landowners. Operation and maintenance of the system would also be negatively impacted due to the physical addition of more miles of right-of-way to be monitored and maintained, and lost opportunities to cross over to the 30-inch-diameter pipeline at the intermediate MLVs, minimize blow down lengths needed for maintenance, and provide dual feeds into meter stations.

Northwest would install the Snohomish Loop within its existing permanent easement and through the Deer Park, Saddleback, and Lake of the Woods Subdivisions in accordance with site-specific Residential Area Work Plans (see section 4.8.3.1). With a few exceptions, the areas disturbed by construction would be restored to preconstruction conditions. Because installing the loop in another location would decrease system efficiency, increase the pipeline length, and merely shift impacts from one set of landowners to another, an alternative location for the Snohomish Loop was eliminated from further consideration. However, site-specific alternatives were evaluated to avoid impacts on the Deer Park, Saddleback, and Lake of the Woods Subdivisions (see sections 3.5 and 4.8.3.1).

The Fort Lewis Loop would begin approximately 10 miles downstream of the Sumner Compressor Station and end at a point where Northwest's Grays Harbor and Olympia pipelines begin to provide increased reliability. This configuration would take advantage of existing MLV settings at both the start and end points and would allow for collocation with existing structures and minimization of new aboveground structures. Northwest has 75 feet of permanent right-of-way through the residential areas on this loop, and for the most part the right-of-way is currently clear with no encroachment. Most of the residents' fences are at the edge of the right-of-way and would not have to be removed for construction. Because installing the loop in another location would merely shift impacts from one set of landowners to another, an alternative location for the Fort Lewis Loop was eliminated from further consideration.

Replacement of 26-inch-diameter Pipeline with the 36-inch-diameter Loop in the Same Trench

Several comments were received asking why the proposed loops could not be placed in the same location as the existing 26-inch-diameter pipeline in order to decrease construction impacts and the need for new permanent right-of-way. While it is technically feasible to remove the existing 26-inch-diameter pipeline and place the 36-inch-diameter loop in the same trench, information provided by Northwest indicates that this alternative would not necessarily decrease construction right-of-way width or extra workspace requirements when compared to the proposed project. In order to place the new loop in the same trench, the existing pipeline would have to be excavated, cut into sections, and removed from the right-of-way before any work could begin on the new 36-inch-diameter loop. This process would require about the same construction right-of-way width as the proposed project. After the existing pipe was removed, the trench would be enlarged to accommodate the larger diameter pipe. The 36-inch-diameter pipeline would then be installed using normal pipeline construction procedures. Because of the additional work required to remove the 26-inch-diameter pipeline, placing the new loop in the existing trench would result in a substantially longer construction time. This alternative would not eliminate or significantly reduce the need for temporary extra workspace outside the existing right-of-way. Removing the existing

pipe would require additional trucks traveling the right-of-way to haul away the old pipe, and the pipe storage yards would require additional space to store the 26-inch-diameter pipe.

In addition, removing and replacing the existing pipeline using the same trench in areas where the 26-inch-diameter pipeline is currently in service would require Northwest to take the pipeline out of service during construction. Because construction would take place during the summer months, when the system requires its peak capacity, this alternative would result in a reduction in delivery capacity and potential delivery disruptions to the customers subscribed to the system.

As discussed in section 2.7, Northwest would like to leave as much of the 26-inch-diameter pipeline in place as possible in the event that new technology is developed that can more accurately detect stress corrosion cracking. Northwest hopes to utilize the new technology to prove the integrity of the 26-inch-diameter pipeline and possibly put the pipeline back in service if approved by the DOT. Recent market studies confirm the long-term need for transmission capacity to be maintained and ultimately expanded in the Pacific Northwest to accommodate projected natural gas market growth. By leaving the 26-inch-diameter pipeline in place, Northwest would be able to provide additional reliability and may be able to address future increases in demand with little or no additional construction and disruption to landowners.

Site-specific conditions along the Snohomish Loop would require Northwest to remove the 26-inch-diameter pipeline and place the 36-inch-diameter loop in the same trench. There are locations within the 11.9-mile-long loop where Northwest only has 60 feet of permanent right-of-way instead of its typical 75 feet and residential developments have heavily encroached on both sides of Northwest's easement. These constraints limit or completely eliminate any possible extra workspace for construction. The 26-inch-diameter pipeline is not currently operating in this area so it can be removed without affecting current gas deliveries. There are also select areas outside of the Snohomish Loop where encroachment, development, or other limitations confine available workspace so that Northwest would replace the existing 26-inch-diameter pipeline with the 36-inch-diameter loop in the same trench.

While it would be technically feasible to remove the existing 26-inch-diameter pipeline and install the new 36-inch-diameter loop in the same trench in all areas to be looped, this alternative would result in similar impacts, would not be environmentally preferable to the proposed action, and would preclude the future use of the pipeline. Therefore, this alternative was eliminated from further consideration.

Use of the Existing 30-inch-diameter Pipeline

Several commenters inquired whether Northwest could replace the delivery capacity of the 26-inch-diameter pipeline by adding compression to the existing 30-inch-diameter pipeline to transport the required natural gas volumes. This alternative is not hydraulically feasible due to design and operating pressure restrictions. The design of the Capacity Replacement Project already takes into account any available capacity in the existing infrastructure in order to minimize the construction of new facilities. For this reason, along with the limitations of adding compression described above for the compression-only alternatives, this alternative was eliminated from further consideration.

Inserting a Liner or Smaller Pipe Inside the 26-inch-diameter Pipeline

One comment was received asking for evaluation of an alternative that would replace the capacity of the 26-inch-diameter pipeline by inserting a smaller pipe within the existing pipe, or by installation of a liner or sealant that would allow continued use of the existing pipeline. Inserting a smaller diameter pipe in the existing pipeline, which has many bends and elevation changes, does not appear to be technically feasible at the scale of the proposed project. In addition, a smaller diameter pipeline would result in a

hydraulic flow restriction and would not provide for the required gas flow volumes. Further, isolation between the two lines, or cathodic protection, would be difficult to maintain, which would threaten the ultimate integrity of the pipeline system.

Current technology of flexible liners is also limited, and is typically only used for smaller diameter and lower pressure gas pipeline distribution systems. Decreasing operating pressure would result in a hydraulic flow restriction and would not allow for the movement of the required gas volumes. Aside from the technological and hydraulic issues, the DOT has mandated that the 26-inch-diameter pipeline be retired and/or replaced. The use of these alternatives would not address the underlying issues that resulted in the CAO issued by the DOT. Therefore, the FERC staff does not believe these are viable alternatives and eliminated them from further consideration.

No Turn Back Capacity Alternative

As discussed in section 1.1, at the time of the CAO Northwest's system transportation capacity from Sumas to Washougal was fully contracted, with 360 Mdth/d of the contracted capacity dependent upon use of the existing 26-inch-diameter pipeline. However, in May and June 2004, Northwest held a reverse open season soliciting customer turn back of unneeded contract capacity. The reverse open season resulted in a commitment to turn back 13 Mdth/d that would affect the first 179 miles south of Sumas. Northwest's proposed action has assumed this turn back would be approved by the FERC. Without this reduction in required capacity, Northwest would need to construct 1.2 miles of additional 36-inch-diameter loop between the Sumner and Chehalis Compressor Stations and add about 2,000 hp of compression at both the Mount Vernon and Snohomish Compressor Stations. The additional 1.2 miles of loop would be added to the north end of the Fort Lewis Loop between MPs 1338.1 and 1339.3 as shown in Appendix B, figure B-4, sheet 1. The additional environmental impacts of this alternative are summarized in table 3.2.2-1.

The 1.2 miles associated with the No Turn Back Capacity Alternative would result in an additional 20.9 acres of land disturbance. Of the 20.9 acres, 15.6 acres would consist of developed land, 3.7 acres would consist of open land, and 1.6 acres would consist of forest land. A total of about 0.1 acre of scrub-shrub and emergent wetland would be affected. No surface waters would be crossed. The entire 1.2 miles would cross the EPA-designated Central Pierce County sole source aquifer, Clover Chambers Creek Groundwater Management Area (GMA), and aquifer recharge areas. The alternative would cross a carbon tetrachloride plume associated with a former ammunitions plant; however, groundwater at this location is 40 to 60 feet deep and construction activities would be unlikely to encounter the contaminant plume. The alternative would cross hydric soils susceptible to soil compaction and would cross areas with moderate to low seismic risk ratings. No additional threatened or endangered species would be affected by the additional 1.2 miles; one additional cultural resources site would be affected by the alternative. The increased compression would cause minor incremental increases in air emissions.

Because of the additional environmental impacts associated with the No Turn Back Capacity Alternative, it was determined that it was not environmentally preferable to the proposed action and was eliminated from further environmental analysis in this EIS. This alternative may be considered further during the FERC's non-environmental review of the Capacity Replacement Project.

TABLE 3.2.2-1

Environmental Impacts Associated with the No Turn Back Capacity Alternative [a]

Environmental Factor	Unit	Impact
General		
Additional loop length	miles	1.2
Construction disturbance	acres	20.9
Permanent easement	acres	11.1
New permanent easement	acres	2.3
Temporary construction right-of-way	acres	2.3
Temporary extra workspace areas	number	11
Temporary extra workspace areas	acres	5.2
Parcels affected	number	14
Adjacent to existing pipeline	yes/no	yes (with one offset)
Shoreline crossed	miles	0
Land Use		
Developed land affected	acres	15.6
Open land affected	acres	3.7
Forest land affected	acres	1.6
Residences within 50 feet	number	1 (shed)
Commercial structures within 50 feet	number	3
Water Use and Quality		
Waterbody crossings	number	0
Sole source aquifers crossed (Central Pierce County EPA-designated)	miles	1.2
Wellhead protection areas crossed	miles	2.6 [b]
Groundwater Management Areas crossed (Clover Chambers Creek Groundwater Management Area)	miles	1.2
High Groundwater Flood Hazard Areas crossed	miles	0
Aquifer Recharge Areas crossed	miles	1.2
Areas of Groundwater Concern crossed	miles	0
Group A Public Supply Wells within 150 feet	number	0
Group B Public Supply Wells within 150 feet	number	0
Wetlands		
Temporary wetland disturbance	acres	0.1
Palustrine emergent wetlands affected	acres	0.01
Palustrine scrub-shrub wetlands affected	acres	0.08
Palustrine forested wetlands affected	acres	0.00
Total permanent wetland impact	acres	0.08
Soils (Spanaway Soil Association)		
Soils crossed with high water erosion potential	miles	0
Soils crossed with loss of vegetation erosion potential	miles	< 0.1
Soils crossed susceptible to soil compaction	miles	0
Hydric soils crossed susceptible to soil compaction	miles	0
Soils with large stones	miles	1.2
Prime farmland	miles	0

TABLE 3.2.2-1 (cont'd)

Environmental Impacts Associated with the No Turn Back Capacity Alternative [a]

Environmental Factor	Unit	Impact
Geological Resources		
Mass wasting areas crossed	miles	0
High seismic risk rating areas crossed	miles	0
Moderate seismic risk rating areas crossed	miles	0.9
Low seismic risk rating areas crossed	miles	0.3
Threatened and Endangered Species	NA	No difference
Cultural Resources	number	1 (historic railroad grade)
Air Quality and Noise		
Additional compression at the Mount Vernon Compressor Station	horsepower	2,000
Additional compression at the Snohomish Compressor Station	horsepower	2,000

[a] Summary of the additional impacts that would occur if the turn back of 13 Mdth/d of long-term capacity is not approved by the FERC (i.e., if 360 Mdth/d of capacity is required to be replaced between Sumas and Washougal, Washington).

[b] Three separate but overlapping wellhead protection areas would be crossed; therefore, total cumulative mileage exceeds the additional loop length.

NA = Not applicable.

3.3 ROUTE VARIATIONS AND NON-STANDARD PARALLEL OFFSETS

Route variations differ from system alternatives or major route alternatives in that they are identified to reduce impacts on specific localized features or to satisfy requests by a landowner. Northwest's standard design calls for installation of the new loops at a 20-foot offset to the east of the existing 30-inch-diameter pipeline. Non-standard parallel offsets would occur where the loop is installed at slightly wider or narrower separations than the standard 20-foot offset from the 30-inch-diameter pipeline, but is still located within Northwest's existing right-of-way. Some non-standard parallel offsets would leave or be located at the edge of Northwest's existing right-of-way but would still be located within 50 feet of either the existing 26-inch- or 30-inch-diameter pipelines (i.e., pull-out areas). Where the new loop is forced to leave the corridor entirely and would be located greater than 50 feet from the existing pipelines, a route variation would be established.

Table C-1 in Appendix C identifies the location and length of each of these route adjustments and provides Northwest's reason for developing them. The areas where route variations create a new right-of-way and Northwest's rationale for adopting them are presented in table 3.3-1. The locations of these minor route variations are shown on the maps in Appendix B.

TABLE 3.3-1

Route Variations Where New Right-of-Way is Created by the Capacity Replacement Project

Facility	Mileposts	Length	Rationale for Route Variation
Sumas Loop	1470.8 - 1470.7	0.1	To avoid crossing Mitchell Creek at a poor location.
Mount Vernon Loop	1424.3 - 1423.4	0.9	To accommodate the HDDs of the North and South Forks Stillaguamish Rivers.
Snohomish Loop		- None -	
Fort Lewis Loop	1325.3 - 1325.1	0.1	To accommodate the State Highway 72 bore crossing.

As previously discussed, the collocation of facilities is generally preferred by land management agencies, land use planners, and other regulatory agencies and has several inherent engineering and environmental advantages. Perhaps the most important of the environmental advantages is that new land disturbance is minimized. By overlapping the construction right-of-way with other previously disturbed existing rights-of-way, the amount of new land disturbance can be reduced significantly. Because of these advantages, alternatives that deviate from the existing right-of-way are driven by issues such as where remaining adjacent to the existing right-of-way is impracticable for engineering reasons or would result in more environmental impact. For these reasons, the increased offsets and minor route variations proposed by Northwest were reviewed and determined to be warranted.

3.4 ABANDONMENT ALTERNATIVES

As part of the Capacity Replacement Project, Northwest has proposed to retain as much of the existing 26-inch-diameter pipeline in place as possible for potential future use. Several comments were received recommending that Northwest remove the existing 26-inch-diameter pipeline if it is to be taken out of service. Several alternatives to abandoning the existing pipeline in place are discussed in section 3.2.2.2. These include permanently returning the existing 26-inch-diameter pipeline to service, like-kind replacement of the 26-inch-diameter pipeline, and removing the 26-inch-diameter pipeline and placing the 36-inch-diameter loop in the same trench. In each case, it was concluded that abandoning the 26-inch-

diameter pipeline in place would be environmentally preferable unless site-specific conditions (e.g., areas where encroachment, development, or other limitations confine available workspace) necessitate its removal and replacement with the 36-inch-diameter loop in the same trench. Furthermore, abandoning the 26-inch-diameter pipeline in place in the locations along the non-looped portions of Northwest's system would eliminate disturbance to 188.5 miles of the right-of-way with the exception of the activities that would occur at 48 locations to isolate the 26-inch-diameter pipeline from other system components (see section 2.1.3). These abandonment activities would temporarily disturb a total of 14.4 acres of land within Northwest's existing permanent right-of-way. If Northwest were to remove the 26-inch-diameter pipeline in the 188.5-mile-long unlooped portion of its system, a minimum of 1,714 acres of land would be disturbed.[2]

Abandonment of the existing 26-inch-diameter pipeline in place would involve purging the pipeline to remove existing gas and accumulated materials such as condensates. As discussed in section 2.1.3, nitrogen, an inert gas, would be used to purge the pipeline. Water would not be used or discharged as part of the purging activities. After the pipeline is purged, it would be filled with nitrogen at a low pressure, capped, and maintained with cathodic protection over an indefinite period to minimize corrosion and degradation. Northwest is optimistic about the future of the 26-inch-diameter pipeline because new technology is being developed that may allow the pipeline to be put back in service for future gas deliveries. Assuming that the pipeline anomalies could be identified and repaired to meet DOT requirements, the existing pipeline could potentially provide a cost-effective and low impact alternative to address future gas demands as compared to constructing new facilities.

Because Northwest's proposal to leave as much of the pipeline in place as possible would reduce environmental impact and allow it to be put back into service for future gas deliveries with minimal environmental impact and disruption to landowners, other alternatives were eliminated from further consideration.

3.5 CONSTRUCTION METHOD ALTERNATIVES

As previously discussed, the Snohomish Loop has certain site-specific conditions that would require Northwest to remove the 26-inch-diameter pipeline and put the 36-inch-diameter loop in its place. During project planning, Northwest evaluated the alternative of doing multiple crossovers between laying the 36-inch-diameter loop east of the 30-inch-diameter pipeline and removing only certain sections of the 26-inch-diameter pipeline where the right-of-way was restricted. However, this option created operational and safety concerns because it is critical for Northwest Operations personnel to know exactly where the pressurized operating pipelines are located on the easement. A frequent change in the relative location of the pipelines would create a risk of not correctly identifying the pressurized lines. Because of the risk associated with frequent crossovers, it was determined that replacement of the 26-inch-diameter pipeline with the 36-inch-diameter loop in the same trench is the most reasonable construction alternative for the Snohomish Loop.

In response to a scoping comment, an evaluation of the feasibility of using the HDD method to install the 36-inch-diameter loop through the Deer Park Subdivision on the Snohomish Loop was conducted. The HDD method is described in section 2.3.2. To use the HDD method, Northwest would require temporary extra workspace at the entry and exit points and a long straight section at either end in order to assemble, x-ray, and pressure test the entire drill pipe string for pullback into the drilled hole. However, there is limited workspace in this area due to planned developments, roads, and residential structures. The HDD would need to extend over 10,000 feet to avoid the subdivision, which is not

[2] Based on a 75-foot-wide right-of-way. Northwest would likely need a wider right-of-way and temporary extra workspace in some locations.

technically feasible because the longest drill lengths currently achieved with 36-inch-diameter pipe are approximately 6,500 feet.

An option to make the HDD shorter and still avoid the entire neighborhood could not be identified. On the north end of the subdivision, there is a steep hill that leads down to Evans Creek and a wetland area. Northwest could not set up a drilling operation in this wetland due to standing water and the associated environmental impacts on the wetland. Another option would be to stop the drill somewhere within the neighborhood, which would require adequate workspace for an exit pit. Under this option, assembly of the pipe section would block streets and interfere with access by local residents. The pipe assembly area could potentially be shortened by using a two-stage pullback; however, this method greatly increases the risk of HDD failure. Additionally, an HDD operation is noisy and would likely require 24-hour-a-day work schedules during the drilling, reaming, and pullback processes. Based on these reasons, crossing the Deer Park Subdivision using the HDD method would be neither a technically feasible nor environmentally preferable alternative and it was eliminated from further consideration.

Although the HDD method may be infeasible for large residential areas, it is generally the preferred method to cross major and sensitive waterbodies because it avoids disturbance to both the waterbody and the vegetation on both sides of the crossing. Northwest proposes to cross the North Fork Nooksack River, North Fork Stillaguamish River, and South Fork Stillaguamish River using the HDD method. If an HDD cannot be completed, Northwest proposes to install the crossings using the wet open-cut method. The wet open-cut method is described in section 2.3.2. Because it is uncertain at this time whether an HDD would be successful, it is not possible to eliminate the alternative crossing method for these waterbodies from further consideration. As a result, an analysis of both the proposed and alternative crossing methods for these waterbodies is presented in the applicable resource discussions in section 4.0 (i.e., surface water resources; wetlands; vegetation; aquatic resources; land use, recreation and special interest areas, and visual resources; and cultural resources).

Use of the HDD method for crossing Pilchuck Creek and the Nisqually River was also evaluated by Northwest and determined not to be feasible based on the results of its geotechnical investigation. Therefore, Northwest proposes to cross these two waterbodies using the wet open-cut method. If the proposed wet open-cut crossing method is not approved at these two waterbodies and no other underground options are available, Northwest would use the aerial span method. The aerial span method is described in section 2.3.2. Because it is uncertain at this time whether Northwest would be allowed to use the wet open-cut crossing method, it is not possible to eliminate the alternative crossing method for these waterbodies from further consideration. As a result, an analysis of both the proposed and alternative crossing methods for these waterbodies is presented in the applicable resource discussions in section 4.0 (i.e., surface water resources; wetlands; vegetation; aquatic resources; and land use, recreation and special interest areas, and visual resources).

As discussed in section 2.3.2, several comments on the draft EIS were received from residents in the Saddleback Subdivision regarding impacts on the subdivision associated with Northwest's proposed temporary extra workspaces, access road, and expanded aboveground facility site at the southern end of the Snohomish Loop. Alternatives to avoid the use of the proposed temporary extra workspaces, access road, and expanded aboveground facility site in the Saddleback Subdivision are discussed in section 4.8.3.1. Comments were also received from landowners in the Lake of the Woods Subdivision on the Snohomish Loop regarding impacts on a septic system and associated drain field as well as landscaping. A discussion of the Lake of the Woods Subdivision, including alternatives to minimize impacts on this area, is included in section 4.8.3.1.