SWAMP CREEK PLANNING STUDY

Final Report

CONTRACT NO: E63008E

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CERTIFICATE OF ENGINEER

The technical material and data contained in this report were prepared under the supervision and direction of the undersigned, whose seal as a professional engineer licensed to practice as such is affixed below.

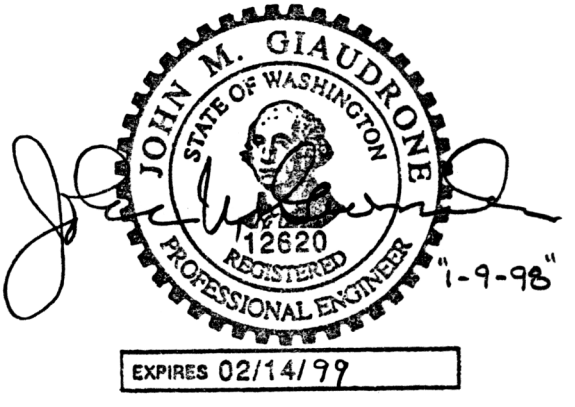

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Table of Contents

Table of Figures

Appendices

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SWAMP CREEK PLANNING STUDY

Final Report

Executive Summary

Introduction

The purpose of this project is to evaluate two possible pipeline routes beginning at the northern terminus of King County's existing 36-inch Swamp Creek Trunk, extending north through the Swamp Creek Basin and connecting to Alderwood Water and Sewer District's (AWSD) 36-inch sewer at the King/Snohomish County line. A recommended alternative was developed based upon the evaluation of engineering, environmental, and constructibility issues, and cost estimates for each alternative.

The trunk extension must be constructed in order to provide relief to the Northshore Utility District's (NUD) local connecting sewer as required by an agreement between King County, the City of Brier, and the AWSD. NUD has recently advised the County that their system will soon be reaching capacity and the County should begin plans for design and construction of an extension as soon as possible.

Alternative Route Descriptions

Alternative 1 - Swamp Creek Route begins at the northern terminus of King County's Swamp Creek Trunk at the intersection of 73rd Avenue NE and NE 191st Street and proceeds west along NE 191st Street to the east boundary of the Kenmore Elementary School. At the school boundary the route turns north and generally follows the route of the existing NUD local connecting sewer on the west side of Swamp Creek to an undercrossing of the creek near the northern end of the proposed pipeline. From the creek crossing the route continues parallel with the NUD local connecting sewer to NE 204th Street where it connects with the southern terminus of AWSD's sewer.

Alternative 2 - 73rd Avenue NE Route begins at a connection with King County's Swamp Creek Trunk at a point approximately 150 feet south of the intersection of 73rd Avenue NE and NE 191st Street. From the new connection the proposed route proceeds north by northeast to clear the east side of the bridge for an undercrossing of Swamp Creek and then turns north within the right-of-way of 73rd Avenue NE and northwest within the right-of-way of 73rd Avenue NE and NE 204th Street to a connection with the southern terminus of AWSD's sewer.

Flow and Pipe Sizing

The proposed pipeline will intercept flows from the Swamp Creek Basin which includes portions of both King County and Snohomish County. King County's Wastewater Treatment Division provided the following design flows for the new pipeline:

Snohomish County Flow	31.6 MGD
King County Flow	2.3 MGD
Total Design Flow	33.9 MGD

Based upon the above design flows, a 36-inch diameter pipe (n=0.013) flowing full will provide 34 MGD capacity at a minimum slope of 0.0065 feet/foot.

Alternative Comparison

Following is a list of significant issues and/or highlights of the Alternatives:

Alternative 1	**Alternative 2**
Swamp Creek Route	**73rd Avenue NE Route**
• Replaces NUD local connecting sewer	• Minimizes environmental impacts and permitting
• Open-cut - 4,517 LF	• Open-cut - 1,964 LF
• Trenchless / Jack and Bore - 150 LF	• Trenchless / Jack and Bore - 2,431 LF
• Creek crossing at north end	• Creek crossing at south end
• Offsite disposal excavated material	• Offsite disposal excavated material
• Imported bedding and backfill	• Imported bedding and backfill
• Need for protection of adjacent structure	• Longer roadway restoration
• Higher right-of-way/easement requirements	• Higher traffic control requirements
• More difficult soil conditions	• More utility conflicts
• More ground water difficulty	• Higher transportation impacts
• Greater potential for surface water, flooding and water quality impacts	

Alternative 1 Swamp Creek Route	Alternative 2 73rd Avenue NE Route
• Greater regulation and permitting difficulty	
• Greater operation and maintenance costs	
• Total Project Cost $4.8 Million	• Total Project Cost $8.2 Million

Selection of Preferred Alternative

Selection of the Preferred Alternative was accomplished through a project team workshop process. Two workshops were held with the project team. Participants in these workshops included both King County and Consultant Team members.

An additional meeting was held with the primary stakeholder for the project, Northshore Utility District. Representatives of King County, Northshore Utility District, and the Consultant Team were participants.

At each workshop the findings of the draft report were presented. Next, an alternative comparison fact sheet which summarized the quantifiable issues for each alternative was presented. Once the facts surrounding each alternative had been discussed, a blank worksheet for comparison of the subjective issues was provided to gather the project team's collective assessment of how well each alternative met the project goals, any additional engineering design issues, construction issues, geotechnical issues, environmental/permitting issues, and issues of cost for operation and maintenance. Based on a detailed review, on an item by item basis, of each issue on the worksheet, a rating of difficulty with a scale of HIGH - MODERATE - LOW was established for each issue.

Based upon the results of the planning study and outcome of the workshops, Alternative 2 - 73rd Avenue NE Route is selected as the preferred alternative. Alternative 2 was selected because it minimizes environmental impacts and permitting and provides the best opportunity to meet the proposed schedule for project completion. Although Alternative 1 has a lower cost, it has a higher risk associated with right-of-way/easement requirements, environmental impacts, and permitting. Maintenance access would also be difficult under Alternative 1. If maintenance access were needed that resulted in a permanent feature (e.g. road) under Alternative 1, right-of-way/easement requirements, environmental review, and permitting would be further complicated. All of these issues have the potential to significantly delay construction of the trunk extension and increase the likelihood of a sewage overflow in the Northshore system along Swamp Creek.

I. Introduction

Background

King County's Swamp Creek Trunk is a 36-inch pipeline that carries wastewater from the area of NE 191st Street in Kenmore south to King County's Kenmore Interceptor at the north end of Lake Washington. Flow from the Swamp Creek basin in Snohomish County is currently transported to King County's Swamp Creek Trunk through the Northshore Utility District's (NUD) 18 to 21-inch local connecting sewer. King County must construct an extension from the Swamp Creek Trunk to the Alderwood Water and Sewer District's (AWSD) 36-inch sewer at the King/Snohomish County line.

The trunk extension must be constructed in order to provide relief to the NUD's local connecting sewer as required by an agreement between King County, the City of Brier, and the AWSD. NUD has recently advised the County that their system will soon be reaching capacity and the County should begin plans for design and construction of an extension as soon as possible.

Scope of This Work

The purpose of this project is to evaluate two possible pipeline routes beginning at the northern terminus of King County's existing 36-inch Swamp Creek Trunk, extending north through the Swamp Creek Basin and connecting to AWSD's 36-inch sewer at the King/Snohomish County line. A recommended alternative will be developed based upon the evaluation of engineering, environmental, and constructibility issues and cost estimates for each alternative. Draft preliminary design information sufficient to determine the feasibility of pipeline routes will be presented.

The entire Swamp Creek Basin is shown on Figure 1 - Basin Map. The project area is shown with greater detail on Figure 2 - Project Area Map.

III. Engineering Design Issues

Design Criteria

***Pipe Roughness (Mannings* n)**

The Washington State Department of Ecology (WDOE), in their Manual DOE78-5, specifies that a Mannings *n* value of 0.013 be used in the Mannings formula for the design of all sewer facilities (regardless of pipe material), except for inverted siphons, where an *n* value up to 0.015 may be used.

For this project, a Mannings *n* value of 0.013 was provided.

Minimum (Flushing) Velocity

The flow velocity within sanitary sewers should be at least 2.0 feet per second (fps) in order to prevent the settlement of solids. Slopes and diameters of sewers, specified herein, have been chosen to provide this velocity, or greater, at design flow.

WDOE Manual DOE78-5 requires that all sewers be designed and constructed to provide a mean velocity, when flowing full, of not less than 2.0 fps. The 2.0 fps minimum velocity is desired during low flow conditions. Under special conditions, slopes slightly less than that required to provide 2.0 fps may be permitted.

For this project, a 2.0 fps minimum velocity was provided.

Maximum Velocity

High velocity in sewers should be avoided because the solids carried in the flow may erode the pipe. A typical upper limit for sanitary sewers is 10 fps. For velocities close to this upper limit, lining of the lower portion of the sewers with abrasion-resistant material may be advisable. An additional concern with high-velocity is the potential for release of sulfur emissions.

WDOE Manual DOE78-5 requires that special provisions be made to protect pipe from internal erosion or displacement from shock where velocities are 15 fps or greater.

For this project a 10 fps maximum velocity when flowing full was provided.

Minimum Depth of Cover

Sewers should be installed at a depth sufficient to accept gravity service from adjacent properties and to prevent freezing and physical damage.

WDOE Manual DOE78-5 requires that a three-foot minimum depth of cover be maintained.

For this project a three-foot minimum depth of cover was provided.

Maximum Trench Depth

Trenching for sewers is generally limited to 20-foot depth to invert of pipe. Additional depth is possible although both cost and construction considerations become more of an issue as depth increases. When trench depth becomes excessive, consideration should be given to one of the trenchless technology options.

For this project open cut trenching was limited to a maximum depth to invert of 20 feet except for very short isolated deeper sections.

Flow and Pipe Sizing

The proposed pipeline will intercept flows from the Swamp Creek basin which includes portions of both King County and Snohomish County. King County's Wastewater Treatment Division provided the following design flows for the new pipeline:

Snohomish County Flow	31.6 MGD
King County Flow	2.3 MGD
Total Design Flow	33.9 MGD

The above flows are for saturation condition in the basin and include allowances for the peak inflow and infiltration expected once in 20 years (i.e. the 20-year peak flow at saturation).

Based upon the above design flows, a 36-inch diameter pipe (n=0.013) flowing full will provide 34 MGD capacity at a minimum slope of 0.0065 feet/foot. Velocity flowing full at this minimum slope is 7.6 feet per second.

Pipe Material Considerations

Several different pipe materials could be considered for this project and selected based upon the type of construction to be undertaken. For open-cut construction or for jack and bore construction within a casing pipe the following pipe materials could be considered:

- Reinforced Concrete Pipe (RCP)
- Ductile Iron Pipe (DIP)
- Polyvinyl Chloride Pipe (PVC)
- High Density Polyethylene Pipe (Spirolite)

For trenchless construction without a casing the following pipe materials could be considered:

- Reinforced Concrete Jacking Pipe
- Clay Jacking Pipe
- Fiber Reinforced Plastic Pipe (Hobas)

Reinforced concrete pipe is normally installed without a lining although Type II Portland cement is sometimes specified for the manufacture of the pipe because it is somewhat superior to Type I in resisting sulfate attack. The inside of ductile iron pipe is regularly lined with cement mortar but a more corrosion resistant epoxy lining is available. The other pipes indicated do not usually require further lining since the parent material is already very resistant to corrosion and chemical attack.

Reinforced concrete pipe was assumed for this project. Pipe materials should be further evaluated during pre-design.

IV. Engineering Construction Issues

Alternative 1: Swamp Creek Route

Trench Depth

Depth to invert along the route will vary from 10 to 20 feet with depths of 15 to 20 feet for 427 feet of pipeline and depths of 10 to 15 feet for the remaining 4,240 feet of pipeline. See Figure 4 for the Swamp Creek Route - Proposed Profile.

Construction can likely be carried out using open cut techniques and stacked trench boxes to provide temporary shoring. Temporary shoring will be required to support the trench side walls and to prevent the damaging or undermining of the adjacent NUD local connecting sewer.

Bedding and Backfill

Imported backfill and bedding material will likely be required over most of the route due to the anticipated saturated condition of the native material. Since most of the area along the route is undeveloped, backfill material requirements and compaction criteria should be less stringent than those required in roadway routes.

Excavated Material

With excavated depth of as much as 20 feet, this route will generate a large volume of excavation spoils. These spoils will need to be stockpiled along the construction easement or exported offsite to a temporary stockpile. The excavation spoils may have a high fines content and will be diffucult to re-use as backfill if significant amounts of groundwater are encountered. If excavation spoils are not reusable, import fill will be required

Groundwater

Because of high groundwater table within the creek bed, dewatering measures (sumps and/or well points) will likely be required during construction. Based on groundwater levels reported in the NUD construction notes for the local connecting sewer, it is anticipated that the invert of the proposed sewer will be 5 to 10 feet below the groundwater levels reported for the summer of 1965. No information was available regarding how groundwater was managed during construction of the NUD local connecting sewer. Construction should be completed during the dry summer months, when the creek and groundwater levels are at their lowest. According to local landowners, Swamp Creek periodically floods during the wet season.

Temporary Access Roadway

Because of the undeveloped nature of the route, it will likely be necessary to construct a temporary single lane roadway adjacent to the proposed trench location to provide access

for construction equipment, trucking, and general access for construction personnel. Since much of this route crosses flood plain, it is expected that this temporary access road will have to be removed at the end of construction and the area returned to existing conditions.

Creek Under-Crossing

This route crosses Swamp Creek in the section of sewer between manholes located at Station 41+26 and 45+06. Open cut and jack and bore are feasible methods for crossing the creek. Boulders and wood debris may be encountered within the creek channel which could make jack and bore methods difficult. Open cutting would likely involve construction of one half of the crossing at a time utilizing coffer dam and pumps to control the water.

Connections to Existing Sewers

Because of the substantial flow carried by the existing NUD local connecting sewer and the necessity of connecting to "live" manholes at each end of the project, it will be important to plan the connections for a low flow period. It will also be necessary to have sufficient pumping equipment to pump around the connection while it is being accomplished.

During construction it will be necessary to transfer sewers serving a residential area and the Kenmore Elementary School from the NUD local connecting sewer to the new sewer as quickly as possible. During the period of disconnection, temporary pumping equipment will have to be utilized to pump around the connection.

Protection of Adjacent Structure

One residence has been identified which is located in close proximity to the proposed pipe. The residence is located on the east side of Swamp Creek just north and adjacent to the section of sewer between manholes located at Station 41+26 and 45+06. The foundation of the house appears to be less than 10 feet from the centerline of the new sewer. It will be necessary to under pin or otherwise protect the existing structure or purchase the property and remove a portion of the structure to complete the construction by open cut methods.

Traffic Detours

Since most of the route is undeveloped it is expected that requirements for traffic detouring will be minimal. In those instances that construction is required in the street right-of-way (trenching in paved areas and connection to existing manholes), local detouring will be necessary.

Right-of-way

The existing NUD local connecting sewer is located in the center of a 10-foot-wide easement. An additional 15-foot-wide easement will be required for the new construction. A 20-foot-wide temporary construction easement located adjacent to the permanent easement should be obtained for construction of a temporary access roadway.

This temporary construction easement could revert back to the land owner upon completion of the project.

Alternative 2: 73rd Avenue NE Route

Trench Depth

Depth to invert along the route will vary from 15 to 35 feet with depths of 30 to 35 feet for 970 feet of pipeline, depths of 20 to 30 feet for 1,205 feet of pipeline, and depths of 15 to 20 feet for the remaining 2,220 feet of pipeline. See Figure 6 for the 73rd Avenue NE Route - Proposed Profile.

The deep excavation depths will require sloped side walls or temporary shoring. Temporary shoring consisting of stacked trench boxes is typically limited to depths to about 20 feet. Excavations in excess of 20 feet, that cannot be sloped, will require temporary shoring consisting of soldier piles and lagging or trenchless technology (i.e. microtunneling).

Groundwater

The southern portion of the route from Station 0+00 to 14+00 is close to Swamp Creek and groundwater will likely be encountered at the creek elevation. Perched water may also be encountered within the glacial deposits. According to NUD personnel the design grade for the local sewer installed between Station 29+30 and 42+25 had to be raised 2 to 3 feet during construction because of the amount of groundwater encountered. Construction should be completed during the dry summer months, when the creek and groundwater levels are at their lowest.

Excavated Material

With excavation depth of as much as 20 feet in the open-cut section, this route will generate a large volume of excavation spoils. These spoils will need to be stockpiled along the roadway or exported off site. The excavation spoils may have a high fines content and will be difficult to reuse as backfill during wet weather conditions or if significant amounts of perched water or groundwater are encountered. If excavation spoils are not reusable, import fill will be required.

Bedding and Backfill

Imported backfill and bedding material will likely be required over the route as it will be necessary to compact the trench backfill to between 92 and 95 percent of the maximum dry density, in order to provide adequate support for the roadway surface.

Creek Under-Crossing

The route crosses Swamp Creek in the section of sewer between manholes located at Station 1+43 and 4+00. The crossing would be accomplished on the east side of the roadway to avoid interfering with the bridge pile foundations. Immediately adjacent to the west side of the bridge is an 8-inch high pressure gas main. The crossing could be

accomplished using either jack and bore or one of the other trenchless construction methods. Boulders and wood debris may be encountered within the creek channel which could make the crossing difficult.

Connections to Existing Sewers

Because of the substantial flow carried by the existing NUD local connecting sewer and the necessity of connecting to "live" manholes at each end of the project, it will be important to plan the connections for a low flow period. It will also be necessary to have sufficient pumping equipment to pump around the connection while it is being accomplished.

During construction it will be necessary to transfer a gravity sewer serving a residential area from the NUD local connecting sewer to the new sewer as quickly as possible. The section of sewer between Station 0+00 and 1+43 conflicts with the existing pipe from the east.

Existing Utility and Roadway Improvements

Open cut construction at the depths required for this route will cause substantial loss of the existing roadway surface. What is not damaged by the actual trench cut will be damaged by the heavy equipment required for construction at this depth and by the volume of trucking required for removal of the excavated material and import of bedding and backfill.

There is an 8-inch high pressure gas main located along the west shoulder of the pavement for the entire route. An 8-inch water main is located on the east side of the roadway along the entire route. From Station 29+30 to 42+25 there is an 8-inch sewer main located near the centerline of the roadway. Each of these utilities is shallow with respect to the new sewer construction. It will be necessary to protect these utilities during construction of the sewer.

Traffic Detours

This route will require traffic detours during much of the construction period. The combination of excessively deep trench excavation and the need for the heavy volume of trucking for removal of the excavated material and import of bedding and backfill will necessitate the temporary closure of the roadway in the area under construction. It would probably be necessary to move the through traffic from 73rd Avenue NE to 68th Avenue NE. Because of the road patterns in the area, a rather complex traffic detour would be required with approvals from the City of Brier, King County, and Snohomish County. Current traffic counts should be taken in the area before designing the detour plan.

Right-of-way

Sufficient right-of-way is available for construction of the sewer along this route except for the section between Stations 1+43 and 4+00 at the Swamp Creek under crossing. Additional permanent easement will be required for the crossing as well as a section of temporary construction easement located adjacent to the permanent easement. This

temporary construction easement could revert back to the land owner upon completion of the project.

V. Geotechnical Issues

The following is a summary of the geotechnical issues relating to the alternative routes. For additional information, see Appendix A - Technical Memorandum - Geotechnical Evaluation of Swamp Creek Sewer Alternatives, dated June 30, 1997, prepared by PacRim Geotechnical, Inc.

Alternative 1: Swamp Creek Route

Surficial Conditions

From Station 0+00 to 3+41 the Swamp Creek Route follows NE 191st Street to the Kenmore Elementary School. A 3 to 5-foot deep drainage ditch is located along the northern shoulder of the roadway. The ground surface along the route generally increases in elevation from Station 0+00 to the northern terminus at Station 46+67. From Station 0+00 to 3+41 and from Station 45+06 to 46+67 the surface of the route is paved. The remainder of the route is unpaved and undeveloped.

General Subsurface Conditions

According to the construction records for the NUD local connecting sewer, the typical soil conditions encountered along the Swamp Creek Route consist of surficial silty sands underlain by "washed hard gravel". Surficial soil conditions observed in the creek bed consist of sandy gravel and gravely sand with occasional cobbles.

Groundwater levels observed during the installation of the NUD local connecting sewer, in the summer of 1965, were generally at a depth of 5 to 8 feet below the ground surface.

Alternative 2: 73rd Avenue NE Route

Surficial Conditions

From Station 0+00 to 43+95 the 73rd Avenue NE route is located within the existing paved roadway of 73rd Avenue NE and NE 204th Street. In general the 73rd Avenue NE route traverses the upland east bank of the Swamp Creek drainage channel. The ground surface along the route increases in elevation from Station 0+00 to 33+50 and then decreases in elevation to the northern terminus at Station 43+95. There is a steep drop off along both sides of the roadway from Station 2+00 to 5+00 and from Station 8+50 to 11+50.

The existing bridge across Swamp Creek on 73rd Avenue NE has been recently reconstructed. Concrete piles support the bridge deck. Numbered paint marks, which are typically painted on the pile to determine depth of embedment are still visible. The marks indicate the piles were driven between 10 to 12 feet below existing ground surface.

Rip-rap consisting of 2-4 man-sized boulders and concrete slabs line the creek bank adjacent to the bridge.

General Subsurface Conditions

Based on available geologic map information the soils underlying the 73rd Avenue NE route are primarily composed of glacial advance outwash (sand and gravel), except for the area between NE 192nd Street and NE 195th Street which is mapped as recent alluvium (clay to gravel). Exposed in the creek bank at the 73rd Avenue NE bridge is silty sandy gravel. Based on the mapped geology, soil conditions are expected to be dense.

Between Stations 2+00 to 5+00 and between Stations 8+50 to 11+50, where the roadway is higher than the surrounding area and very close to Swamp Creek, it is likely constructed on fill overlying alluvial deposits.

Information regarding groundwater conditions along the proposed route was not available. However, in the vicinity of the bridge across Swamp Creek, it is expected that groundwater levels will be at or near the elevation of the creek and will fluctuate with the creek level.

Additional Geotechnical Services

The lack of existing geotechnical information will require a detailed field investigation for whichever sewer route alternative is selected.

Alternative 1: Swamp Creek Route

1. Excavate a total of 10 test pits along the proposed sewer route. Test pits will be excavated with a track excavator capable of excavating to a depth of 20 feet. The existing right-of-way for the adjacent local connecting sewer is only 10 feet in width. In order to excavate test pits to the required depth and not disturb the existing sewer the test pits will need to be located on property adjacent to the right-of-way, and be kept a minimum of 10 feet away from the existing sewer. Prior to excavating the test pits permission to work on private property will need to be secured.
2. Drill a total of 5 soil borings along the route and install temporary monitoring wells to obtain groundwater information and to perform well tests. Boring depths will range from 15 to 25 feet. Relatively undisturbed samples will be collected for testing to determine soil parameters.
3. Perform in-situ permeability tests in the monitoring wells and/or percolation tests in the test pits to quantify soil permeability characteristics. This information will be used to provide dewatering recommendations and for use in design of dewatering methods during construction.
4. Evaluate alternatives for crossing Swamp Creek. Construction methods such as open cut and jack and bore will be evaluated.

A King County grading permit may be required for the exploration work along the Swamp Creek route since the route crosses flood plain and/or wetland areas. It is expected that restoration work may be required to return the exploration sites to existing conditions.

Alternative 2: 73rd Avenue NE Route

1. Drill a total of 12 soil borings along the route and install approximately 10 temporary monitoring wells to obtain groundwater information and to perform in-situ permeability tests. Borings will be drilled at probable jacking pit and receiving pit locations. Borings will likely be drilled in the roadway requiring a traffic control plan and flaggers. Boring depths will range from 20 to 60 feet. Relatively undisturbed samples will be collected for laboratory testing to determine soil parameters.
2. Perform variable head or slug tests in the monitoring wells to quantify soil permeability characteristics. This information will be used to provide dewatering recommendations and for use in design of dewatering methods.
3. Evaluate alternatives for crossing Swamp Creek. The feasibility of jack and bore and other trenchless construction methods will be evaluated.

VI. Environmental Compliance and Permitting

Elements of the Environment

Consideration of environmental impacts of a proposal is required by the State Environmental Policy Act (SEPA), WAC 197-11 and RCW 43.21C. SEPA contains a list of "elements of the environment" that must be considered in an environmental analysis. Where a particular element of the environment is not affected by the proposal, analysis of that element is not required. The following analysis is based on SEPA's elements of the environment list, and includes only those elements which may be affected by the proposal, and for which there was existing environmental information.

Water

Surface

Swamp Creek flows through the area proposed for both routes. Swamp Creek is considered a "Class 1 Stream" by King County, the highest and most important stream category in the County. It is also designated as a "Shoreline of the State" by the State of Washington, which requires regulation and protection under the State Shoreline Management Act and King County Shoreline Management Master Program. The regulatory implications of these classifications are discussed below under the section entitled "policies, plans and regulations".

Two tributaries flow into Swamp Creek in the project area. The eastern tributary enters Swamp Creek at about NE 198th Street. The western tributary flows into Swamp Creek at about NE 195th Street. Both tributaries are designated as "Class 3 Streams" by King County. A Class 3 Stream is "intermittent or ephemeral during years of normal rainfall" and is not used by salmonids. The regulatory implications of this classification are discussed below under the section entitled "Polices, Plans, and Regulations".

The 1990 King County Sensitive Areas Map Folio does not show any wetlands in the project area. However, there is one wetland nearby that could be affected by construction of the trunk extension. "Swamp Creek Wetland No. 3" is a large (92 acre) scrub-shrub, shallow marsh and forested wetland located to the east of 73rd Avenue NE, south of NE 192nd Street (King County BALD, 1991). This wetland also contains a heron rookery containing 20 Great Blue Heron nests, and is considered a "unique wildlife habitat" (King County Planning, 1993).

Ground

See geotechnical evaluation.

Flooding

Figures 3 and 5, located in the Alternative Route Descriptions section, show the Flood Hazard Areas designated by the Federal Emergency Management Agency (FEMA), Flood Insurance Rate Maps (FEMA 1995). The area adjacent to Swamp Creek is "Zone AE", a 100-year flood plain where the base flood elevations of 44 feet to 82 feet have been established. The width of the flood plain in the study area varies from 200 feet to 1,200 feet. The widest flood plain area is north of approximately NE 195th Street. The floodway, also shown on Figures 3 and 5, encompasses Swamp Creek, and land mainly to its west. Again, the area around NE 195th Street has the widest floodway (approximately 250 feet).

Alternative 1 will cross Swamp Creek (a "Class 1 stream") once, at the northern end of the route, and will cross the western tributary (a "Class 3 stream")where it enters Swamp Creek (approximately NE 195th Street). This route will need to be constructed through 100-year flood plains throughout nearly the entire length. In some areas, it would be inside the floodway.

Alternative 2 will cross Swamp Creek (a "Class 1 stream") at the southern end of the route, and will cross the eastern tributary (a "Class 3 stream") in the 19800 block of 73rd Avenue NE. This route avoids the 100-year flood plains and floodway of Swamp Creek, except where it crosses Swamp Creek. Depending on how the new pipe would cross the creek, its height above the creek may be above the base flood elevation line, and may not be in the flood plain.

Water Quality

Swamp Creek lies within the Cedar River basin, originates within Snohomish County north of Lake Washington, and flows south approximately 10.9 river miles where it discharges into the right bank (RB) of the Sammamish River. The 25-square mile Swamp Creek watershed (see Appendix B-1) consists of single-family residential, rural, and urban development, and drains more than 34 miles of streams and tributaries (King County SWM, 1996).

Swamp Creek's water quality regularly fails to meet state water quality standards. Problem pollutants found at high concentrations in Swamp Creek include fecal coliform bacteria, nutrients, and several trace metals. In addition, dissolved oxygen concentrations have occasionally been lower than desired to support cold-water fish species. The primary cause of these problems is nonpoint source pollution (Snohomish County Public Works, 1994).

Plants and Animals

The Washington State Department of Fish and Wildlife priority habitat and species map for the area does not indicate any priority habitat or species in the project area. Swamp Creek is designated as "critical spawning habitat for resident fish species within streams", and the map indicates that anadromous fish runs are present in Swamp Creek (WSDFW, 1996).

Swamp Creek provides habitat for anadromous species including coho salmon (*Oncorhynchus kisutch*), chinook salmon (*O. tchawytscha*), sockeye salmon (*O. nerka*), steelhead (*O. mykiss*) as well as cutthroat trout (*O. clarki*). Resident fish species in the watershed include rainbow trout (*Oncorhynchus mykiss spp.*), cutthroat, kokanee (*O.* nerka), three spined stickleback (*Gasterosteus* aculeatus), sculpin (*Cottus sp.*), and dace (*Rhinichthyes osulus*). Salmon populations have decreased dramatically in the watershed over the past 15 years due to reduced rearing habitat, degraded water quality, and altered runoff levels during storm events (King County SWM, 1996).

As mentioned above, Swamp Creek Wetland No. 3, located to the southeast of the project area is home to 20 Great Blue Heron nests—a unique wildlife habitat. Other species known to use this habitat area include the Common Merganser, Red-tailed Hawk, Bald Eagle, Belted Kingfisher, Cormorant, Canada Goose and Mallards (King County Planning, 1993). Geese and mallards were observed in the project area and a Great Blue Heron was sighted flying above the footbridge in Wallace Swamp Creek Park, which is within 500 feet of both alternative routes (S. Greenberg, personal observation, Aug. 21, 1996).

Vegetation in the project corridor varies widely. Types of vegetation commonly found within the corridor include deciduous and evergreen trees, shrubs, grass, and wet soil plants.

Land Use

Current Land Use

Land use in the project area is predominantly single-family residential, with scattered vacant land, a 17-acre County park (Wallace Swamp Creek Park) and a school (Kenmore Elementary). The project area is zoned R-1-P west of 73rd Avenue NE and either R-6-P or R-8-P east of 73rd Avenue NE. These zones are all "urban residential", with maximum densities of 1, 6 or 8 dwelling units per acre. The urban residential zone allows uses such as single-family homes, parks, trails, day care facilities, schools, and utilities. The "P-suffix" for each zone refers to specific Northshore Community Plan policies and regulations. Those that are applicable to the Swamp Creek sewer project are discussed or referenced in this study.

Planned Land Use

The 1994 King County Comprehensive Plan designates planned land use in the project area for Urban Residential, 1 dwelling unit per acre, west of 73rd Avenue NE, and Urban Residential, 4-12 dwelling units per acre, east of 73rd Avenue NE.

Recreation

Alternative 1 runs through Wallace Swamp Creek Park. Multiple conversations with King County Parks Division staff have led to little information about this park. The park

was acquired by King County in 1992-1993 using open space bond funds. Based upon conversations with the Parks Division, there are no plans for improvements to the park.

Transportation

Alternative 2 may require detouring of 73rd Avenue NE through traffic to 68th Avenue NE to accommodate construction. Traffic counts were obtained from King County for 73rd Avenue NE and 68th Avenue NE (see Appendix B-2). Generally, 73rd Avenue NE (a collector arterial) has more traffic than 68th Avenue NE (a minor arterial) in the northbound direction. The reverse is true for the southbound direction. A southbound 73rd Avenue NE detour would shift approximately 1,537 vehicles per day (ADT) to 68th Avenue NE—a traffic increase of approximately 46 percent. A northbound 73rd Avenue NE detour would shift approximately 3,098 vehicles per day (ADT) to 68th Avenue NE—a traffic increase of approximately 76 percent. More exact counts should be taken at the proposed detour points to determine the exact impact of the detours.

Collector arterials are "intra-community highways connecting residential neighborhoods with community centers and facilities." For collector arterials in an urban environment the King County Road Standards (KCRS) provide for a 44-foot minimum pavement width including bikeways between vertical curb and gutter and sidewalks in a 60-foot minimum right-of-way width. 73rd Avenue NE has a 22-foot-wide pavement section with 4 to 7-foot-wide shoulders on each side for most of the route. Only a very short section of the right-of-way near the south end of the route has a 40-foot-wide pavement section with vertical curb and gutter and sidewalks.

Minor arterials are "intra-community highways connecting community centers and facilities." For minor arterials in an urban environment KCRS provides for a 44-foot minimum pavement without provision for bikeways between vertical curb and gutter and sidewalks in an 84-foot minimum right-of-way width. 68th Avenue NE, the proposed detour route, has a 22-foot-wide pavement section with 2-4-foot-wide shoulders on each side for most of the route. Only a very short section of the right-of-way has a 44-foot-wide pavement section with vertical curb and gutter.

The King County Northshore Community Plan calls for improvement of 73rd Avenue NE from NE 192nd Street to NE 205th Street with a walkway or pathway for pedestrians, a separate equestrian pathway, and paved shoulders. This project (number N-41) is designated a "low priority" in the Plan. Timing for this improvement project is unscheduled.

Policies, Regulations, and Permits

A variety of policies and regulations apply to location and construction of the proposed project. The following summarizes these policies and regulations, and discusses the permits that may be required for the project.

King County Comprehensive Plan

The King County Comprehensive Plan was adopted in 1994 to guide future development in unincorporated King County. The following policies apply to the project:

NE-308: Development within designated Shoreline Environments shall preserve the resources and ecology of the water and shorelines, avoid natural hazards, promote visual and physical access to the water and preserve archeological, traditional cultural resources, and navigation rights. Protection of critical area shall take priority over visual values and physical access.

NE-311: River and stream channels should be preserved, protected and enhanced for their hydraulic, ecological and aesthetic functions.

NE-312: King County, in partnership with other jurisdictions and interested parties, should continue restoring stream and river channels and surrounding riparian areas to enhance water quality and fish and wildlife habitat and to mitigate flooding and erosion.

NE-330: The existing flood storage and conveyance functions and ecological values of flood plains, wetlands, and riparian corridors should be protected, and where possible, enhanced or restored.

NE-331: King County's flood plain land use and flood plain management activities should be carried out in accordance with the King County Flood Hazard Reduction Plan.

Northshore Community Plan

The Northshore Community Plan Update was adopted by King County in 1993 to provide guidance for future development in the Northshore area of King County, which includes the project area. The Northshore Community Plan continues in effect, supplementing the 1994 King County Comprehensive Plan.

NR-11: A stream corridor wide enough to maintain the natural biologic and hydraulic function of streams in the Northshore planning area's drainages should be preserved in all development proposals by use of native growth protection tracts or other appropriate mechanisms. The natural drainage systems...should be restored, maintained, and enhanced to protect water quality, preserve existing aquatic habitat, reduce public costs and prevent environmental degradation.

NR-13: Public improvements and private developments should not alter natural drainage systems without mitigating measures which eliminate increased risk of flooding and erosion, negative impacts on surface and ground water quality, reductions in ground water recharge, and loss of aquatic or riparian habitat.

U-7: If sewer lines are extended to the Swamp Creek area, they should be designed and located to avoid impacts to environmentally sensitive areas such as flood plains, and stream crossings should not be allowed.

King County Zoning Code (Title 21A)

In 1994, King County adopted a new Zoning Code to implement the 1994 King County Comprehensive Plan. This Code has been amended a number of times through 1996. The portion of the King County Zoning Code (Title 21A) that applies to this project is Chapter 21A.24, Environmentally Sensitive Areas.

Sec. 21A.24.070.A allows an exception to the provisions of Chapter 21A.24 for public agencies and utilities, if there is no "practical alternative" that has less impact on the sensitive area, and the proposal minimizes impacts on sensitive areas. This process is called a "public agency utility exception (PAUE)". The process for a PAUE requires public notice, an opportunity for the public to request a public hearing on the proposal, and allows for appeals. There is no definition of "practical alternative". The decision on whether there is a "practical alternative" would be made by King County Department of Development and Environmental Services (DDES) staff as part of the review of the PAUE request. A PAUE must be granted for portions of Alternative 1, as discussed below.

The sensitive areas regulated by Chapter 21A.24 that apply to Alternative 1 are flood hazard areas, and streams. These sensitive areas are defined and discussed below:

Flood Hazard Areas. "Flood hazard areas" are those areas subject to inundation by the base flood and those areas subject to risk from channel relocation or stream meander (Sec. 21A.06.475). A flood hazard area consists of four components: flood plain, flood fringe, zero-rise floodway, and FEMA floodway. (Sec. 21A.24.230) Much of the Alternative 1 route lies within a flood hazard area (see Figures 3 and 5).

Flood plain: "Flood plain" is the total area subject to inundation by the base flood. (Sec. 21A.06.495). The base flood is also known as the 100-year flood. There are no regulations that apply to the flood plain. However, regulations do apply to components of the flood plain (flood fringe and zero-rise floodway). Much of the Alternative 1 route lies within a flood plain (see Figures 3 and 5).

Flood Fringe: "Flood fringe" is that portion of the flood plain outside of the zero-rise floodway. Portions of Alternative 1 lie within the flood fringe (see Figures 3 and 5). Development within the flood fringe cannot reduce the effective base flood storage volume of the flood plain. If this volume is reduced, mitigation would include creating compensatory storage on or off site.

Zero-Rise Floodway: The "zero-rise floodway" is the channel of a stream and that portion of the adjoining flood plain which is necessary to contain and discharge the base flood flow without any measurable increase in flood height. This definition is broader than the FEMA floodway, but always includes the FEMA floodway. The boundaries of the 100-year flood plain, as shown on the FEMA maps, are considered to be the boundaries of the zero-rise floodway unless otherwise delineated by a special study. (Sec. 21A.06.505) Development in both the zero-rise floodway and FEMA floodway cannot increase the base flood elevation, unless the FEMA maps are amended, and property owners affected by the increased flood elevations consent to the impacts on their property. Utilities may be allowed, if no feasible alternative is available. (Secs.

21A.24.250 and 21A.24.260) Portions of Alternative lie within both the zero-rise and FEMA floodways.

Wetlands may exist along the route for Alternative 1. A wetlands biologist should walk the route and determine the nature and extent of any wetlands. If wetlands do exist, Secs. 21A.24.320 through 21A.24.350 would apply. Of particular interest is Sec. 21A.24.330.F, which contains specific requirements for locating sewer utility corridors in wetlands (see Appendix B-3).

Swamp Creek is defined as a "Class 1 stream" in the King County Sensitive Areas Map Folio. The following requirements apply to Alternative 1:

A 100-foot buffer along the sides of Swamp Creek is required (Sec. 21A.24.360.A.1). Averaging of this buffer width may be allowed if it will provide additional natural resource protection, and as long as the total area contained in the buffer does not increase (Sec. 21A.24.360.B).

Utilities may be allowed within stream buffers if no practical alternative location is available, and the requirements of Sec. 21A. 24.330.F are met (see Appendix B-3).

Stream crossings may be allowed if the requirements of Sec. 21A.24.370.G are met (see Appendix B-4).

Both tributaries of Swamp Creek are defined as "Class 3 streams" in the King County Sensitive Area Map Folio. Crossings of "Class 3 streams" when dry may be made with open cuts as provided in Sec 21A.24.370.G (see Appendix B-4).

King County Shoreline Management Master Program

Swamp Creek is designated a "shoreline of the state" by King County's Shoreline Management Master Program (SMMP) (Title 25). Ordinance 3689 designates Swamp Creek as a "rural" shoreline environment. Both alternatives must comply with the SMMP, where they are within 200 feet of Swamp Creek. Utilities are permitted in the rural shoreline environment (Sec. 25.20.110). The following discusses Title 25 requirements for construction of utilities in the rural shoreline environment.

Utilities shall avoid disturbance of unique and fragile areas, and avoid disturbance of wildlife spawning, nesting and rearing areas (Sec. 25.16.160.A).

Utilities shall minimize visual impact, harmonize with or enhance the surroundings, not create a need for shoreline protection, and utilize natural screening to the greatest extent possible (Sec. 25.16.160.B).

Construction and maintenance of utilities must maximize preservation of natural beauty and conserve natural resources, minimize scarring of the landscape, minimize siltation and erosion, protect trees, shrubs, grasses, natural features and topsoil from drainage, and avoid disruption of critical aquatic and wildlife stages (Sec. 25.16.160.C).

In addition to the above requirements from Title 25, King County's adopted shoreline policies apply to this project (Ordinance 3692). The policies on utilities must be met (see Appendix B-5).

The following permits may be required for this project:

Federal:

The Army Corps of Engineers requires a permit for construction in a wetland or stream. The Corps can review, comment and condition the entire project—even areas outside of wetlands and streams. Contact Person at the Corps is Jack Gossett (206-764-6902).

Nationwide Permit 12 is required for "utility line backfill and bedding" in a wetland or stream. Conditions that must be met include: minimizing disturbance in wetlands and streams; in wetlands, the top 6 to 12 inches of the trench must be backfilled with wetland topsoil from the trench; use of native vegetation for revegetation, where necessary. An *Individual Permit* is required if the afore mentioned conditions can not be met. Review time for the *Nationwide Permit 12* is 30-45 days.

Other Corps permits may be required, depending on the specifics of the proposed project.

State:

The State of Washington permits include approvals by the Departments of Ecology, and Fish and Wildlife.

A *Hydraulic Project Approval* (HPA) is required by the Dept. of Fish and Wildlife (DFW) for work that uses, diverts, obstructs or changes the natural flow or bed of any water of the State (which includes Swamp Creek). An HPA takes 30-45 days to process.

A *National Pollutant Discharge Elimination System* (NPDES) permit is required by the Dept. of Ecology (DOE) for stormwater discharges from construction sites with disturbed soil area of 5 acres or more. The DOE has estimated that a project the size of the sewer project would take about 18 months to review and process. This project is not expected to disturb more than 5 acres.

A *Temporary Modification of Water Quality Criteria (Water Quality Modification)* is required by the DOE for activities that might cause short-term water quality standard violations (such as increased sedimentation during construction). This permit takes about 6 weeks to process.

A *Section 401 Water Quality Certification* is required by the Army Corps of Engineers and is administered by DOE for any federal license or permit to conduct any activity that may result in any discharge into surface waters. The 401 Certification takes about a year to process.

Local:

King County requires the following permits related to land use and construction.

A *Shoreline Substantial Development Permit* (SSDP) is required for construction within 200 feet of Swamp Creek and its wetlands. An SSDP takes about 120 days to process.

A *Public Agency Utility Exception* (PAUE) is required to waive or reduce requirements of King County Code Chapter 21A.24 (Environmentally Sensitive Areas). To receive a

PAUE, the Wastewater Treatment Division must show that there is no practical alternative to the proposed development with less impact on the sensitive area; and the proposal minimizes impact on sensitive areas. Processing time is approximately 120 days.

A *Clearing and Grading Permit* is required for construction outside of a public road right-of-way. This takes about 4 weeks for review.

A *State Environmental Policy Act (SEPA) checklist* is required to assist in making a threshold determination for the proposal. A threshold determination is the decision made by the lead agency as to whether or not an Environmental Impact Statement is required for a proposal. The project's SEPA designated lead agency is the King County Department of Natural Resources (KCDNR).

For the portion of the sewer line in the public right-of-way, a *franchise permit* is required by Property Services. This takes about 2 weeks for review.

VII. Alternative Comparison

General

This section discusses the two alternative routes and provides a direct comparison of the important features of each, including costs. Capital costs include construction costs with sales tax; costs for land acquisition and/or easements; and allied costs for engineering, geotechnical services, construction management, and project administration. The costs were prepared to a level of effort appropriate for comparison of alternatives and should be viewed as a range, not an absolute cost.

Both alternative routes meet the overall goal of providing a connection between the northern terminus of King County's existing 36-inch Swamp Creek Trunk and the AWSD sewer at the King County/Snohomish County line.

Alternatives Comparison

Alternative 1 Swamp Creek Route	Alternative 2 73rd Avenue NE Route
Engineering Construction Issues	
Trench Length, Depth, and Construction Technique	
Length of the proposed route is 4,667 feet.	Length of the proposed route is 4,395 feet.
The depth to invert along the route will vary from 10 to 20 feet with depths of 15-20 feet for 427 feet of length and with depths of 10 to 15 feet for the remaining 4,240 feet of pipeline.	The depth to invert along the route will vary from 15 to 35 feet with depths of 30-35 feet for 970 feet of length, depths of 20 to 30 feet for 1,205 feet, and depths of 15 to 20 feet for the remaining 2,220 feet of pipeline.
Open cut trenching techniques with stacked trench boxes can likely be used throughout the route except in the area of the creek water under crossing.	Open cut trenching techniques with stacked trench boxes can likely be used where the depths are limited to 20 feet except in the area of the creek under crossing. For excavations in excess of 20 feet soldier piles with lagging or trenchless construction (i.e. microtunneling) is required.

Alternative 1 Swamp Creek Route	Alternative 2 73rd Avenue NE Route
Bedding and Backfill	
Imported backfill and bedding material will be required.	Same as for Alternative 1
Much of the route is undeveloped, and probably will remain underdeveloped for environmental reasons, which should minimize the compaction requirements.	It will be necessary to compact the trench backfill to between 92 and 95 percent of the maximum dry density, in order to provide adequate support for the roadway surface.
Groundwater	
Wells points or sumps will be required for the creek crossing.	Same as for Alternative
Limited groundwater information is available. It is assumed that well points would be required along the entire route.	From Station 0+00 to 14+00 the route is close to Swamp Creek and groundwater will likely be encountered at the creek elevation. Perched water may be encountered within the glacial deposits. Well points may be required through much of the route.
Because of the potential of Swamp Creek flooding, all construction should be limited to the driest summer months.	Although flooding of Swamp Creek should have less effect on this route, construction should be limited to the driest summer months when the creek and groundwater levels are at their lowest.
Creek Under-Crossing	
The route crosses Swamp Creek in the section of sewer between manholes located at Station 41+26 and 45+06. The crossing would be constructed on the north side of the existing NUD local connecting sewer.	The route crosses Swamp Creek in the section of sewer between manholes located at Station 1+43 and 4+00. The crossing would be constructed on the east side of the roadway to avoid interfering with the bridge pile foundations.
The crossing could be constructed using either open cut or jack and bore methods. Open cutting would likely involve construction of one half of the crossing at a time utilizing coffer dam and pumps to control the water. A jack and bore	The crossing could be constructed using either jack and bore or one of the other trenchless construction methods. The proposed crossing is 257 feet in length.

Alternative 1 Swamp Creek Route	Alternative 2 73rd Avenue NE Route
crossing would require a 150-foot minimum distance between pits.	
Boulders and wood debris may be encountered within the creek channel which could make jack and bore method difficult.	Boulders and wood debris may be encountered within the creek channel which could make the crossing difficult using either of the methods.
Connection to Existing Sewers	
Because of the substantial flow carried by the existing NUD local connecting sewer and the necessity of connecting to "live" sewer and/or manholes at each end of the project, it will be important to plan the connects for a low flow period. It will also be necessary to have sufficient pumping equipment and personnel available to pump around the connection while it is being accomplished.	Same as for Alternative 1.
During construction of the new pipeline it will be necessary to transfer a gravity sewer serving a residential area and another serving the Kenmore Elementary School from the NUD local connecting sewer to the new sewer as quickly as possible. During the period of disconnection, temporary pumping equipment and personnel will need to be available.	During construction of the new pipeline, it will be necessary to transfer a gravity sewer serving a residential area from the NUD local connecting sewer to the new sewer as quickly as possible. The section of sewer between Station 0+00 and 1+43 conflicts with the existing pipe from the east. During the period of disconnection, temporary pumping equipment and personnel will need to be available.
Traffic Detours	
Since most of the route is undeveloped it is expected that requirement for temporary closure of the roadway or traffic detouring will be minimal. The heavy volume of trucking required for removal of excavated material and import of bedding and backfill may necessitate local lane closures.	This route will require traffic detours during much of the construction period. The combination of excessively deep trench excavation and the need for the heavy volume of trucking for removal of excavated material and import of bedding and backfill will require the temporary closure of the roadway in the area under construction.
In those instances that construction is	It would probably be necessary to move

Alternative 1 Swamp Creek Route	Alternative 2 73rd Avenue NE Route
required in the street right-of-way, local detouring will be necessary. Because of the local nature of any closure or detour, approval would only be required from King County.	the through traffic from 73rd Avenue NE to 68th Avenue NE. Because of the road patterns in the area a rather complex traffic detour would be required with approvals from the City of Brier, King County, and Snohomish County. Current traffic counts should be taken in the area before designing the detour plan.
Right-of-way	
The existing NUD local connecting sewer is located in the center of a 10-foot-wide easement. The existing easement is not sufficient for construction of the sewer. An additional 15-foot-wide permanent easement together with a 20-foot-wide temporary construction easement located adjacent to the permanent easement should be obtained for construction of the sewer and the temporary access roadway.	Sufficient right-of-way is available for construction of the sewer along this route except for the section between Stations 1+43 and 4+00 at the Swamp Creek under crossing. An additional 10-foot-wide permanent easement will be required for the crossing as well as a 15-foot-wide temporary construction easement located adjacent to the permanent easement. This temporary construction easement could revert back to the land owner upon completion of the project.
Temporary Access Roadway	
Because of the undeveloped nature of the route, it will be necessary to construct a temporary single lane roadway adjacent to the proposed trench to provide access during construction. Since much of this route crosses flood plain, it is expected that this temporary access road will have to be removed at the end of construction.	Temporary access roadway is not required.
Protection of Adjacent Structure	
An existing residence is located on the east side of Swamp Creek just north and adjacent to the section of sewer between manholes located at Station 41+26 and 45+06. The foundation of the structure appears to be less than 10 feet from the centerline of the new sewer. It will be necessary to underpin or otherwise	Not applicable to Alternative 2.

Alternative 1 Swamp Creek Route	Alternative 2 73rd Avenue NE Route
protect the existing structure or purchase the property and remove a portion of the structure.	
Excavated Material	
With trench depths of 10 to 20 feet over the entire route, a large volume of excavated material will be generated (substantially more volume than for Alternative 2).	With trench depths of 15 to 20 feet over the open-cut section of the route, a large volume (but substantially less than Alternative 1, because of less open-cut length) of excavated material will be generated.
This excavation material will need to be temporarily stockpiled along the construction easement or exported offsite to a temporary stockpile or to disposal.	This excavated material will need to be temporarily stockpiled along the trench and within the road right-of-way or exported offsite to a temporary stockpile or to disposal.
Since the excavated material may have a high fines content and will likely be wet, it is unlikely that it can be reused as backfill.	Same as Alternative
If excavated material is not reusable imported backfill will be required.	Same as Alternative 1.
Existing Utility and Roadway Improvements	
The existing 18 to 21-inch NUD local connecting sewer parallels the proposed route through the entire length. The existing NUD local connecting sewer would be abandoned in place with this alternative.	The existing 18 to 21-inch NUD local connecting sewer will remain in use with this alternative.
Not applicable to Alternative 1	An 8-inch high pressure gas main is located along the west shoulder of the pavement for the entire route.
Not applicable to Alternative	An 8-inch water main is located on the east side of the roadway along the entire route.
Not applicable to Alternative 1.	An 8-inch sewer main is located near the centerline of the roadway from station 29+30 to 42+25.

Alternative 1 Swamp Creek Route	Alternative 2 73rd Avenue NE Route
Since depths required for this route are less, and since actual construction length in roadway section is substantially shorter, damage to roadway surface would be less with this alternative.	Open cut construction at the depths required for this route will cause complete loss of the existing roadway surface. What is not damaged by the actual trench cut will be damaged by the heavy equipment required for construction at this depth and by the volume of trucking required for removal of the excavated material and import of bedding and backfill.
Not applicable to Alternative 1.	Trenchless construction for depths exceeding 20 feet would provide for installation of the new pipeline below that of any conflicting utilities and would limit severe damage to the areas open cut or those near the push/receiving pits required for construction.
Geotechnical Issues	
Surficial Conditions	
The route parallels the Swamp Creek drainage channel for most of this alternative.	The route traverses the upland east bank of the Swamp Creek drainage channel.
With the exception of the 150-foot-long crossing of Swamp Creek, the ground surface along the route generally increases in elevation from Station 0+00 to the northern terminus at Station 46+67.	The ground surface along the route increases in elevation from Station 0+00 to 33+50 and then decreases in elevation to the northern terminus at Station 43+95.
From Station 0+00 to 3+41 and from Station 45+06 to 46+67 the surface of the route is paved. The remainder of the route is unpaved and generally undeveloped.	There is a steep drop off along both sides of the roadway from Station 2+00 to 5+00 and from Station 8+50 to 11+50.
Not applicable to Alternative	The existing bridge across Swamp Creek on 73rd Avenue NE has been recently reconstructed. Concrete piles support the bridge deck. Numbered paint marks, which are typically painted on the pile to

Alternative 1 Swamp Creek Route	Alternative 2 73rd Avenue NE Route
	determine depth of embedment, are still visible. The marks indicate the piles were driven between 10 to 12 feet below existing ground surface. Rip-rap consisting of 2-man to 4-man-sized boulders and concrete slabs line the creek bank adjacent to the bridge.
General Subsurface Conditions	
According to the construction records for the NUD local connecting sewer, the typical soil conditions encountered along the Swamp Creek Route consisted of surficial silty sands underlain by "washed hard gravel".	Based on available geologic map information, the soils underlying the 73rd Avenue NE Route are primarily composed of glacial advance outwash (sand and gravel), except for the area between NE 192nd Street and NE 195th Street which is mapped as recent alluvium (clay to gravel).
Surficial soil conditions observed in the creek bed consist of sandy gravel and gravely sand with occasional cobbles.	Exposed in the creek bank at the 73rd Avenue NE bridge is silty sandy gravel. Based on the mapped geology, soil conditions are expected to be dense. Between Stations 2+00 to 5+00 and between Stations 8+50 to 11+50, where the roadway is higher than the surrounding area and very close to Swamp Creek, it is likely constructed on fill overlying alluvial deposits.
Groundwater levels observed during the installation of the NUD local connecting sewer, in the summer of 1965, were generally at a depth of 5 to 8 feet below the ground surface.	Information regarding groundwater conditions along the proposed route was not available. However, in the vicinity of the bridge across Swamp Creek, groundwater levels are expected to be at or near the elevation of the creek and to fluctuate with the creek level.
Additional Geotechnical Services Required	
A total of 10 test pits will need to be excavated along the proposed sewer route. Test pits will be excavated with a track excavator capable of excavating to a depth of 20 feet. The existing easement for the adjacent local connecting sewer is only 10 feet in	A total of 12 soil borings will need to be drilled along the route and approximately 10 temporary monitoring wells installed. Borings will be drilled at probable jacking pit and receiving pit locations. Borings will likely be drilled in the roadway requiring a traffic control

Alternative 1 Swamp Creek Route	Alternative 2 73rd Avenue NE Route
width. In order to excavate test pits to the required depth and not disturb the existing sewer the test pits will need to be located on property adjacent to the existing easement, and be kept a minimum of 10 feet away from the existing sewer. Prior to excavating the test pits, permission to work on private property will need to be secured. A total of 5 soil borings will be drilled along the route and temporary monitoring wells installed. Boring depths will range from 15 to 25 feet. Relatively undisturbed samples will be collected for testing to determine soil parameters.	plan and flaggers. Boring depths will range from 20 to 60 feet. Relatively undisturbed samples will be collected for laboratory testing to determine soil parameters.
In-situ permeability tests will need to be performed in the monitoring wells and/or percolation tests in the test pits to quantify soil permeability. This information will be used to provide dewatering recommendations and for use in design of dewatering methods.	Variable head or slug tests will need to be performed in the monitoring wells to quantify soil permeability. This information will be used to provide dewatering recommendations and for use in design of dewatering methods.
Alternatives for crossing Swamp Creek will need to be evaluated. Both open cut and jack and bore methods will be evaluated.	Alternatives for crossing Swamp Creek will need to be evaluated. Jack and bore, and other trenchless construction methods will be evaluated.
A King County grading permit may be required for the exploration work along the Swamp Creek route since the route crosses flood plain and/or wetland areas. It is expected that restoration work may be required to return the exploration sites to existing conditions.	Not applicable to Alternative 2.

Environmental Issues

Water	
The sewer crosses and then parallels Swamp Creek for most of the route. Swamp Creek is considered a "Class 1 Stream" by King County, the highest and most important stream category in the	The sewer crosses Swamp Creek and then remains outside the creek or flood plain areas for its entire length. Swamp Creek is considered a "Class 1 Stream" by King County, the highest

Alternative 1 Swamp Creek Route	Alternative 2 73rd Avenue NE Route
County. It is designated as a "Shoreline of the State" by the State of Washington, which requires regulation and protection under the State Shoreline Management Act and King County Shoreline Management Master Program.	and most important stream category in the County. It is designated as a "Shoreline of the State" by the State of Washington, which requires regulation and protection under the State Shoreline Management Act and King County Shoreline Management Master Program.
The western tributary flows into Swamp Creek at about NE 195th Street. It is considered a "Class 3 Stream" by King County.	The eastern tributary flows into Swamp Creek at about NE 198th Street. It is considered a "Class 3 Stream" by King County.
The King County Sensitive Areas Map Folio does not show any wetlands in the project area. However, there is one wetland (Swamp Creek Wetland No. 3) nearby that could be affected by the construction. This wetland is 92 acres in size.	Same as for Alternative 1. However, since the route does not follow the creek, the potential for impacting any wetlands is less than for Alternative 1.
Groundwater issues are indicated under Geotechnical Issues.	Same as for Alternative 1
This alternative will cross Swamp Creek once at the northern end of the route, and will cross the western tributary where it enters Swamp Creek. This route will need to be constructed through 100-year flood plains throughout nearly the entire length. In some areas, it would be inside the floodway.	This alternative will cross Swamp Creek once on the east side of the bridge at the southern end of the route, and will also cross the eastern tributary. Except for these specific crossings the route will be constructed outside of the creek or flood plain areas for its entire length.
Swamp Creek lies within the Cedar River basin. The water quality regularly fails to meet state water quality standards.	Same as for Alternative 1.
Plants and Animals	
The Washington State Department of Fish and Wildlife priority habitat and species map for the area does not indicate any priority habitat or species in	Same as for Alternative 1.

Alternative 1 Swamp Creek Route	Alternative 2 73rd Avenue NE Route
the project area	
Swamp Creek provides habitat for several species of fish including several varieties of salmon. Salmon populations have decreased dramatically in the watershed over the past several years due to reduced rearing habitat, degraded water quality, and altered runoff levels during storm events.	Same as for Alternative 1. However, since the route does not follow the creek, the potential for impacting the fish population or habitat is less than Alternative 1.
The Swamp Creek Wetland No. 3, located downstream for the project area is home to 20 Great Blue Heron nests.	Same as for Alternative 1. However since the route does not follow the creek, the potential for impacting the Great Blue Heron population or nests is less than for Alternative 1.
Vegetation in the corridor includes deciduous and evergreen trees, shrubs, grass, and wet soil plants.	Vegetation in the corridor includes deciduous and evergreen trees, shrubs, and grass.
Land Use	
Current land use in the project area is predominately single-family residential, with scattered vacant land, a 17-acre County park (Wallace Swamp Creek Park) and a school (Kenmore Elementary). The project area is zoned R-1-P west of 73rd Avenue NE and either R-6-P or R-8-P east of 73rd Avenue NE.	Same as for Alternative 1.
The 1994 King County Comprehensive Plan designates planned land use in the project area for Urban Residential, 1 dwelling unit per acre, west of 73rd Avenue NE, and 4 to 12 dwelling units per acre, east of 73rd Avenue NE.	Same as for Alternative 1.
Recreation	
This alternative runs within an easement through Wallace Swamp Creek Park.	This alternative runs within the road right-of-way adjacent to the east side of Wallace Swamp Creek Park.
There appear to be no plans for any	Same as for Alternative 1. However,

Alternative 1 Swamp Creek Route	Alternative 2 73rd Avenue NE Route
improvement to the park at this time.	since the route does not fall within the park, the potential for impacting any future park construction is less than for Alternative 1.
Transportation	
All but a limited length of section at each end of this route is undeveloped and located within easements through private properties. The short sections at each end of this route are located within the 73rd Avenue NE right-of-way.	This route is located within the 73rd Avenue NE right-of-way.
Same as for Alternative 2.	73rd Avenue NE is a collector arterial. For collector arterials in an urban environment the King County Road Standards (KCRS) provide for a 44-foot minimum pavement width including bikeways between vertical curb and gutter and sidewalks in a 60-foot minimum right-of-way width. 73rd Avenue NE has a 22-foot-wide pavement section with 4 to 7-foot-wide shoulders on each side for most of the route. Only a very short section of the right-of-way near the south end of the route has a 40-foot-wide pavement section with vertical curb and gutter and sidewalks.
Since most of the route is undeveloped it is expected that requirement for traffic detouring will be minimal. In those instances that construction is required in the street right-of-way (trenching in paved areas and connection to existing manholes), local detouring will be necessary.	This route will require traffic detours during much of the construction period. The combination of excessively deep trench excavation and the need for the heavy volume of trucking for removal of the excavated material and import of bedding and backfill will necessitate the temporary closure of the roadway in the area under construction.
Although it may be necessary to move traffic from 73rd Avenue NE to 68th Avenue NE, it would only be for the short time that connections were being	It would probably be necessary to move the through traffic from 73rd Avenue NE to 68th Avenue NE. Because of the road patterns in the area a rather complex

Alternative 1 Swamp Creek Route	Alternative 2 73rd Avenue NE Route
made in 73rd Avenue NE.	traffic detour would be required with approvals from the City of Brier, King County, and Snohomish County.
Same as for Alternative 2.	68th Avenue NE is a minor arterial. For minor arterials in an urban environment KCRS provides for a 44-foot minimum pavement with provision for bikeways between vertical curb and gutter and sidewalks in an 84-foot minimum right-of-way width. 68th Avenue NE, the proposed detour route, has a 22-foot-wide pavement section with 2-4-foot-wide shoulders on each side for most of the route. Only a very short section of the right-of-way has a 44-foot-wide pavement section with vertical curb and gutter.
Same as for Alternative 2.	Traffic counts were obtained from King County for 73rd Avenue. NE and 68th Avenue NE (Appendix B-2). Generally, 73rd Avenue NE (a collector arterial) has more traffic than 68th Avenue NE (a minor arterial) in the northbound direction. The reverse is true for the southbound direction. A southbound 73rd Avenue NE detour would shift approximately 1,537 vehicles per day (ADT) to 68th Avenue NE—a traffic increase of approximately 46 percent. A northbound 73rd Avenue NE detour would shift approximately 3,098 vehicles per day (ADT) to 68th Avenue NE—a traffic increase of approximately 76 percent. Additional counts should be taken at the proposed detour points to better determine the impact of the detours.
Same as for Alternative 2.	The King County Northshore Community Plan calls for improvement of 73rd Avenue NE from NE 192nd St. to NE 205th Street with a walkway or

Alternative 1 Swamp Creek Route	Alternative 2 73rd Avenue NE Route
	pathway for pedestrians, a separate equestrian pathway, and paved shoulders. This project (number N-41) is designated a "low priority" in the Plan. Timing for this improvement project is unknown.
Policies, Regulations, and Permits	
See the subsection entitled "Policies, Regulations, and Permits" under the section of this report entitled "Environmental Compliance and Permitting". The policies, regulations, and permits listed affect both alternative routes, but to differing degrees.	See the subsection entitled "Policies, Regulations, and Permits" under the section of this report entitled "Environmental Compliance and Permitting". The policies, regulations, and permits listed affect both alternative routes, but to differing degrees.
Permitting of Alternative 1 will be more difficult and will require substantially more effort and time than for Alternative 2.	Permitting of Alternative 2 will be less difficult and will require substantially less effort and time than for Alternative
Of most concern is the requirement to obtain a Public Agency Utility Exception (PAUE) for construction within a sensitive area. To obtain a PAUE it is necessary to establish that no "practical alternative" is available.	A PAUE is not required for Alternative 2.
Operation and Maintenance Issues	
There are no significant operation costs associated with this alternative. The existing NUD local sewer which parallels this route will be abandoned under this alternative. The issue of maintenance of this alternative centers on the difficulty of maintaining access to the manholes along the creek section of the route once the temporary construction road is removed and the area restored. Brush including blackberries will quickly return to the route which will require annual clearing if the route is to be kept open. Without road access, it will be difficult, if not impossible, to get vehicular access for any scheduled maintenance or inspectors.	There are no significant operation costs associated with this alternative. The existing NUD local sewer which presently carries both the local flow and the flows from AWSD will not be abandoned under this alternative. It will continue to carry the local flows after the AWSD flows have been intercepted with King County's new 36-inch trunk extension. Leaving the existing NUD local sewer to carry the local flows allows the few existing local connections, the Kenmore Elementary School, and that portion of the basin located west of Swamp Creek, to continue service without substantial

Alternative 1 Swamp Creek Route	Alternative 2 73rd Avenue NE Route
This access difficulty could increase the cost of maintenance for this alternative.	additional construction. The removal of the AWSD flows from the local sewer reduces the flow in the local sewer to an extent which will probably require periodic flushing. Maintenance for this alternative is not expected to be out of the ordinary. Access to the manholes along the route will be from the existing county road. The manholes are deep. Those in the trenchless section vary in depth from 20 to 35 feet. Spacing between manholes in the trenchless section are as great as 900 feet. This extended manhole spacing could increase the cost of maintenance for this section of pipe.
Capital Cost	
Appendix C includes a planning level cost estimate for the alternative. A summary of the cost estimate for this alternative is as follows: Total Anticipated Construction Cost $3,174,804 Allied Costs (35%) $1,111,182 Property Acquisition (Easements) $ 518,375 Total Anticipated Project Cost $ 4.80 Million	Appendix C includes a planning level cost estimate for the alternative. A summary of the cost estimate for this alternative is as follows: Total Anticipated Construction Cost $ 6,088,965 Allied Costs (35%) $ 2,131,138 Property Acquisition (Easements) $ 18,125 Total Anticipated Project Cost $ 8.24 Million

VIII. Selection of Preferred Alternative

General

Selection of the preferred alternative was not a simple process. After completion of the draft report through the development of the alternative comparisons and preparation of planning level cost estimates, it became apparent that Alternative 1 had a much lower cost relative to Alternative 2, but that Alternative 1 carried a much higher risk for environmental and permitting issues than Alternative 2. For this reason it was decided to undertake the selection process through the use of a project team workshop process.

Project Team Workshops

Two workshops were held with the project team after the draft report was completed through development of the alternative comparison section. Participants in these workshops were:

King County

- Janice Johnson, King County Project Manager
- Richard Carlson
- Ed Cox
- Eric Davison
- Tim Goon
- Bob Peterson
- Bob Swarner
- Mann-Ling Thibert
- Larry Underdahl

Consultant

- John Giaudrone, Consultant Team Project Manager

At each of the workshops the findings of the draft report were presented. Next, an alternative comparison fact sheet which summarized the quantifiable issues for each alternative was presented. See Appendix D-1 Alternative Comparison - Fact Sheet. Once the facts surrounding each alternative had been discussed, a blank work sheet for comparison of subjective issues relating to each alternative was provided. See Appendix D-2 Alternative Comparison - Subjective Issues (Blank Worksheet). The blank work sheet for comparison of subjective issues was used to collect the project teams' collective assessment of how well each alternative met the project goals, any additional engineering

design issues, engineering construction issues, geotechnical issues, environmental/permitting issues, and issues of cost for operation and maintenance.

The main thrust of the workshops was the detailed review, on an item by item basis, of each issue on the worksheet for comparison of subjective issues and the development of a rating on a HIGH - MODERATE - LOW scale with HIGH signifying very difficult and LOW signifying relatively easy. See Appendix D-3 Alternative Comparison - Subjective Issues (Completed Worksheet).

Stakeholder Meeting

An additional meeting was held with the primary stakeholder for the project, Northshore Utility District. Participants in the stakeholder meeting were Janice Johnson - King County, Ron Gehrke - General Manager for Northshore Utility District, and John Giaudrone - Consultant.

During the stakeholder meeting, the findings of the draft report were shared with Northshore Utility District and comments were solicited. The Appendix D-1 Alternative Comparison - Fact Sheet was discussed. The Appendix D-3 Alternative Comparison - Subjective Issues (Completed Worksheet) was discussed in detail. Although the Swamp Creek Route would provide for the abandonment of the existing NUD local connecting sewer, the Northshore Utility District recognizes the risk from both an environmental and permitting standpoint.

Preferred Alternative

The preferred alternative is Alternative 2: 73rd Avenue NE Route. Although it has the higher cost ($8.2 Million), requires trenchless construction for 2,431 LF, and does not provide for the abandonment of the existing NUD local connecting sewer, it has the least environmental and permitting issues to overcome during the design and construction periods. This alternative provides the best opportunity to meet the proposed schedule for project completion. See Figures 5 and 6 for the plan and profile of the preferred alternative. See Appendix C for a planning level cost estimate for the preferred alternative.

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