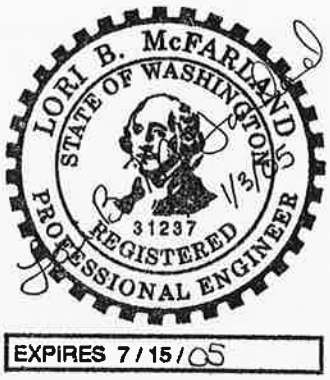
Harbour Reach
Extension Route Study

Prepared for:
City of Mukilteo
4480 Chennault Beach Road
Mukilteo, WA 98275



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Otak Project No. 30442

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Section 1 — Executive Summary

Project Background

The southern portion of the City of Mukilteo is isolated from the rest of the City by a deep ravine formed by Picnic Point Creek. It is connected to the Harbour Pointe area and the north city area only at the City's eastern boundary by State Route 525 (SR 525), also known as Mukilteo Speedway, and Saint Andrews Drive, a steep, curvy, residential street inadequate to handle heavy traffic. The Harbour Pointe area contains most of the City's services, including police and fire stations and other municipal facilities, schools, a library, recreational facilities, light industrial and commercial areas. To reach the Harbour Pointe area via SR 525, residents in the south must pass through the intersections with Beverly Park Road and Harbour Pointe Boulevard, both of which are heavily congested. As a result, many drivers use Saint Andrews Drive as an alternate route. The City has received many complaints of speeding and excessive traffic on this residential street and is therefore interested in developing a suitable alternate route. In addition, most of the City's future annexation area lies south of the City and experiences the same access problems.

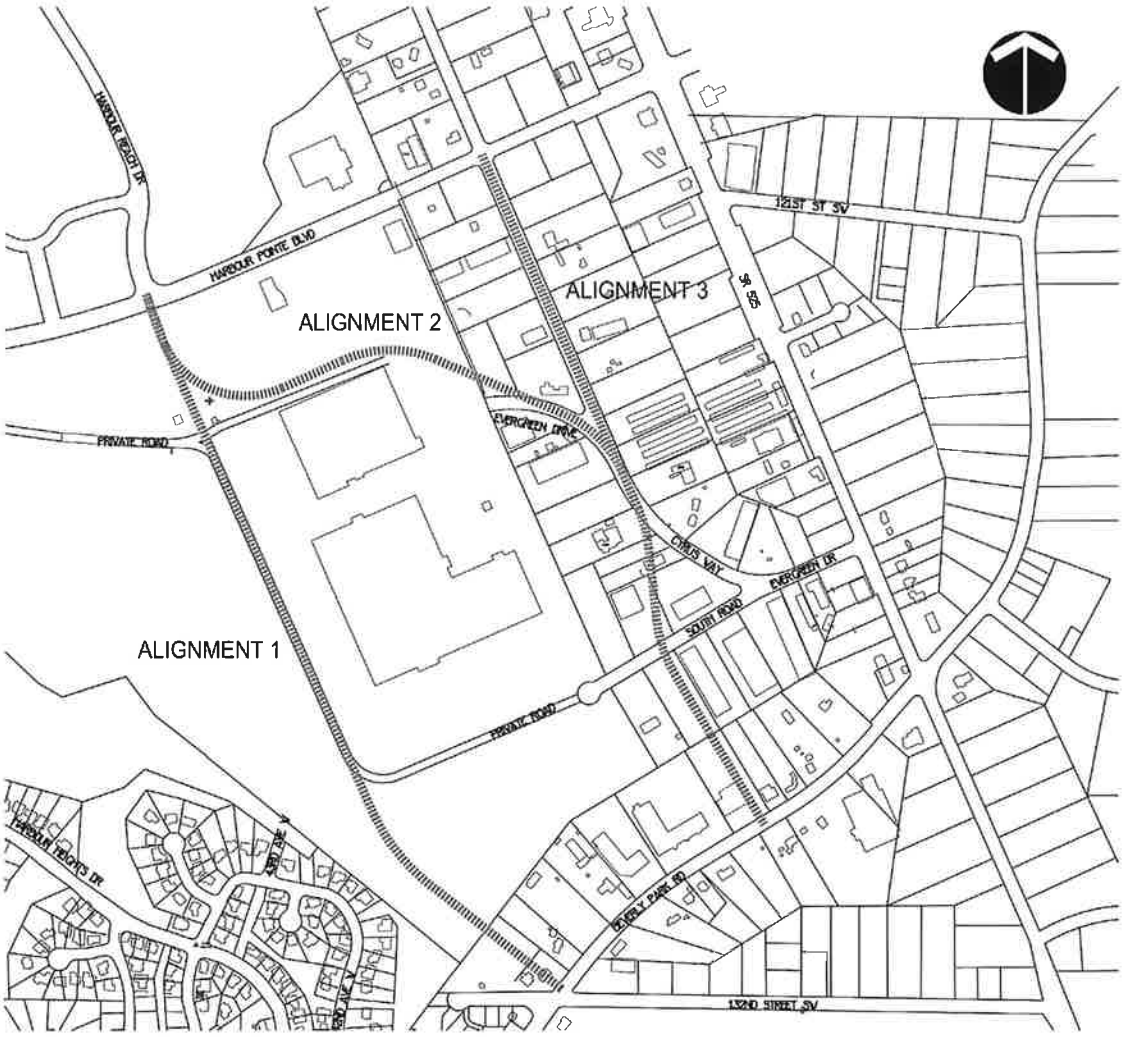
Congestion on SR 525 is projected to worsen, but additional widening is not considered feasible. The need for an alternate route has also been apparent in the City's emergency response planning. Any occurrence that congests or blocks SR 525 between Harbour Pointe Drive and Beverly Park Road significantly increases emergency response times to the south portion of the City. A new arterial is needed to reduce congestion on SR 525, benefiting Mukilteo and the surrounding region, including Whidbey Island, Everett, Snohomish County, and Paine Field.

Alignment Selection and Description

Alignments were selected to meet the City's goals of reducing congestion on SR 525, improving connectivity to the southern portion of the City for emergency response and improving access to schools, businesses, and other amenities, and protection of the residential character of the existing neighborhoods. Five possible alignments were identified. Two alignments were eliminated early because of failure to meet the project goals. The other three were evaluated based on roadway characteristics, geotechnical feasibility, environmental permitting feasibility and impacts, traffic considerations, stormwater requirements, required structures, right-of-way needs, and project cost.

The three alignments studied are shown in Figure 1 and are summarized below.

Figure 1 — Alignments 1, 2 & 3



Alignment 1
Beverly Park Road connection: 132nd Street SW
Harbour Pointe Boulevard connection: Harbour Reach Drive
Total length: 3,690 feet

Alignment 1 includes new roadway construction at the north and south ends. The middle portion makes use of approximately 1,500 feet of existing roadway, currently under private ownership. As part of a rezone agreement for Sector 20 of the Harbour Pointe Master Planned development, the property owner has committed to donate this portion of roadway plus other roadways and rights-of-way within its control.

A 300-foot three-span bridge is proposed for the crossing of the North Fork of Picnic Point Creek. Significant retaining walls are also required for Alignment 1.

Alignment 2
Beverly Park Road connection: Approximately 900 feet southwesterly of SR 525
Harbour Pointe Boulevard connection: Harbour Reach Drive
Total length: 4,250 feet

Alignment 2 includes new roadway construction at the north and south ends. The middle portion follows portions of Cyrus Way and Evergreen Drive. Cyrus Way would become the third leg of a tee-intersection. One portion of Evergreen Drive would become a dead end.

Alignment 2 crosses the North Fork of Picnic Point Creek, and a 320-foot three-span bridge is proposed for the crossing. Alignment 2 includes significant retaining walls.

Alignment 3
Beverly Park Road connection: Approximately 900 feet southwesterly of SR 525
Harbour Pointe Boulevard connection: Cyrus Way
Total length: 3,250 feet

Alignment 3 follows Alignment 2 from its southern connection at Beverly Park Road to the intersection of Cyrus Way and Evergreen Drive. Alignment 3 continues along Cyrus Way, rebuilding the profile to meet arterial standards. No bridge is necessary for Alignment 3, but significant retaining walls are required.

Alignment Evaluation

The evaluation of the three alignments is summarized in Table 1.

Table 1 — Summary of Alignment Evaluation

	Alignment 1	Alignment 2	Alignment 3	No-Build
Roadway Characteristics				
• Horizontal	Good	Poor	Good	---
• Vertical	Fair	Fair	Poor	---
• Access	Good	Poor	Poor	---
Geotechnical	Feasible	Feasible	Feasible	Feasible
Environmental	Feasible	Feasible	Feasible	Feasible
• Wetland Impact	Least impact	---	Most impact	No impact
• Stream Impact	Least impact	Most impact	---	No impact
Traffic				
• Operation	Good	Fair	Fair	Poor
• Capacity	Good	Fair	Fair	Poor
• Circulation	Good	Good	Fair	Poor
Right-of-way needs	Low impact	High impact	High impact	No impact
Project Cost	$10,040,000	$15,340,000	$9,400,000	Data unavailable

As the prime motivators for the project have been traffic-related, including emergency response, it follows that traffic-related measurements have the highest priority in determining the recommended alternative. Alignment 1 provides the best improvement to traffic operation, capacity, and circulation. It also rates well in the other categories evaluated as follows:

- Good roadway characteristics
- Geotechnically feasible
- Environmentally feasible with least impact of three alignments
- Right-of-way impacts are low
- Project cost is reasonable based on the product delivered

Recommendations and Implementation

Based on the evaluation of project goals, as well as considerations such as roadway characteristics, geotechnical feasibility, environmental feasibility and potential environmental impacts, traffic-related criteria and project cost, the recommended alternative is implementation of Alignment 1.

Alignment 1 connects to Beverly Park Road at 132nd Street SW on the south end and connects to Harbour Pointe Boulevard at Harbour Reach Drive on the north end. The proposed Alignment 1 adds 0.70 miles of new minor arterial and accomplishes all of the project goals, particularly reducing congestion on SR 525 (Mukilteo Speedway) and providing better connection to the south portion of the City.

Impacts from that project that will require mitigation include:

- Environmental impacts that will be addressed in detail during the environmental documentation phase of the project.
- Proximity of the new roadway to the Pacific Pointe development. Mitigation in the form of a landscaped earth berm is proposed to address added noise and aesthetics for the Pacific Pointe development.
- Added traffic to 132nd Street SW. Proposed mitigation limits turning movements at the Beverly Park Road/Harbour Reach Extension intersection by essentially making the 132nd Street SW connection right in/right out at this point. It preserves the connection to SR 525.

The project cost is estimated at $10,040,000, assuming construction in 2007-08. Several factors, such as available funding, may delay construction of the project and inflation factors should be added to the project cost to account for any schedule adjustments. Because the project benefits a greater region by reducing congestion on SR 525 and Snohomish County roads, it is likely to be considered favorable to other agencies for funding partnerships. Requests for partnership and funding should be made to Snohomish County, Washington State Department of Transportation, Washington State Transportation Improvement Board, Puget Sound Regional Council, and various federal funding programs.

Section 2 — Introduction

Having recognized a need for improved connectivity in its south end, the City of Mukilteo has directed Otak Inc. to prepare a route study for the addition of a minor arterial linking Harbour Pointe Boulevard with Beverly Park Road or Picnic Point Road. Otak has gathered a project team including subconsultants Transportation Engineering Northwest (TENW) to assist with traffic projections and analysis, and Jones & Stokes Associates (JSA) for assistance on environmental topics. Otak's team also coordinated with the City's on-call geotechnical consultant, Zipper Zeman Associates, Inc. (ZZA).

The project is listed as a capacity project in the City's Transportation Plan, approved by City Council on April 5, 2004. Council also approved the initial route study as part of the 2004 budget.

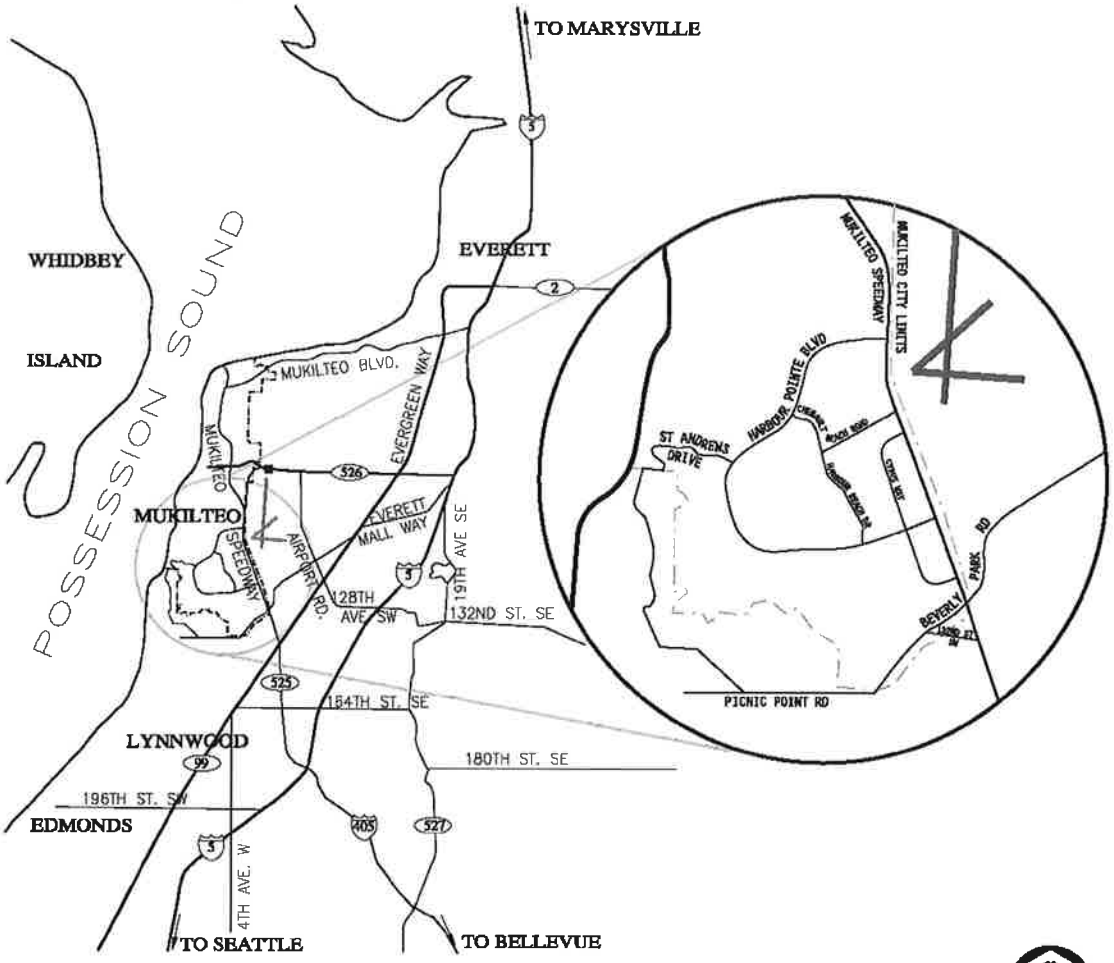
The objectives of the study will be to delineate and provide preliminary analysis of three alignments, as well as a No-Build alternative. Analysis will include identification of environmental, permitting, geotechnical and traffic issues; right-of-way needs; and the preparation of a detailed planning-level cost estimate. This report will summarize and document the findings of this study and recommend a preferred alternative. The report will assist the City in planning and procuring funding for the project. It will also assist right-of-way acquisition, preliminary engineering efforts and it will provide a guide to addressing environmental issues and permitting.

Project Background

The City of Mukilteo, located in south Snohomish County, is bordered on the east by the City of Everett, on the south by unincorporated Snohomish County, and on the north and west by Possession Sound. Especially in the southern portion of the City, streams feeding into the Sound have created deep ravines that divide the City into isolated pockets of developed areas, connected at the City's eastern boundary by SR 525.

The southernmost of these ravines has been carved by Picnic Point Creek which extends to SR 525, more than 2.5 miles inland. The ravine is crossed in only one location by Picnic Point Road, less than one-half mile from its outlet to the Sound. Picnic Point Road connects to Harbour Pointe Boulevard via Saint Andrews Drive.

Figure 2 — Vicinity Map



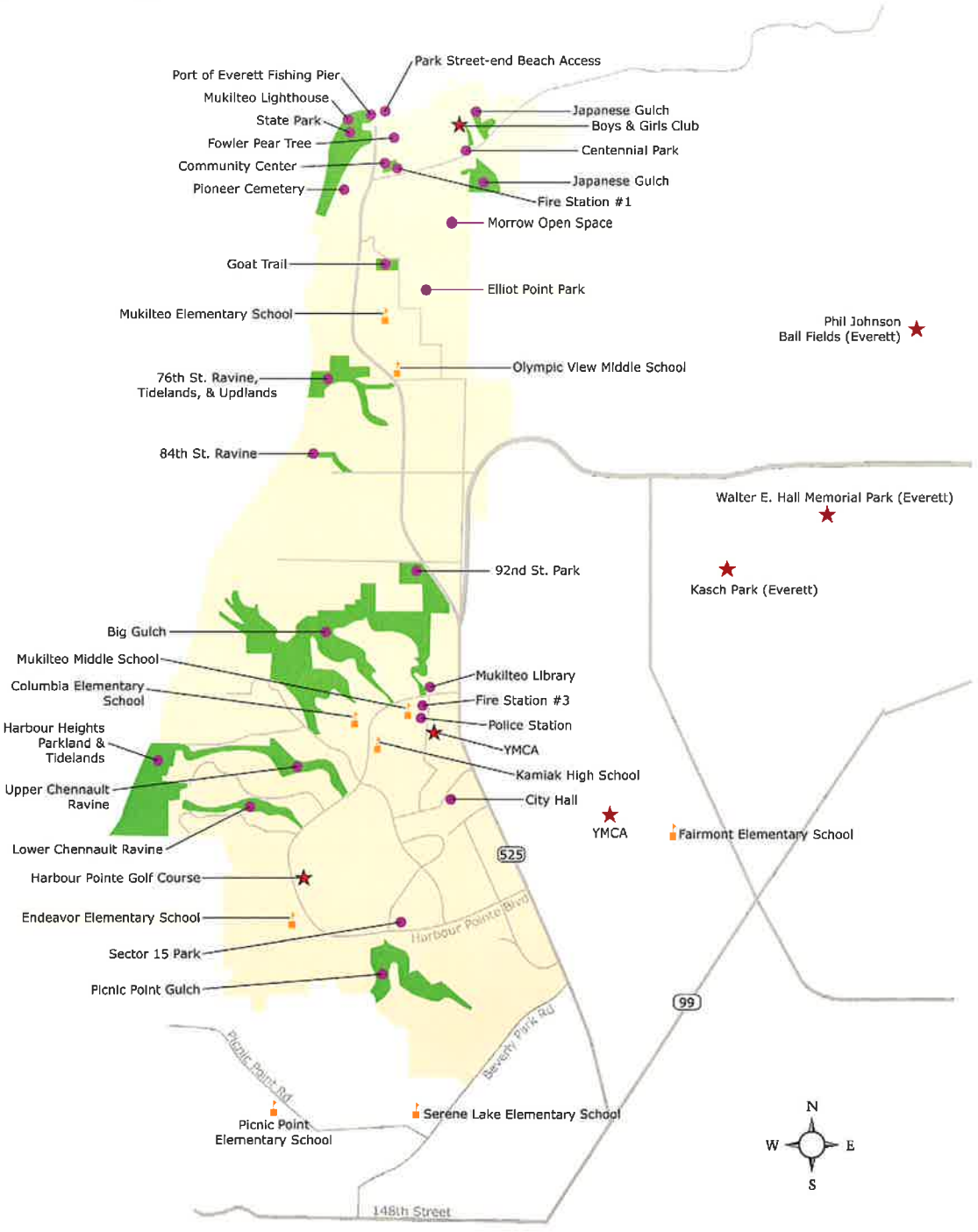
VICINITY MAP

Because of the ravine, only SR 525 and Saint Andrews Drive connect the southernmost portion of the City and the Harbour Pointe area where most of the City's services, including municipal facilities, schools, a library, recreational facilities, light industrial and commercial areas, are located. City services are shown in Figure 3.

To reach the Harbour Pointe area via SR 525, residents in the south must pass through the intersections with Beverly Park Road and Harbour Pointe Boulevard, both of which are heavily congested. As a result, many use Saint Andrews Drive, a steep, curvy, residential street poorly equipped to handle heavy traffic, as an alternate route. The City has received many complaints of speeding and excessive

traffic on this residential street and has been interested in developing a suitable alternate route.

Figure 3 — City Services



It is estimated that 1,000 Mukilteo residents are currently affected by poor access. The situation will only grow worse as the City annexes its urban growth areas. Most of the City's future annexation area lies south of the City and experiences the same access problems. The annexation area is bounded on the west by Possession Sound, on the south by 148th Street SW, and on the east by SR 99/Airport Road. This area will support an additional 11,000 residents as build-out is reached in approximately 2025.

The same area is approximately twelve percent of the area served by the Mukilteo School District. When contacted, the school district estimated that as many as 28 buses would likely use the new arterial to avoid SR 525 during the morning rush hour.

The need for an alternate route has also been apparent in the City's emergency response planning. Any occurrence that congests or blocks SR 525 between Harbour Pointe Drive and Beverly Park Road significantly increases emergency response times to the south portion of the City.

The 2004 City of Mukilteo Transportation Plan adopted April 5, 2004 documented that without the extension of Harbour Reach Drive, the level of service (LOS) at the two key intersections of SR 525 will reach LOS F by year 2020. Additional widening of SR 525 is not considered to be feasible. A new arterial will be needed to reduce congestion on SR 525, benefiting Mukilteo and the surrounding region, including Whidbey Island, Everett, Snohomish County, and Paine Field.

Project Goals

Project goals were developed with the assistance of City of Mukilteo staff to be consistent with City planning policies. The goals are listed below in order of precedence.

1. Improve the level of service at the intersections of SR 525 (Mukilteo Speedway) with Beverly Park Road and Harbour Pointe Boulevard.
2. Improve connectivity for emergency response to the south portion of the City.
3. Improve connectivity and convenience for citizens and others reliant on Mukilteo services to the urban activity center in the master-planned Harbour Pointe mixed-use area.
4. Increase connectivity to commercial/industrial areas.
5. Improve pedestrian connection for the south portion of the City.

6. Protect quality of residential areas by minimizing project impacts to surrounding neighborhoods.

These goals will be used to compare alternatives and select the recommended alternative.

Section 3 — Area of Study

Area of Route Study

For a new arterial to draw enough traffic away from SR 525 and significantly reduce congestion, it has to be placed in an advantageous location. Looking at the overall area, it must connect to Beverly Park Road on the south end, rather than Picnic Point Road in order to be attractive to the majority of residents in the area south of Picnic Point Creek. This rationale narrowed the area considered in this route study in the westerly direction. It was further determined that alignments east of Cyrus Way would not be considered because the proximity to SR 525 would cause inefficiencies in traffic operation because queues at traffic signals would overlap and producing a negative impact on level of service.

Connection Points

For the new arterial to operate well, signalized intersections will be required at both ends. There are no signalized intersections or other points along Beverly Park Road that provide a clear advantage for connection to the new arterial roadway. The Beverly Park connection point should be selected to provide good alignment characteristics and to minimize impacts on land use.

Harbour Pointe Boulevard on the north end of the proposed arterial is currently signalized at Harbour Reach Drive and Cyrus Way. There are no other locations along Harbour Pointe Boulevard that provide a clear advantage for connection to the proposed arterial.

Harbour Reach Drive extends between Harbour Pointe Boulevard and Chennault Beach Road, with Chennault Beach Road continuing to the northern side of the Harbour Pointe Boulevard Loop. It is a minor arterial with a posted speed limit of 35 mph. Its horizontal alignment is gently curving and flat. It provides an effective entrance from residential areas into the area bounded by Harbour Pointe Boulevard and SR 525 that contains municipal facilities, schools, a library, recreational facilities, and light industrial and commercial areas.

Figure 4 — Aerial View

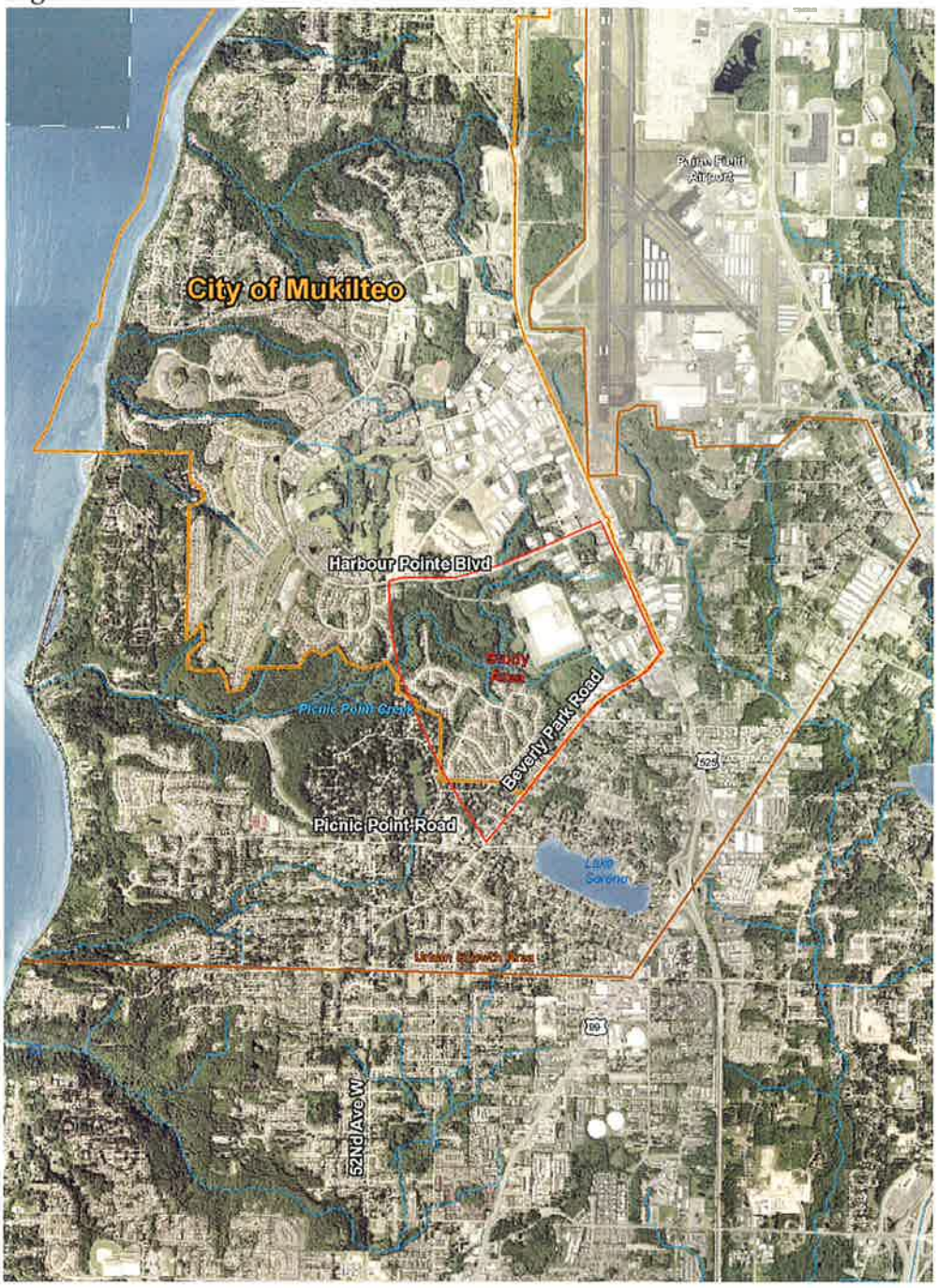


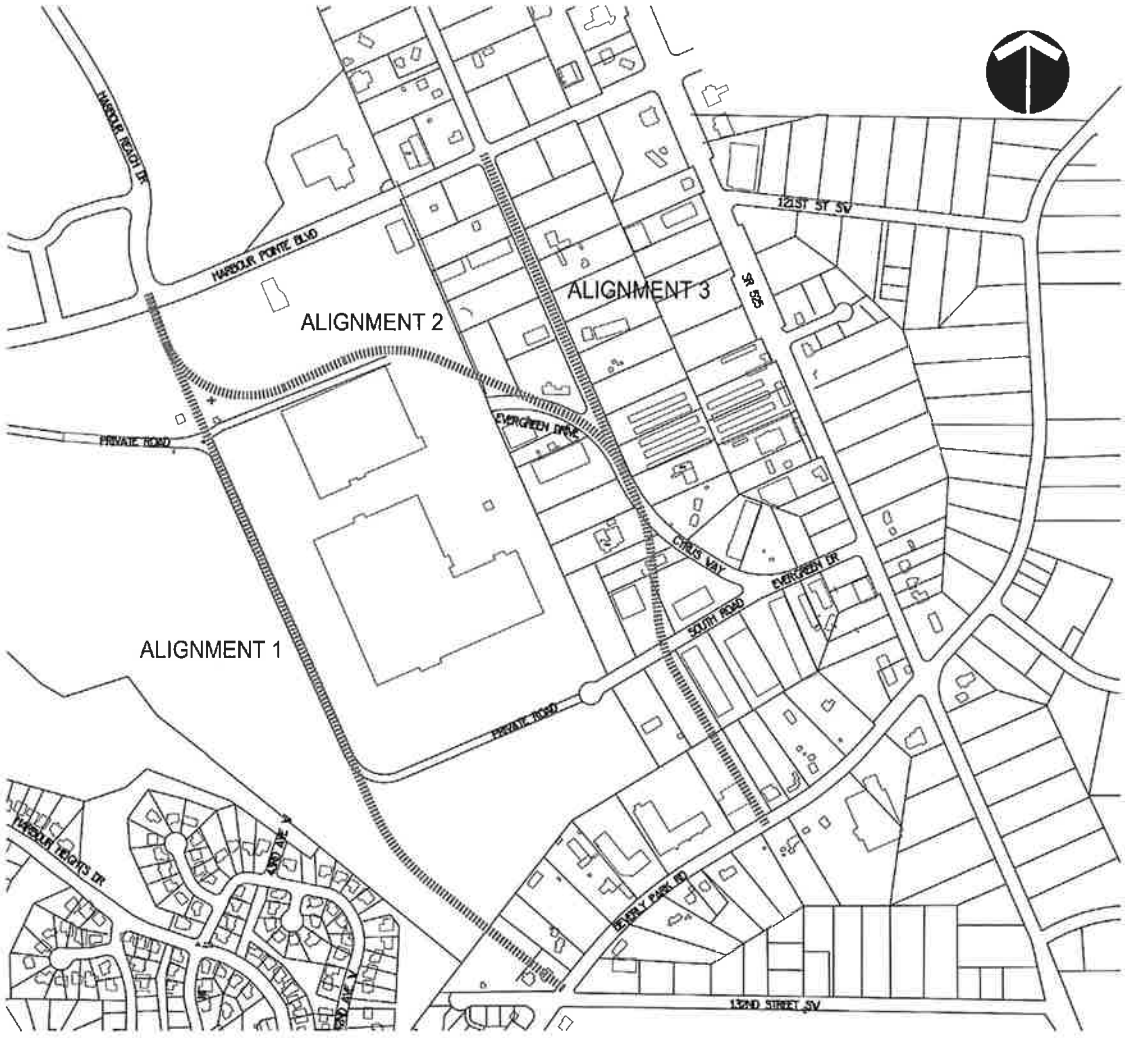
Photo 1 — Looking South at intersection of Harbour Reach Drive and Harbour Pointe Boulevard

Section 4 — Alignment Description and Selection

Alignment Descriptions

Using mapping derived from aerial photography, Alignments 1, 2 and 3 were chosen for study, all meeting the project goals with varying degrees of success, as quantified later in this report. The alignments are shown in plan view in Figure 5 and in detail on plan/profile sheets in Appendix A. The following sections describe the primary features of Alignments 1, 2 and 3.

Figure 5 — Alignments 1, 2 & 3



Section 4 — Alignment Description and Selection

Continued

Alignment 1

Beverly Park Road connection: 132nd Street SW
Harbour Pointe Boulevard connection: Harbour Reach Drive
Total length: 3,690 feet

Table 2 — Alignment 1 Features

Approximate Station	**Alignment 1 Feature**
10+00	New signal at intersection of Beverly Park Road and 132nd Street SW
10+00 to 14+25	Slopes downward at approx. 2%, berm to be constructed on left to buffer impacts to Pacific Point housing development
14+25	New intersection with Pacific Place to access Pacific Point housing development
14+25 to 23+55	Gentle curve to right and downward slope of approx. 10%. Exact alignment still to be determined in this area — to maximize useable area, minimize neighborhood impacts and cost. Alignment hugs side of hill, and crosses intermittent stream using bottomless arch culvert
23+55	New intersection with South Road
23+55 to 40+35	Flat grade, uses existing private roadway
40+35	New intersection with unnamed existing private road, to serve future housing development
40+35 to 46+90	Upward slope of approx. 3%, crosses N. Fork Picnic Point Creek and associated wetland with three span bridge
46+90	Existing signal modified for new 4th leg of intersection at Harbour Pointe Boulevard and Harbour Reach Drive

Photo 2 — Existing private roadway Stations 23+55 to 40+35

Section 4 — Alignment Description and Selection

Continued

Alignment 2

Beverly Park Road connection: Approximately 900 feet southwesterly of SR 525
Harbour Pointe Boulevard connection: Harbour Reach Drive
Total length: 4,250 feet

Table 3 — Alignment 2 Features

Approximate Station	**Alignment 2 Feature**
10+00	New signal at Beverly Park Road approx. 900 feet west of SR 525
10+00 to 19+00	Slopes downward at approx. 2% to 8% across currently undeveloped private property. Including filling approx. 0.43 acres of wetland and buffer. Will require mitigation.
19+00	New intersection with South Road
19+00 to 25+00	Gentle curve to right and flat slope, across private property with existing light industrial businesses
25+00 to 29+80	Follows existing Cyrus Way alignment. South of this section, Cyrus Way will be deadended to serve adjacent parcels only. South Road will be the through route to SR 525.
29+80	The new arterial will curve left to follow Evergreen Drive, and a new T-intersection will be formed with the northerly portion of Cyrus Way as the third leg.
29+80 to 47+40	Arterial follows Evergreen Drive right-of-way for a distance of approx. 300', then proceeds across private property, and parallels a private access road, hugging a hillside. Includes filling approx. 0.35 acres of wetland and buffer. Will require mitigation.
47+40	New intersection with existing unnamed road to serve existing and future industrial properties, and future housing development
47+40 to 52+50	Arterial curves sharply to right and crosses N. Fork of Picnic Point Creek and associated wetland with three span bridge
52+50	Existing signal modified for new 4th leg of intersection at Harbour Pointe Boulevard and Harbour Reach Drive

Photo 3 — Alignment 2 parallels this private drive on the opposite side of the fence

Alignment 3

Beverly Park Road connection: Approximately 900 feet southwesterly of SR 525
Harbour Pointe Boulevard connection: Cyrus Way
Total length: 3,250 feet

Alignment 3 is identical to Alignment 2 from the intersection with Beverly Park Road to the intersection of Evergreen Drive.

Table 4 — Alignment 3 Features

Approximate Station	**Alignment 3 Feature**
10+00	New signal at Beverly Park Road approx. 900 feet west of SR 525
10+00 to 19+00	Slopes downward at approx. 2% to 8% across currently undeveloped private property. Including filling approx. 0.43 acres of wetland and buffer. Will require mitigation.
19+00	New intersection with South Road
19+00 to 25+00	Gentle curve to right and flat slope, across private property with existing light industrial businesses
25+00 to 29+80	Follows existing Cyrus Way alignment. South of this section, Cyrus Way will be deadended to serve adjacent parcels only. South Road will be the through route to SR 525.
29+80	The new arterial continues north on Cyrus Way, and the intersection of Cyrus Way and Evergreen Drive is reconstructed to form a T-intersection.
29+80 to 42+50	Arterial follows Cyrus Way modifying existing grades to improve sight distance. Includes filling approx. 0.35 acres of four wetlands and buffers. Will require mitigation.
42+50	Existing signal requiring minimal modifications at Harbour Pointe Boulevard and Cyrus Way

Photo 4 — Looking south on Cyrus Way Stations 29+80 to 42+50

Two other alignments (Alignment 4 and Alignment 5) were also examined, and eliminated early in the process based on failure to meet project goals as described later in this chapter. Alignments 4 and 5 make use of existing residential streets in the Faire Harbour housing development.

Converting existing residential streets to minor arterial usage is problematic for several reasons. The streets have been constructed to residential standards with narrower lane widths, on-street parking, closely spaced driveways, lesser pavement thickness, and less stringent sight distance requirements than would be required for a minor arterial roadway. The increase in traffic and noise and loss of safety for pedestrians would also likely outrage the neighborhood if the projected 10,000 vehicles per day were added.

Alignment 4
Beverly Park Road connection: Harbour Heights Drive
Harbour Pointe Boulevard connection: Harbour Reach Drive
Total length: 4,300 feet

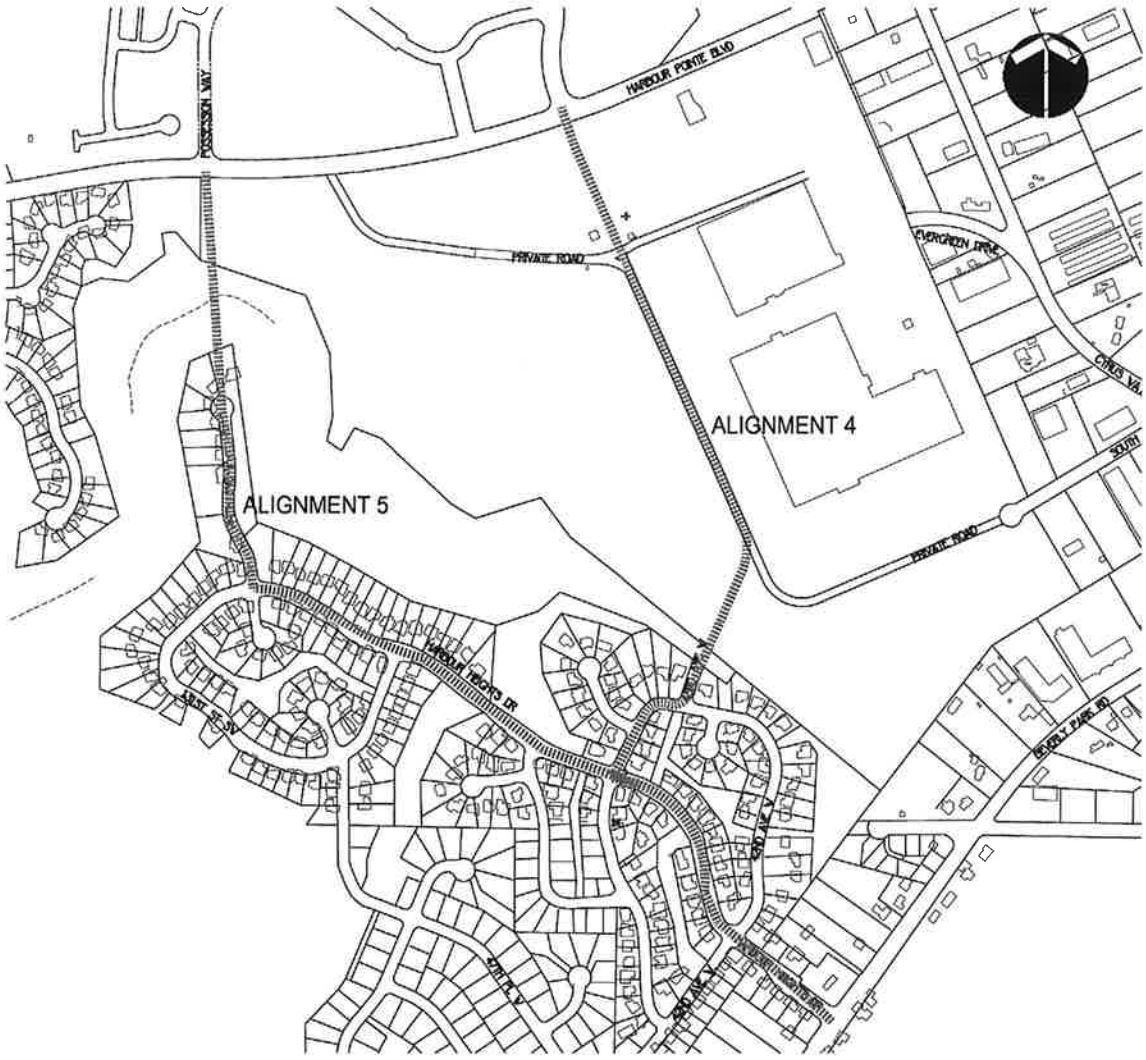
Alignment 4 follows Harbour Heights Drive for approximately 1,500 feet. It then turns northeast onto 43rd Avenue W. After 500 feet, 43rd Avenue W ends and new roadway continues northeast to meet an existing private road at the intersection with South Road. Alignment 4 is identical to Alignment 1 from that point to Harbour Reach Drive. A new signal would be required at the Beverly Park connection point.

Alignment 5
Beverly Park Road connection: Harbour Heights Drive
Harbour Pointe Boulevard connection: Possession Way
Total length: 5,300 feet

Alignment 5 follows Harbour Heights Drive for approximately 4,300 feet to the end of the road. It then continues northerly to intersect Harbour Pointe Boulevard at the intersection of Possession Way. A new signal would be required at both connection points.

Alignments 4 and 5 through the Faire Harbour development are shown in Figure 6.

Figure 6 — Eliminated Alignments



A final alternative is the No-Build alternative, in which no arterial would be added, leaving traffic to use congested SR 525 or residential Saint Andrews Drive.

Comparison of Alignments with Project Goals

All alignments identified and the No-Build alternative are compared against project goals in Table 5. The project goals are repeated here for convenience to the reader.

1. Improve the level of service at the intersections of SR 525 (Mukilteo Speedway) with Beverly Park Road and Harbour Pointe Boulevard.
2. Improve connectivity for emergency response to the south portion of the City.

3. Improve connectivity and convenience for citizens and others reliant on Mukilteo services to the urban activity center in the master-planned Harbour Pointe mixed-use area.
4. Increase connectivity to commercial/industrial areas.
5. Improve pedestrian connection for the south portion of the City.
6. Protect quality of residential areas by minimizing project impacts to surrounding neighborhoods.

Ratings are based on a scale of 1 to 5, with 1 being the poorest and 5 the best.

Table 5 — Alignment Ratings

Project Goals *(listed in order of precedence)*	**Alignment**					**No Build**
	1	**2**	**3**	**4**	**5**	
LOS at SR 525 intersections	5	5	4	3	2	1
Emergency response	5	3	2	3	2	1
Public access to urban center	5	4	3	3	3	1
Connection to commercial/ industrial area	4	5	3	2	1	1
Pedestrian connection to south end of City	5	2	2	3	3	1
Protect residential areas	4	5	5	1	1	1
Total Points	**28**	**24**	**19**	**15**	**12**	**6**

Alignments 1, 2 and 3 were found to accomplish project goals sufficiently to justify further study, whereas Alignments 4 and 5 did not, and will not be addressed further in this report. The No-Build alternative also does not accomplish project goals significantly but this report will continue discussion as appropriate to assist in future permitting efforts.

Alignments 1, 2 and 3, as well as a No-Build alternative were further developed and evaluated with respect to roadway characteristics, geotechnical issues, environmental and permitting issues, traffic analysis, stormwater requirements, required structures, right-of-way needs, and project cost, as discussed in the following sections.

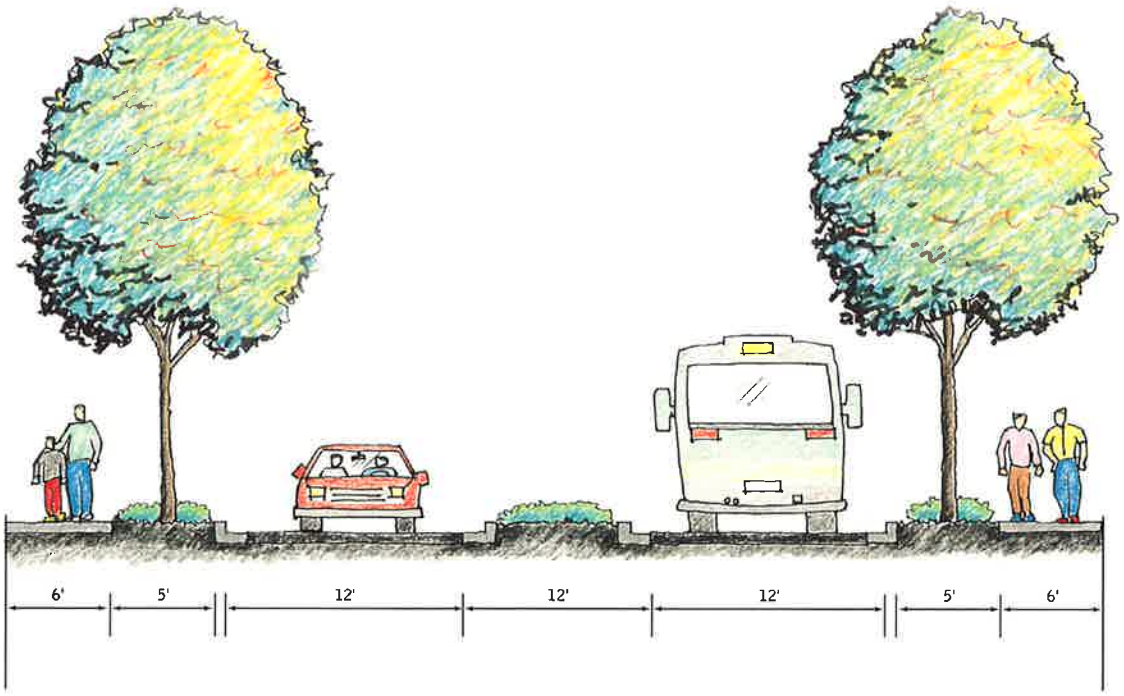
Section 5 — Alignment Evaluation

Alignment Criteria

The new roadway will be designed as a minor arterial with a posted speed of 35 mph and a design speed of 40 mph. Generally, Washington State Department of Transportation (WSDOT) design methods will be used, except where Mukilteo has an applicable standard in place, or WSDOT standards are inappropriate for urban application. Depending on funding sources, the project may be required to meet the Local Agency Guidelines published by WSDOT.

The proposed roadway section, shown in Figure 7 will be two 12-foot travel lanes, a 12-foot left turn lane/planted median, curb/gutter, 5-foot planter strip adjacent to curb where space permits, and six-foot sidewalks on both sides, though variances are anticipated in areas where lots are fully developed or to conform with existing developer agreements. The planter strip may be eliminated when provision of such is onerous, but will be mitigated by widening the sidewalk to seven feet. Wherever possible, the proposed right-of-way width will be 80 feet. Retaining walls will be needed for all three alignments, but will only be constructed when slopes cannot be accommodated within right-of-way or slope easements.

Figure 7 — Typical Roadway Section



Roadway Characteristics

Horizontal Alignment

Alignments 1 and 3 easily meet the horizontal alignment design criteria. Both are also relatively straight with few curves required.

Alignment 2 requires several curves. For Alignment 2, it is not feasible to meet the design speed of 40 mph in the horizontal curve between Stations 47+40 and 52+50. For this section of roadway, a warning sign would be posted reducing the speed by 5 mph to 30 mph.

Vertical Alignment

All three alignments require a steep grade to transition from the elevation of Beverly Park Road to the terrain to the north. Alignment 1 descends eighty feet at a grade of 10%. Alignments 2 and 3 descend forty feet at an 8% grade.

After the descent, Alignments 1 and 2 are relatively flat. Alignment 3 is also flat for a distance of 1,000 feet, but then has a sizable dip before flattening out to meet Harbour Pointe Boulevard. The dip is necessary to provide feasible tie-ins to existing driveways. The profile shown minimally achieves adequate stopping sight distance requirements.

Access

Alignment 1 requires less driveway access than Alignments 2 or 3. This is a distinct advantage since it is desirable to have fewer access points on minor arterials for safety and traffic operations purposes. Alignment 1 will have three intermediate intersections and approximately four driveways when all adjacent properties have developed. Alignment 2 will also have three intermediate intersections, but may have up to twenty driveways. Alignment 3 will have only two intermediate intersections but as many as thirty driveways could require access to the arterial.

Geotechnical Considerations

General

A geotechnical assessment of the alternatives was performed by Zipper Zeman Associates, Inc. (ZZA) dated August 12, 2004 and is included in Appendix D. Site conditions were evaluated by reviewing published geologic maps, reviewing geotechnical reports prepared by ZZA and others that describe conditions in the site vicinity, and by observing surface conditions during a field reconnaissance.

The site vicinity is predominantly underlain at shallow depths by Vashon lodgement glacial till. Secondary surficial recessional outwash deposits and fill material have been documented along the alignments. Recent alluvium is present within the ravine features. Granular advance outwash deposits underlie the glacial till at depths of 10 to 60 feet. Discontinuous groundwater perched above or within the glacial till has been documented at variable depths in the project vicinity. The regional groundwater table is generally within the advance outwash deposits below the glacial till.

The alignments lack evidence of significant erosion or landsliding, including the ravine features located at the southern and northern portions of the site vicinity. The lodgement glacial till will be well suited for support of bridge, retaining wall, and culvert foundations.

Road subgrade improvement is likely to be required in areas underlain by recent alluvium, significantly weathered glacial till, and in areas of undocumented fill. It would be feasible from the geotechnical perspective to use the native glacial till and outwash deposits as structural fill, although the till is moisture-sensitive and grading with the till soils will only be feasible during periods of extended dry weather unless soil amendments such as cement or kiln dust are used.

Seismic Conditions

Figure 16-2 presented in the 1997 Uniform Building Code classifies the subject site as being within Seismic Zone 3. Based on the subsurface conditions encountered at the site and published geologic literature, a Soil Profile Type of S_C should be used to describe average properties of soil within the upper 100 feet beneath the site. This designation describes soils that are considered very dense with shear wave velocities in the range of 1,200 to 2,500 feet per second, Standard Penetration Test values greater than 50, and an undrained shear strength greater than 2,000 psf.

The underlying glacially consolidated soils (glacial till, advance outwash) are quite dense and would not be susceptible to liquefaction during a seismic event. The normally consolidated alluvium may liquefy during a seismic event, and result in settlement of structures or embankments built above these soils. In these areas, subgrade improvement will be required to prevent liquefaction.

The largest earthquakes that have occurred in the Puget Sound region are generally sub-crustal events with epicenters ranging from about 30 to 42 miles deep. For this reason, surficial faulting, or earth rupture, as a result of deep seismic activity is typically not observed in the Puget Sound Region. The project site is located approximately one mile south of the projected trace of the South Whidbey Island

fault. The recurrence interval of movement along this fault system is still unknown, although it is hypothesized to range from hundreds of years to several thousand years. Due to the suspected long recurrence interval, the potential for surficial ground rupture at the site is considered to be low during the expected life of the project.

Surface Conditions

Conditions observed along the alignments during a surface reconnaissance are referenced to the centerline stationing shown on the plan and profile drawings. The feature locations should be considered approximate as the alignments had not been field staked prior to the reconnaissance.

Table 6 — Surface Conditions

	Approximate Station	Alignment Feature
Alignment 1	10+00 to 14+50	Alignment passes through previously graded residential properties
	14+50 to 19+50	Slope lacks evidence of significant erosion or instability. Groundwater seepage on the slope was not observed. The alignment borders a graded slope along this interval; the grass-covered slope has an inclination of approximately 50 percent (2H:1V) and lacks surficial evidence of erosion or instability. Groundwater seepage was absent as well during our reconnaissance. The slope was reportedly graded in the early 1990s.
	19+50 to 21+00	The alignment passes through an irregularly surfaced, moderately wooded area. The presence of irregular topography, nested boulders, and numerous saplings suggests that this area had been graded in the not too distant past.
	21+00 to 24+00	This portion comprises the lowermost portion of the South Ravine. The slopes lack evidence of erosion or instability, and groundwater seepage was absent during the site visit. Weathered glacial till was observed in shallow excavations. The ravine floor contains two shallow drainage pathways, one of which was dry at the time of the site visit. The flow paths are only mildly incised into recent alluvial deposits of sand, silt, fine gravel, and some organic materials. North of the South Ravine, the alignment passes through a graded and sparsely wooded slope and level area that abut the existing access road that extends along the west side of the Boeing complex. Sand and gravel were observed on the surface in this area; topography suggests that it is likely fill material.
	24+00 to 42+00	The alignment follows the existing Boeing access road. The existing road spans drainages and the grade separation is achieved by high concrete walls that extend below the road on both sides. The walls lack evidence of distress and no evidence of erosion at the bottoms of the walls was observed.
	42+00 to 46+50	The ravine slopes and floor are moderately to densely wooded. The slope inclinations on the south side are on the order of 20 percent, and are slightly steeper on the north side — on the order of 30 percent. Shallow excavations on the slopes disclosed weathered glacial till. Both the north and south side slopes lack evidence of significant erosion, instability, and groundwater seepage. There is a moderately sized alder grove on the north side of the ravine, and the

		presence of these trees may be indicative of some past shallow instability. However, the ground surface does not reflect soil movement of significant depth. The ravine floor contains a well-defined flow path (Picnic Creek) that is only mildly incised into the recent alluvium and underlying glacial till that mantle the ravine floor.
Alignment 2	10+00 to 19+00	Alignment 2 follows a descending path through graded and grass-covered residential and commercial properties.
	19+00 to 25+00	The alignment passes through developed commercial properties that have been subject to past grading; this developed portion of the alignment extends to the intersection with Cyrus Way. A steep slope approximately 10 to 16 feet high is located between approximately STA 20+25 and STA 22+50 alongside one of the commercial buildings within the alignment. The topography in the developed area suggests the presence of fill material.
	25+00 to 35+00	Alignment 2 follows Cyrus Way then Evergreen Drive to near its western terminus at the east end of the Boeing property. The alignment passes through areas that have been cut and filled in the past. Weathered glacial till soils were observed in cut exposures along the north side of Evergreen Drive. The alignment passes through a gently sloping wooded rise between approximately STA 33+00 (where the alignment leaves Evergreen Drive) and STA 35+00 (the east side of the Boeing property).
	35+00 to 47+50	Alignment 2 skirts the north side of the Boeing property, passing through a moderately to densely wooded area. The south side of the right-of-way shown on the plans passes through cut and fill sections on the Boeing property, including a high concrete wall located on the property line between approximately STA 36+20 and STA 38+80. The concrete wall lacks evidence of distress. Topography and stands of young alder saplings between approximately STA 38+50 and STA 43+20 suggest that portions of the alignment were graded in the not too distant past, most likely in association with construction of the Boeing facility. Much of this portion of the alignment slopes down toward the North Ravine at inclinations ranging from approximately 18 to 36 percent. The slopes lack evidence of significant erosion or instability, and also lack groundwater seepage.
	47+50 to 51+90	Alignment 2 crosses the North Ravine in essentially the same location as the north end of Alignment 1, and conditions are similar.
Alignment 3	10+00 to 25+00	The southern portion of Alignment 3 is the same as Alignment 2 from Beverly Park Road to the intersection with Cyrus Way.
	25+00 to 42+50	Cyrus Way portion of the alignment passes through a substantial dip before climbing to a relatively level area that extends to the intersection with Harbour Point Boulevard. The dip slopes are inclined at approximately 12 to 13 percent. Developed commercial properties line both sides of the road and there is no surficial evidence of significant erosion, instability, or groundwater seepage along the alignment.

Based upon the document review, field reconnaissance, and experience with other projects of a similar nature, it appears that construction of Harbour Reach Extension along any of the three potential alignments would be feasible from the geotechnical perspective. Soil and groundwater conditions are generally favorable

for grading, as well as for support of structure foundations. The existing slopes along portions of the alignments are not anticipated to present particular difficulties in terms of stability, and in most cases the slopes are not so steep as to present challenges to the operation of construction equipment.

Geotechnical Considerations — Environmentally Critical Areas

Chapter 17.52, *Critical Areas Regulations*, of the Mukilteo Municipal Code defines regulated geologic hazard sensitive areas in terms of "critical slopes". Critical slopes are characterized in terms of the potential risk of erosion or landsliding based upon the combination of soil type, slope inclination, and the presence or absence of groundwater seepage. The Code requires geotechnical evaluation of potentially critical slopes (slopes with inclinations 20 percent or greater) depending upon these factors, as illustrated in Table A, *Decision Flow Chart*, in Chapter 17.52.

Critical slopes along the three alignments are summarized below. It should be noted that although the Code may not specifically call for site-specific geotechnical evaluations in some locations in regard to evaluating critical slopes, such evaluations would be warranted during the road design phase in order to evaluate subgrade conditions and soil types as part of an overall geotechnical evaluation.

Geologic Critical Areas — Alignment 1

Slopes with inclinations of 20 percent are present at the south end of Alignment 1 between approximately STA 14+50 and STA 19+50. Considering the anticipated presence of glacial till soils, and the absence of groundwater seepage, specific geotechnical evaluation related to the slopes would not be required by the Code. Considering the apparently graded 50 percent slope adjacent to the alignment between approximately STA 15+50 and STA 19+50, the Code could require a location-specific geotechnical evaluation. The sideslopes of the South Ravine are less than 20 percent and are anticipated to be underlain by glacial till; the Code would not require a site-specific geotechnical evaluation. The North Ravine sideslope inclinations ranged from approximately 20 to 30 percent and are also anticipated to be underlain by till; the Code would not require a site-specific geotechnical evaluation.

The *City of Mukilteo Critical Areas Landslide Hazard Map* indicates that the portion of Alignment 1 extending from Beverly Park Road to approximately STA 14+50 has been mapped as a *Moderate Landslide Hazard* area, while the interval from approximately STA 14+50 to STA 24+00 (the intersection of Alignment 1 with the access road along the west side of the Boeing complex) has been mapped as a *High*

Landslide Hazard area. More recent United States Geological Survey mapping designates these same areas as having a low landslide hazard risk.

Geologic Critical Areas — Alignment 2

The Code would require a site-specific geotechnical evaluation of the steep slope located between approximately STA 20+25 and STA 22+50 since its inclination exceeds 40 percent. The remainder of the slopes are inclined at less than 40 percent, are anticipated to be underlain by glacial till, and would not require site-specific evaluations relative to critical slopes according to the Code criteria.

Geologic Critical Areas — Alignment 3

The only critical slope area along Alignment 3 is the steep slope located between approximately STA 20+25 and STA 22+50 on the commercial property at this location. The Code would require a site-specific geotechnical evaluation of this slope.

Additional Geologic Considerations

Alignment 1 will incorporate the existing access road along the west side of the Boeing facility. Portions of the road are supported by fill embankments contained by concrete walls of considerable size. Culverts pass below the road as well. If Alignment 1 is selected as the preferred alternative, it would be prudent to review the design and construction records for the retaining walls in order to verify that the walls' integrity is adequate for the intended future purpose and to verify that they do not possess some shortcomings that the City may be required to rectify. In addition, there would be value in assessing the condition of the culverts below the road in order to verify their condition and to identify potential future maintenance requirements or capacity shortcomings. The existing wall located along the north end of the Boeing facility may require evaluation as well, given its proximity to Alignment 2.

Environmental Considerations

A critical areas reconnaissance was performed by Jones & Stokes dated July 27, 2004, and revised December 28, 2004 for Alignments 1, 2 and 3. A technical memorandum of their findings is included as Appendix B. The reconnaissance identified the approximate boundaries of critical areas (wetlands and streams). It also assessed wetland and stream classification and identified any fatal flaws associated with each alternative in relation to potential environmental impacts. The reconnaissance report also discussed federal, state and local environmental permitting considerations. Following is a discussion of the results of the reconnaissance, advantages and disadvantages of each alignment from an

environmental and permitting perspective, and an overview of applicable permit actions that may be necessary for project implementation.

Nine wetlands and three streams were identified within the three alternative alignments. Resources associated with each alignment were given a specific identifier. For example, wetlands associated with Alignment 1 and Alignment 2 would be identified as W1-1 and W2-1 respectively. Several of these resources occur within multiple alignments due to alignment overlap. Tables 7 and 8 summarize wetland and stream resources identified per alignment. Proposed revisions to the City of Mukilteo Critical Areas Ordinance, Mukilteo Municipal Code, Chapter 17.52B Ordinance No. 987 (City of Mukilteo 1991) are pending subject to City Council approval. The stream and wetland ratings and buffer designations have been provided for both the existing and proposed Critical Areas Ordinance.

Table 7 — Wetland Ratings and Buffer

Resource ID	Cowardin Class	Existing Ordinance[1]		Proposed Ordinance[2]	
		Mukilteo Rating	Buffer Width (ft.)[1]	Mukilteo Rating	Buffer Width (ft.)[2]
W1-1[3]	PFO	II	50	II	100
W1-2	PFO	II	50	III	80
W1-3	PFO	II	50	II	100
W1-4	PSS	N/A	N/A	N/A	N/A
W2-1[4]	PFO	II	50	III	80
W3-1	PSS	II	50	III	80
W3-2	PFO	II	50	III	80
W3-3	PFO	II	50	III	80
W3-4	PEM	II	50	III	80

[1] Mukilteo Municipal Code, Chapter 17.52B Ordinance No. 987. (1991)
[2] Mukilteo Municipal Code, Draft Chapter 17.52C (2004) (Buffer width assumes Low or High Mass Wasting Potential)
[3] Wetland W1-1 is crossed by both Alignments 1 and 2
[4] Wetland W2-1 is crossed by both Alignments 2 and 3

Table 8 — Stream Ratings and Buffer

Resource ID	Fish Bearing	Existing Ordinance[1]		Proposed Ordinance[2]	
		Mukilteo Rating	Buffer Width (ft.)	Mukilteo Rating	Buffer Width (ft.)
S1-1	No	III	25	Type 5L	75
S1-2[3]	No	III	25	Type 4H	100
S3-1	No	III	25	Type 4L	75

[1] Mukilteo Municipal Code, Chapter 17.52B Ordinance No. 987. (1991)
[2] Mukilteo Municipal Code, Draft Chapter 17.52C (2004) (Buffer width assumes Low or High Mass Wasting Potential)
[3] Stream S1-2 is crossed by both Alignments 1 and 3

No fish or wildlife habitat conservation areas are present within one mile of the proposed project alignments (WDFW 2004).

Based upon the inventory of critical areas, and the preliminary alignment drawings, the construction of Alignment 1 would result in the least amount of impact to wetland and stream resources. Alignment 3 would result in the greatest amount of wetland fill impacts. Alignment 2 would result in the greatest amount of impact to the Picnic Point Creek Native Growth Protection Area.

All three of the proposed alignments would require the removal of regulated wetland or stream buffer vegetation, and the hydraulic modification or filling of wetland and/or stream resources. Thus, all three alignments will require federal, state, and local environmental permits, as discussed later in this section. In general, in order to satisfy the environmental permitting requirements, the greater amount of impact to critical areas results in a greater amount of compensatory mitigation.

Table 9 below outlines the environmental advantages and disadvantages of each of the proposed alignments. Advantages are generally associated alignment characteristics that avoid or minimize impacts to critical areas, while disadvantages identify potential impact locations. References to environmental permitting considerations are made throughout this discussion.

Table 9 — Environmental Advantages and Disadvantages

	Advantages	Disadvantages
Alignment 1	The proposed alignment utilizes portions of existing road right-of-way, which will prevent impacts to Wetlands W1-2, W1-3, and W1-4 and associated buffers (STA 29+00 to STA 36+00). This assumes that the existing retaining walls will remain within their current footprint. Wetland W1-1 and Picnic Point Creek (Stream S1-2) would be spanned with a bridge structure thus avoiding wetland and stream fill impacts	The crossing of Stream S1-1 would require a culvert and, subsequently, compensatory mitigation. This impact would trigger Section 404 and 401 permitting requirements, as well as state and local (City of Mukilteo) permitting requirements. The spanning of Picnic Point Creek (Stream S1-2) would require the removal of forested riparian buffer areas as regulated by the City of Mukilteo
Alignment 2	Road crossing at Wetland W1-1 and Picnic Point Creek (Stream S1-2) would be spanned with a bridge structure thus avoiding wetland and stream fill impacts.	Alignment 2 runs parallel to W1-1 and Picnic Point Creek (Stream S1-2) at the top of the ravine. This alignment would result in buffer impacts along approximately 1,400 linear feet of Picnic Point Creek which is considered a Native Growth Protection Area. Wetland fill would also occur adjacent to station 38+00 (W1-1). The crossing of Wetland W2-1 would result in approximately 150 linear-feet of wetland fill, and would also impact wetland buffers. Compensatory mitigation would be required to satisfy federal, state, and local permit requirements.
Alignment 3	Utilizes existing road (Cyrus Way) right-of-way, thus minimizing potential critical area impacts.	The existing road will need to be widened which will incur fill impacts to Wetlands W3-1, W3-2, W3-3, W3-4. Wetland W2-1 will also be impacted just as it is in Alignment 2. Compensatory mitigation would be required to satisfy federal, state, and local permit requirements.

Environmental Permitting Considerations

The discussion below presents conclusions related to potential federal, state, and local environmental permitting requirements associated with the proposed road alignments. This discussion is based upon assumed impacts to wetlands, streams, or fish and wildlife resources that could result from construction as outlined above.

Federal Permits

Filling or dredging activities within wetland areas and other waters of the U.S. (i.e. streams) would trigger Section 404 and Section 401 permit requirements, administered by the U.S. Army Corps of Engineers, Seattle District (Corps) and the Washington State Department of Ecology (DOE) respectively. Both of these permits can be applied for using the Joint Aquatic Resource Permit Application (JARPA). Several supporting documents would need to be provided as part of these permit applications including:

- Biological Assessment — the Corps would be required to complete ESA Section 7 consultation with NOAA Fisheries and U.S. Fish and Wildlife Service prior to issuing a Section 404 permit. It is also required if the project is being funded partially or wholly with federal funds regardless of a Section 404 permit nexus;
- Wetland and Stream Delineation and Report; and
- Wetland Mitigation Report.

The Corps may require the preparation of an Environmental Assessment (EA) for National Environmental Policy Act (NEPA) compliance, or may elect to utilize an internal process to satisfy NEPA requirements. If impacts to cultural resources are suspected, the Corps may require Section 106 National Historic Preservation Act compliance, in which case a technical report investigating potential impacts to cultural resources would be required.

State Permits
All alignments would require State permits including:

- Hydraulic Project Approval (HPA)
- State Environmental Policy Act (SEPA) Checklist

An HPA is required for any work that uses, diverts, obstructs, or changes the natural flow or bed of any water of the state. The HPA is issued by the Washington Department of Fish and Wildlife (WDFW) and is applied for using the JARPA. Information needed for an HPA includes general plans for the overall project, such as project alignment and construction features; detailed construction plans and specifications of the proposed work within waters of the state; detailed plans and specifications for the protection of fish life, including Best Management Practices (BMPs); and any proposed mitigation measures.

In the SEPA Checklist, project impacts are described, including all potential impacts to geologic sensitive areas, wetlands, streams, vegetation, fish and wildlife, air and water quality, and other natural resources. Land use, aesthetics, noise, light and glare, and other additional potential impacts are also detailed, along with measures to mitigate those impacts.

Local Permits — City of Mukilteo
All alignments would require compliance with the City's Critical Areas Ordinance, which includes the protection of wetlands and streams. Projects that impact wetlands, streams, and associated buffers would require a Wetland and Stream Delineation and Report and a Conceptual Wetland Mitigation Report.

Table 10 summarizes the potential permit requirements for all three alignments.

Table 10 — Summary of Potential Environmental Compliance Requirements

Compliance Requirement	Regulatory Agency	Triggered By	Associated Plans, Reports, or Applications Required
Section 404 Clean Water Act	U.S. Army Corps of Engineers (Corps)	Dredging or excavation in wetlands	Joint Aquatic Resources Permit Application (JARPA) Biological Evaluation Wetland and Stream Delineation and Report Conceptual Wetland Mitigation Report
Section 401 Clean Water Act	Department of Ecology (DOE)	Dredging or excavation in wetlands	JARPA
National Environmental Policy Act (NEPA)	Corps	Federally funded or permitted project with potential environmental impacts	Categorical Exclusion, NEPA Environmental Assessment, or NEPA Environmental Impact Statement (EIS)
Section 106 National Historic Preservation Act	Federal lead agency (Corps) or State historic Preservation Office (SHIPO)	Potential effects to cultural resources	Section 106 Cultural Resources Technical Report
Endangered Species Act Section 7 Consultation	NOAA Fisheries and U.S. Fish and Wildlife Service (USFWS)	Required in conjunction with Corps Section 404 permit or federal funding	Biological Assessment (BA)
Hydraulic Project Approval (HPA)	Washington Department of Fish and Wildlife (WDFW)	Diversion of surface water flow	JARPA
State Environmental Policy Act	City of Mukilteo	Project with potential environmental impacts	SEPA Checklist Environmental Assessment or EIS
Critical Areas Ordinance	City of Mukilteo	Impacts to wetlands, streams, and associated buffers	Critical Areas Report, including a wetland and stream delineation and mitigation plan.

Traffic Considerations

Operations

Traffic analyses were performed to identify intersection and channelization needs of the alternatives considered. See Appendix C — *Memorandum Re: Harbour Reach*

Drive Extension Traffic Operational Needs Analysis by TENW December 16, 2004. Traffic forecasts were based on Sector 20 and Comprehensive Plan Update 2020 analysis prepared by Transportation Engineering Northwest (TENW) in 2003. Future trip generation assumed 150 single-family homes and 1.1 million square feet of light industrial uses, which results in a p.m. peak hour trip generation of 960 vehicle trips (270 entering and 690 exiting.)

A simulation model was created representing a roadway network for each alignment alternative. Table 11 summarizes intersection levels of service at key locations under each alignment option. As shown, as the diversion potential diminishes from Alignment 1 to Alignment 3, intersection levels of service at key locations on SR 525 experience increased congestion.

Table 11 — 2020 Intersection Levels of Service by Alignment

Intersection	Level of Service/Delay [1]			
	Alignment 1	**Alignment 2**	**Alignment 3**	**No-Build**
SR 525 at Beverly Park	D 51	D 55	E 55	F >100
SR 525 at Harbour Pointe Blvd	E 57	E 65	E 77	F 98
Cyrus Way at Harbour Pointe Blvd	C 29	C 28	C 30	D 42
Harbour Reach Drive at Harbour Pointe Blvd	B 20	B 24	D 40	B 13
New Arterial at Beverly Park Drive[2]	C 31	D 40	C 30	N/A

1. Analysis based on Synchro 5 and HCS 2000 results using HCM 2000 LOS and control delays. All delays are expressed in seconds per vehicle.
2. Location of intersection varies depending on alignment.

The total delay at the five intersections is 188 seconds for Alignment 1, 212 seconds for Alignment 2, 232 seconds for Alignment 3 and at least 253 seconds for the No-Build alternative. From this we can conclude that operationally, Alignment 1 is the most effective alignment. It is also more effective than the No-Build alternative. Under the No-Build alternative, not only is the delay greater at the two intersections on SR 525, but the distance to reach the destination is farther.

In addition to level of service analysis, TENW also performed detailed queuing analysis and provided recommendations for left turn queue lengths for each effected intersection. For all alignments, there was adequate spacing between intersections for storage queue lengths. See Appendix C.

Capacity

In 2020, the forecast level of service is rated at B and C at the north and south ends of Alignment 1, leaving extra capacity to handle growth beyond the planning period. Construction of the new arterial will also free up capacity on SR 525. In the City's 2004 Transportation Plan, the volume of the proposed arterial is projected at approximately 1,000 vehicles in the PM peak hour. Since most of these same trips would have routed through the Beverly Park Road and Harbour Pointe Boulevard intersections with SR 525 as left turns, the level of services will improve significantly on SR 525.

Alignments 2 and 3 also increase level of service by providing a new arterial and relieving congestion on SR 525. Since the improvements to level of service provided by these alignments is less, the increase to capacity would also be less.

Circulation

All three alignments provide improved circulation. The north connection point at Harbour Reach Drive provides the best opportunities for connecting the southern portion of the City to municipal facilities including police and fire stations, schools, a library, recreational facilities and light industrial and commercial areas. Both Alignments 1 and 2 connect at this location, but Alignment 1's shorter and more direct alignment makes it the most effective alignment for circulation.

For Alignment 3, the north connection point at Cyrus Way provides good connection to commercial and light industrial areas, but is less direct in connection to other facilities.

Stormwater Requirements

Stormwater requirements for Alignments 1, 2 and 3 were reviewed using the Department of Ecology's 1992 Stormwater Management Manual for the Puget Sound Basin as documented in a technical memorandum dated June 25, 2004, and included in Appendix E. All alignments require both detention and water quality, based on increases to impervious and pollution-generating surface areas.

Alignment 1 can be collected and treated as one basin. There is an existing detention pond and existing water quality biofiltration swales adjacent to the private roadway that will become a portion of Alignment 1. Based on an existing agreement between the property owner and the City of Mukilteo, these facilities can be enlarged to serve the proposed roadway. Because earthwork to expand ponds and swales is significantly less expensive than the use of vaults, stormwater facilities for Alignment 1 are less expensive than for other alternatives. Costs to upsize these

facilities have been incorporated into the cost estimate for Alignment 1, included in Appendix G

Alignment 2 consists of two separate stormwater basins and vaults will be required in each basin for detention and water quality treatment. Because Alignment 2 adds the most impervious and pollution-generating surface area, stormwater facilities are the largest and most expensive for this Alignment. Because of their size, it will be difficult to find space within the right-of-way to locate them, and additional land may need to be purchased.

Alignment 3 consists of three separate basins. Vaults will also be required for each basin for detention and water quality treatment. The southern-most basin requires large vaults. Because of its size, it may require additional land to be purchased. The other two basins require relatively small vaults that should fit within right-of-way.

Structures Type, Size and Location

Structures needs have been assessed and described in a technical memorandum dated August 10, 2004, and revised December 27, 2004, included in Appendix F. Alignments 1 and 2 both cross the North Fork of Picnic Point Creek at approximately the same location. A three-span bridge is proposed in both alignments, although the bridge for Alignment 2 will be approximately 20 feet longer because of the southern abutment location. The Alignment 1 bridge will be 300 feet long. The Alignment 2 bridge will be 320 feet long. Bridge width will be 51 feet from edge of deck to edge of deck. Alignment 3 does not require a bridge.

All three alignments require both cut and fill walls. Alignment 1 has significant cut and fill walls on both sides of the roadway between Stations 16+00 and 24+00. Alignments 2 and 3 have significant fill walls on both sides of the roadway between Stations 10+50 and 15+50. Alignment 2 also has large walls on both sides between Stations 36+00 and 47+70.

Right-of-Way Needs

The right-of-way needs for each alternative is summarized in Table 12.

Table 12 — Right-of-Way Needs

Alternative	No. of Parcels Effected	Right-of-Way Take Area (Acres)	Estimated Right-of-Way Cost
Alignment 1	2	2.53	$870,000
Alignment 2	23	7.63	$2,150,000
Alignment 3	31	3.99	$1,640,000
No-Build Alternative	0	N/A	N/A

Right-of-Way Needs — Alignment 1

The City of Mukilteo 2004 Comprehensive Plan, adopted April 5, 2004, provides for growth along the extension of Harbour Reach Drive. In accordance with the Comprehensive Plan policies, the City approved a rezone request to Sector 20 of the Harbour Pointe Master Plan and granted the preliminary plat approval to allow 108 new homes and 300,000 square feet of new industrial development in addition to the 800,000 square feet of industrial development already in place. As part of the rezoning process, the City negotiated an agreement with the developer that secures donation of almost 90 percent of the right-of-way needed to construct Alignment 1, if or when the project proceeds.

With the land from Sector 20 donated, only two parcels require right-of-way acquisition. The two parcels would be purchased in their entirety, and the cost estimates in this report assume the full cost of these parcels.

Of the three alignments, Alignment 1 requires the least area or number of parcels of right-of-way acquisition and has the least impact.

Right-of-Way Needs — Alignment 2

Right-of-way acquisition for Alignment 2 affects 23 parcels. For most of the parcels, acquisition would be strips approximately ten feet wide along the frontage of Cyrus Way or Evergreen Drive. Since many parcels are not developed or fully developed, the impact along the properties would not be great. The impact would be greater for the few parcels fully developed, but would primarily affect driveways and parking areas. The impact would be significant to at least four parcels, either by acquiring the majority of the parcel or taking a building.

A significant portion of the right-of-way take falls within Sector 20, but was not a part of the right-of-way donation negotiated by the rezone agreement.

Comparatively, Alignment 2 has the greatest right-of-way impacts and greatest cost of the three alignments.

Right-of-Way Needs — Alignment 3

Right-of-way acquisition for Alignment 3 affects 31 parcels. For most of the parcels, acquisition would be strips approximately ten feet wide along the frontage of Cyrus Way. Alignment 3 follows Alignment 2 for approximately half its length so impacts are similar to Alignment 2 impacts, only more parcels require frontage acquisition. There are also at least two parcels that would likely be damaged by reduced access for commercial vehicles.

Right-of-way acquisition for Alignment 3 impacts more parcels, but the overall area and cost falls in between Alignments 1 and 2.

Cost Estimates

Planning-level cost estimates have been prepared for each of the three alignments. The estimates are summarized in Table 13 and included in Appendix G.

Table 13 — Planning-Level Cost Estimates

Alternative	Project Cost
Alignment 1	$10,040,000
Alignment 2	$15,340,000
Alignment 3	$9,400,000
No-Build Alternative	N/A

The project cost includes costs for design, environmental documentation and permitting, right-of-way acquisition, construction, design and construction contingencies, and multi-year escalation factors based on the construction of the project in 2007-08.

The project cost of Alignment 3 is least of the three alternatives, largely because the project length is shortest, no bridge is required and it requires smaller quantities of other structures.

The cost of Alignment 1 is the next least expensive. Alignment 2 is the most expensive of the three alignments, because of length of project, structures cost, and storm drainage facility costs.

Summary of Alignment Evaluation

Table 14 summarizes the findings of this report with respect to roadway characteristics, geotechnical issues, environmental and permitting issues, traffic analysis, right-of-way needs, and project cost for Alignments 1, 2, 3 and the No-Build alternative. Stormwater requirements and structures needs are not included in the list because their impact is primarily a function of cost.

Table 14 — Summary of Alignment Evaluation

	Alignment 1	**Alignment 2**	**Alignment 3**	**No-Build**
Roadway Characteristics				
• Horizontal	Good	Poor	Good	- - -
• Vertical	Fair	Fair	Poor	- - -
• Access	Good	Poor	Poor	- - -
Geotechnical	Feasible	Feasible	Feasible	Feasible
Environmental	Feasible	Feasible	Feasible	Feasible
• Wetland Impact	Least impact	- - -	Most impact	No impact
• Stream Impact	Least impact	Most impact	- - -	No impact
Traffic				
• Operation	Good	Fair	Fair	Poor
• Capacity	Good	Fair	Fair	Poor
• Circulation	Good	Good	Fair	Poor
Right-of-way needs	Low impact	High impact	High impact	No impact
Project Cost	$10,040,000	$15,340,000	$9,400,000	Data unavailable

As the prime motivator for considering the project has been traffic-related, it follows that traffic-related measurements have the highest priority in determining the recommended alternative. Alignment 1 provides the best improvement to traffic operation, capacity, and circulation. It also rates well in the other categories evaluated as follows:

- Good roadway characteristics
- Geotechnically feasible
- Environmentally feasible and has least impact of three alignments
- Right-of-way impacts are low
- Project cost is reasonable based on the product delivered.

Section 6 — Recommendation and Implementation

Recommended Alignment

Based on the evaluation of project goals, as well as considerations such as roadway characteristics, geotechnical feasibility, environmental feasibility and potential environmental impacts, traffic-related criteria and project cost, the recommended alternative is implementation of Alignment 1.

Alignment 1 connects to Beverly Park Road at 132nd Street SW on the south end and connects to Harbour Pointe Boulevard at Harbour Reach Drive on the north end. The proposed alignment adds 0.70 miles of new minor arterial and accomplishes all of the project goals, particularly reducing congestion on SR 525 (Mukilteo Speedway) and providing better connection to the south portion of the City.

The project cost is estimated at $10,040,000, escalated based on construction in 2007-08. Detailed cost estimates are included in Appendix G.

Aside from environmental impacts that will be addressed in detail during the environmental documentation phase of the project, impact mitigation that will be necessary for the proximity of the new roadway to the Pacific Pointe development and added traffic to 132nd Street SW. Mitigation in the form of a landscaped earth berm is proposed to address added noise and aesthetics for the Pacific Pointe development. Traffic mitigation for 132nd Street SW is discussed in the following section.

Traffic Impacts — Proposed Mitigation for 132nd Street SW

Connection of Harbour Reach Drive Extension at Beverly Park Road and 132nd Street SW creates the potential for cut-through traffic along 132nd Street SW to SR 525, negatively impacting the neighborhood along 132nd Street SW with increased traffic volumes.

Several options to mitigate these traffic impacts were considered. Option 1 provided for improvements to handle the increased traffic volumes along 132nd by reconstructing 132nd to current standards and installing traffic signals at both ends (Beverly Park Road/Harbour Reach Extension and SR 525). While this option would accommodate the traffic volumes, it was determined to be undesirable because of increased negative impacts on the neighborhood.

Option 2 limited access to 132nd from the Beverly Park Road/Harbour Reach Extension or SR 525 intersections. Option 2A limits turning movements at the Beverly Park Road/Harbour Reach Extension by essentially making the 132nd Street

SW connection right in/right out at this point. It preserves the connection to SR 525. Option 2B disconnects 132nd Street SW from SR 525 and installs a cul de sac at the east end of 132nd. Option 2A provides slightly better level of service at several intersections than Option 2B.

Option 3 was similar to Option 1 but provided traffic calming measures in addition to the street upgrades. These traffic calming measures would manage traffic speeds and discourage cut-through traffic. While this would reduce the level of cut-through traffic compared to Option 1, neighborhood impacts would still be unacceptable.

Based upon the evaluation of potential mitigation options under Alignment 1, Mitigation Option 2A (turning movement restrictions at a new signalized intersection of Harbour Reach Drive/132nd Street SW and Beverly Park Road) is recommended as it would be the most cost effective alternative that provides a maximum level of mitigation of secondary traffic impacts of extending Harbour Reach Drive.

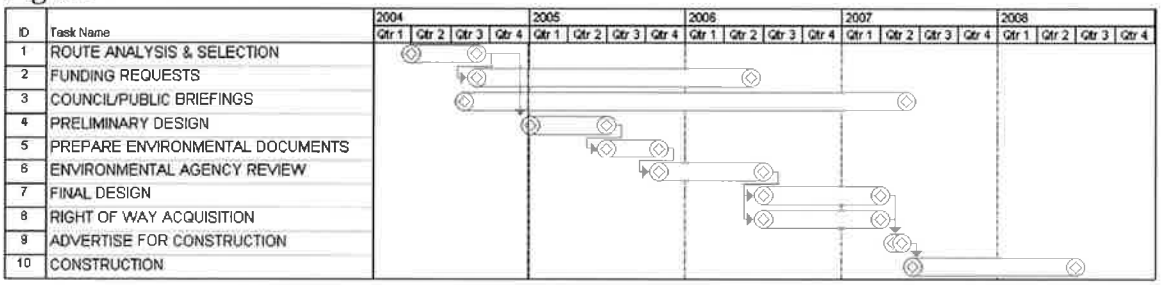
Project Implementation

Schedule

Implementation of the project depends on several factors, such as available funding, permitting, and right-of-way acquisitions. A schedule is shown in Figure 8 that demonstrates one possible sequence of events. Because it is likely that the City will seek federal funding for this project, sequencing of some elements of the schedule will be dictated by federal funding requirements. The schedule shown assumes that the Environmental Documentation must be completed prior to Final Design or Right-of-Way Acquisition.

Tasks are shown in the most streamlined configuration possible. The sequence shown assumes that Preliminary Design will begin in early 2005 and results in construction in 2007-08. As the City has not identified funding to begin preliminary design, this is unlikely. When funding will become available is not known, and the schedule should be adjusted accordingly when such information is available. The cost estimates included in this report are also based on the timeline shown and inflation factors should be added to the project cost to account for any schedule adjustments.

Figure 8 — Schedule



Funding

The project cost is significant and cannot be entirely borne by the City of Mukilteo's capital improvement program. Outside funding sources will be needed. Because the project benefits a greater region by reducing congestion on SR 525 and Snohomish County roads, it is likely to be considered favorable to other agencies for funding partnerships. Requests for partnership and funding should be made to Snohomish County, Washington State Department of Transportation, Washington State Transportation Improvement Board, Puget Sound Regional Council, and various federal funding programs.

The project also benefits the properties immediately adjacent to it, and negotiations have already determined that the Sector 20 property owner will dedicate land, existing roadway improvements and additional frontage improvements as documented in their rezone agreement.

Phasing

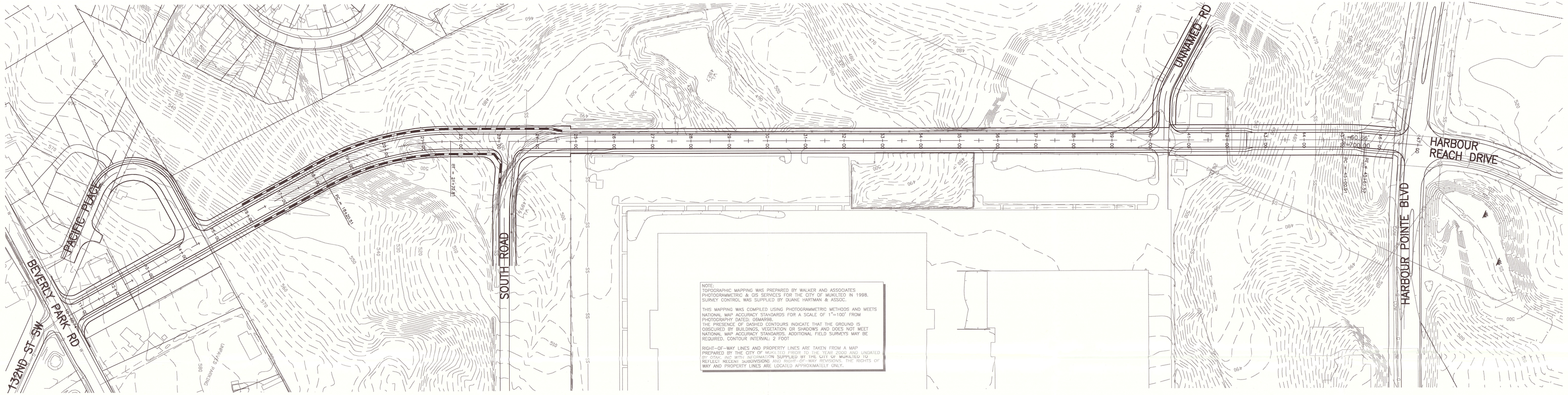
If full funding does not become readily available, a phasing opportunity does exist, although full construction is preferable. As an interim measure, the Alignment 1 project could be constructed from Beverly Park Road to approximate Station 40+50. At that point the existing unnamed road to the east could be used as a connection to Harbour Pointe Boulevard. It connects to Harbour Pointe Boulevard at a stop sign, and there are no plans for a traffic signal at this location. Operationally, this option has drawbacks, but it postpones construction of the most expensive element of the project (bridge over N. Fork Picnic Point Creek).

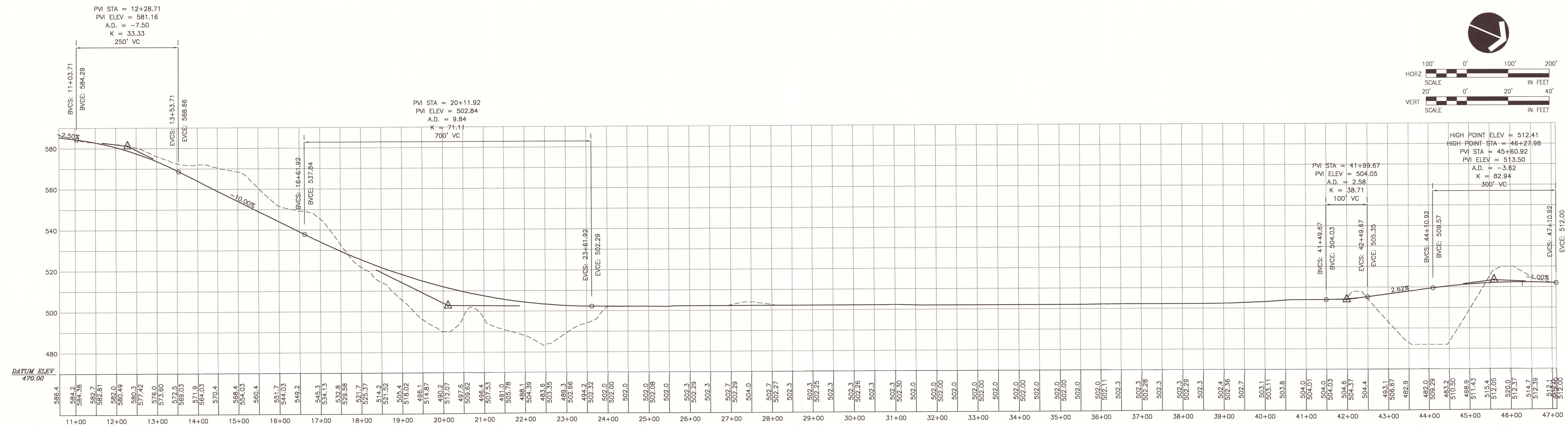
The project cost to construct the first phase would be roughly $6 million. The Phase 2 project to construct the bridge is estimated at $4 million. These estimates are based on 2007-08 construction dollars and should be escalated as the schedule shifts.

Appendix A — Plan Layouts

SEC. 27&28, T.28N., R.4 E.W.M

ALIGNMENT 1



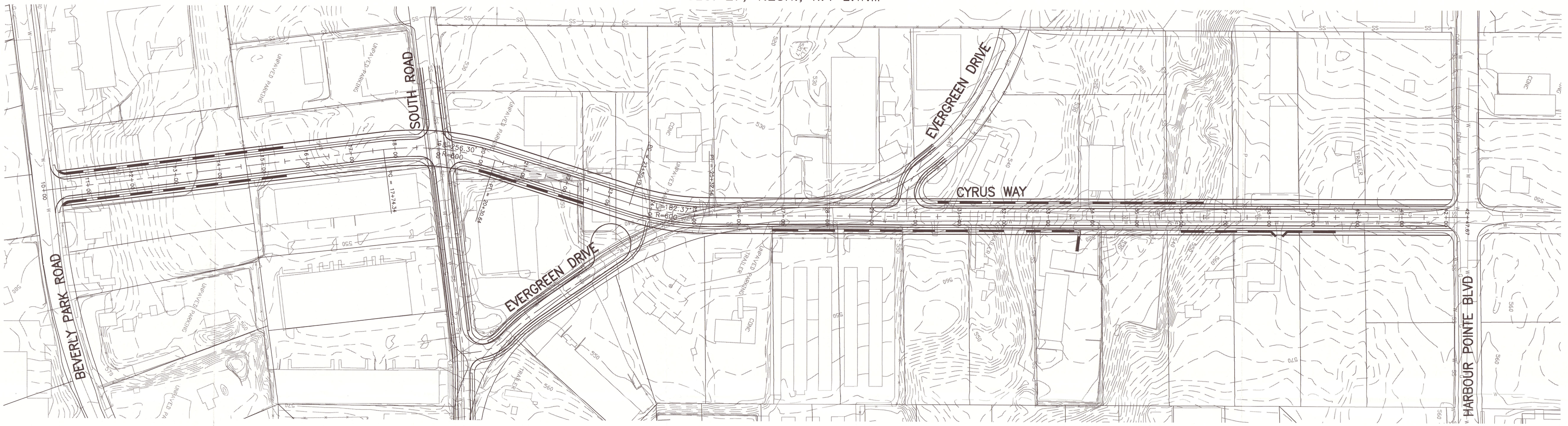


SEC. 27&28,

ALIGNMENT 2

ALIGNMENT 3

SEC. 27, T.28N., R.4 E.W.M

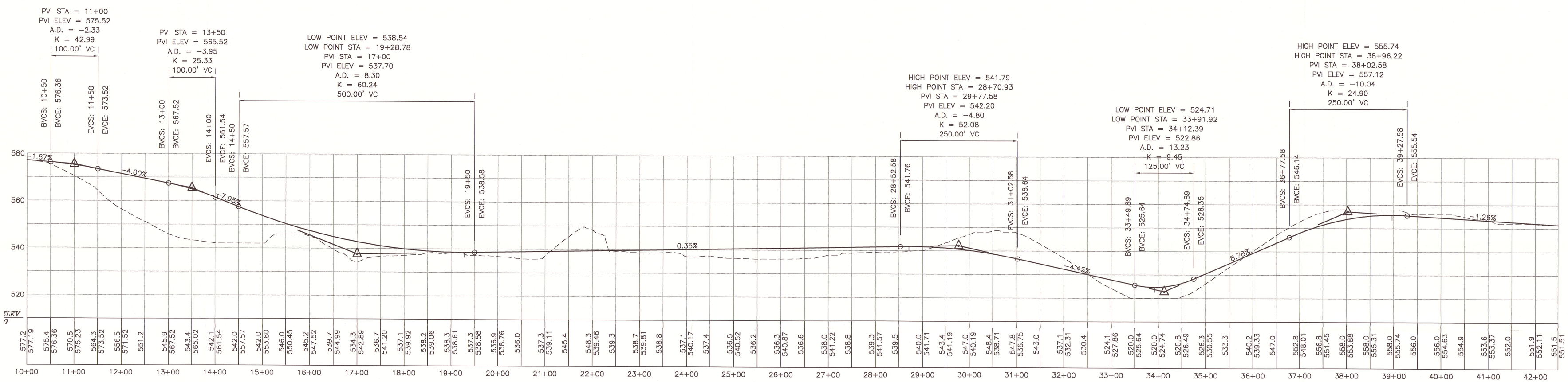


NOTE:
TOPOGRAPHIC MAPPING WAS PREPARED BY WALKER AND ASSOCIATES PHOTOGRAMMETRIC & GIS SERVICES FOR THE CITY OF MUKILTEO IN 1998. SURVEY CONTROL WAS SUPPLIED BY DUANE HARTMAN & ASSOC.

THIS MAPPING WAS COMPILED USING PHOTOGRAMMETRIC METHODS AND MEETS NATIONAL MAP ACCURACY STANDARDS FOR A SCALE OF 1"=100' FROM PHOTOGRAPHY DATED: 06MAR98.
THE PRESENCE OF DASHED CONTOURS INDICATE THAT THE GROUND IS OBSCURED BY BUILDINGS, VEGETATION OR SHADOWS AND DOES NOT MEET NATIONAL MAP ACCURACY STANDARDS. ADDITIONAL FIELD SURVEYS MAY BE REQUIRED. CONTOUR INTERVAL: 2 FOOT

RIGHT-OF-WAY LINES AND PROPERTY LINES ARE TAKEN FROM A MAP PREPARED BY THE CITY OF MUKILTEO PRIOR TO THE YEAR 2000 AND UNDATED BY OTAK, INC WITH INFORMATION SUPPLIED BY THE CITY OF MUKILTEO TO REFLECT RECENT SUBDIVISIONS AND RIGHT-OF-WAY REVISIONS. THE RIGHTS OF WAY AND PROPERTY LINES ARE LOCATED APPROXIMATELY ONLY.

100' 0' 100' 200'
HORZ SCALE IN FEET
20' 0' 20' 40'
VERT SCALE IN FEET



Appendix B — Technical Report
Final Critical Areas Reconnaissance
Jones & Stokes
December 28, 2004

Jones & Stokes

Technical Memorandum

Date: 12/28/04
Lori McFarland, Project Manager
To: OTAK, Inc.

From: John Soden, Biologist

Subject: Final Critical Areas Reconnaissance – Harbour Reach Drive Extension Project

INTRODUCTION

The City of Mukilteo (The City) is currently considering the development of a new three lane arterial to relieve congestion and provide an alternative emergency route through the south end of The City. The proposed road will connect Beverly Park Road with Harbour Pointe Boulevard. Three alternative alignments are currently being considered, with each alignment 0.75 mile in length with an average right-of-way width of 60 to 80 feet. The project area is located within the City limits, mostly within Section 27, Township 28 North, Range 4 East.

The City has retained OTAK, Inc. as lead consultant during the alternative route evaluation process. This critical areas reconnaissance was conducted by Jones & Stokes as part of an alternatives analysis of the proposed alignments. The analysis presented within this technical memorandum is based upon a scoping meeting on April 14, 2004, and preliminary plan drawings provided by OTAK, Inc. This document has been revised per the comments received during the meeting held at the City of Mukilteo offices on July 22, 2004.

The locations of the three proposed alignments are provided in the attached figures. The approximate boundaries of critical areas (i.e. wetlands and streams), and fish and wildlife conservation areas are identified on the attached figures. The purpose of this memorandum is to identify and locate critical area resources, assist The City during the selection of the preferred route alternative, and identify any fatal flaws associated with each alternative in relation to potential environmental impacts.

The contents of this memorandum are presented as follows:

- Study methods.
- Results.
- Conclusions and Recommendations.

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- Environmental Permitting Considerations.

STUDY METHODS

Jones & Stokes visited the project area on June 11, 2004 to perform a reconnaissance-level wetland, stream, and fish and wildlife conservation area survey for each of the three proposed road alignments. Wetlands and streams within 150-feet to each side of the alignments were visually identified. A general assessment of vegetation, soils, and hydrology was made to determine the potential presence or absence of wetlands and streams. Wetland determinations were based upon the methods outlined in *Washington State Wetlands Identification and Delineation Manual* (Ecology 1997), and the *U.S. Army Corps of Engineers Wetlands Delineation Manual* (Environmental Laboratory 1987). The approximate wetland boundary was drawn on a map and replicated in CAD. Property access was limited in some wetland areas during the reconnaissance. However, these wetland areas were visible from accessible areas and from a distance in which potential wetland presence could be identified.

Wetland and stream locations were sketched on aerial maps. Approximate resource boundaries were then transferred to electronic CAD-based data files and are presented on the attached figures. The results presented in this memo are preliminary and do not represent a detailed jurisdictional wetland delineation. *For the purposes of future environmental permitting associated with the proposed road project, wetland and stream boundaries need to be professionally delineated and surveyed.*

Wetland habitat types are based on the U.S. Fish and Wildlife Service (USFWS) wetland classification system (Cowardin et al. 1979). This classification scheme categorizes wetlands according to plant community types and hydrologic regime and is one of many factors commonly used by local jurisdictions to help determine wetland functions and values.

Wetlands ratings were based on City of Mukilteo Critical Areas Regulations Chapter 17.52B 2004 Draft, which is in the process of city approval. The new draft uses the Washington Department of Ecology's (Ecology's) Washington State Wetlands Rating System – Western Washington (#93-074) for their wetland rating system. Streams ratings were based are also based on The City's Critical Areas Regulations, which uses the Washington Department of Natural Resources Stream Typing System (WAC 222-16.031, Interim Water Typing System).

Literature sources reviewed prior to the delineation included:

- U.S. Department of Agriculture (USDA) soils survey (USDA 1983),
- U.S. Department of Interior (USDI), National Wetland Inventory maps (USDI 1987),
- Washington Department of Fish and Wildlife (WDFW) Priority Habitats and Species (PHS) map (WDFW 2004), and
- U.S. Geological Survey (USGS) topographic quadrangle maps.

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RESULTS

Nine wetlands and three streams were identified within the three alternative alignments (See attached figures). Resources associated with each alignment were given a specific identifier. For example, wetlands associated with Alignment 1 and Alignment 2 would be identified as W1-1 and W2-1 respectively. Several of these resources occur within multiple Alignments due to alignment overlap. Tables 1 and 2 summarize wetland and stream resources identified per alignment. Proposed revisions to the City of Mukilteo Critical Areas Ordinance, Mukilteo Municipal Code, Chapter 17.52B Ordinance No. 987. (City of Mukilteo 1991) are pending subject to City Council approval. The stream and wetland ratings and buffer designations have been provided for both the existing and proposed Critical Areas Ordinance.

Table 1. Wetland Ratings and Buffer.

Wetland Resource ID	Cowardin Class	Mukilteo Rating[1]	Buffer Width (ft.)[1]	Mukilteo Rating[2]	Buffer Width (ft.)[2]
W1-1[3]	PFO	II	50	II	100
W1-2	PFO	II	50	III	80
W1-3	PFO	II	50	II	100
W1-4	PSS	NA	NA	NA	NA
W2-1[4]	PFO	II	50	III	80
W3-1	PSS	II	50	III	80
W3-2	PFO	II	50	III	80
W3-3	PFO	II	50	III	80
W3-4	PEM	II	50	III	80

[1] Mukilteo Municipal Code, Chapter 17.52B Ordinance No. 987. (1991)
[2] Mukilteo Municipal Code, Draft Chapter 17.52C (2004) (Buffer width assumes Low or High Mass Wasting Potential)
[3] Wetland W1-1 is crossed by both Alignments 1 and 2
[4] Wetland W2-1 is crossed by both Alignments 2 and 3

Table 1. Stream Ratings and Buffer.

Resource ID	Fish Bearing	Mukilteo Rating[1]	Buffer Width (ft.)[2]	Mukilteo Rating[2]	Buffer Width (ft.)[2]
S1-1	No	III	25	Type 5L	75
S1-2[3]	No	III	25	Type 4H	100
S3-1	No	III	25	Type 4L	75

[1] Mukilteo Municipal Code, Chapter 17.52B Ordinance No. 987. (1991)
[2] Mukilteo Municipal Code, Draft Chapter 17.52C (2004) (Buffer width assumes Low or High Mass Wasting Potential)
[3] Stream S1-2 is crossed by both Alignments 1 and 3

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Wetland W1-1

Wetland W1-1 is southeast of the Harbour Point Boulevard and Harbour Reach Drive intersection associated with Alignment 1 (STA 44+00). This riparian palustrine forested (PFO) wetland is located along both sides of Picnic Point Creek (See Streams S1-2 and S3-1 below). It occupies a wide bench within the floodplain immediately adjacent to the creek. Wetland W1-1 meets The City's definition of a Category II wetland, which requires a 100-foot buffer.

Dominant vegetation observed in Wetland W1-1 includes red alder (*Alnus rubra*) and salmonberry (*Rubus spectabilis*). Other species observed include piggy-back plant (*Tolmiea menziesii*), skunk cabbage (*Lysichiton americanum*), creeping buttercup (*Ranunculus repens*), western red cedar (*Thuja plicata*), stinging nettle (*Urtica dioica*), and elderberry (*Sambucus racemosa*). Vegetation present meets the Corps requirements for evidence of wetland hydrophytic vegetation.

The hydrology of Wetland W1-1 is associated with Picnic Point Creek and a high water table. High flows in the creek likely flood the wetland area and saturate the wetland surface.

Wetland W1-2

Wetland W1-2 is located on the northeast side of an unnamed access road within the Boeing manufacturing facility associated with Alignment 1 (STA 35+00). This PFO wetland is within a very deep depression surrounded by fences on concrete retaining walls. It appears to be part of a stormwater retention system, and is likely connected to additional wetlands, via a culvert(s), on the opposite side of the access road. The wetland was likely larger prior to the construction of the manufacturing facility. Wetland W1-2 meets The City's definition of a Category III wetland, which requires a 75-foot buffer.

Vegetation observed in Wetland W1-2 includes salmonberry, red alder, sitka willow (*Salix sitchensis),* pacific willow (*Salix lasiandra*), and reed canarygrass (*Phalaris arundinacea*). Vegetation present meets the Corps requirements for evidence of wetland hydrophytic vegetation.

Hydrology of Wetland W1-2 comes from a combination of overland runoff, precipitation, and stormwater discharge. A drainage feature is likely present at the bottom of the depression, and likely connects to wetlands on the opposite side of the access road.

Wetland W1-3

Wetland W1-3 is located on the southwest side of the unnamed access road opposite W1-2 associated with Alignment 1 (STA 35+00). This PFO wetland is located within a deep ravine. It is likely connected with wetland W1-2 to the north and may be connected to Picnic Point Creek to the south. The wetland is fenced off with a large concrete retaining wall along the access road. Wetland W1-3 meets The City's definition of a Category III, which requires a 75-foot buffer.

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Vegetation observed in wetland W1-3 includes salmonberry and red alder. Vegetation present meets the Corps requirements for evidence of wetland hydrophytic vegetation.

Hydrology of wetland W1-3 comes from a combination of overland runoff and precipitation. A drainage feature within the wetland likely connects to wetland W1-2 on the opposite side of the access road.

Wetland W1-4

Wetland W1-4 is located on the southwest side of the unnamed access road associated with Alignment 1 (STA 29+50). This wetland is classified a palustrine scrub-shrub (PSS) wetland. An open water area is present, but not likely large enough to obtain an open-water Cowardin classification. It appears the open water is a retention pond that is part of a stormwater retention facility, and may be connected to Picnic Point Creek. The wetland is fenced off with a large concrete retaining wall along the access road. Wetland W1-4 is not rated as it is a stormwater detention pond.

Hydrology of wetland W1-4 comes from a combination of overland runoff and precipitation. A large unnatural ponded area is evidence that this wetland is likely part of a stormwater retention facility. There may be a hydrological connection to Picnic Point Creek at the ponded area.

Wetland W2-1

Wetland W2-1 is located between South Road and Beverly Park Road (STA 13+50 to STA 15+00). This PFO wetland is located in a depressional area that appears to be isolated. It is likely this wetland was historically larger and filled due to the development surrounding it. Wetland W2-1 meets The City's definition of a Category III wetland, which requires a 75-foot buffer.

Vegetation observed in wetland W2-1 includes red alder, salmonberry, Himalayan blackberry (Rubus discolor), pacific willow, sitka willow, reed canarygrass, lady fern (*Athyrium filix-femina*), and creeping buttercup. Vegetation present meets the Corps requirements for evidence of wetland hydrophytic vegetation.

Hydrology of wetland W2-1 comes from a combination of overland runoff and precipitation. It appears that the wetland may be isolated, however, a routine wetland delineation would need to be carried out to make such a determination.

Wetland W3-1

Wetland W3-1 is located on the southwest side of Cyrus Way (STA 40+00 to STA 41+25). This PSS wetland is located in a depressional area that appears to be isolated. It is likely this wetland was historically larger with evidence of fill material around the edges. Wetland W3-1 meets The City's definition of a Category III wetland, which requires a 75-foot buffer.

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Vegetation observed in wetland W3-1 includes salmonberry, sitka willow, reed canarygrass, creeping buttercup, red alder, and soft rush (*Juncus effusus*). Vegetation present meets the Corps requirements for evidence of wetland hydrophytic vegetation.

Hydrology of wetland W3-1 comes from a combination of overland runoff and precipitation. The wetland appears isolated with no evidence of surface water connections to any other waters.

Wetland W3-2

Wetland W3-2 is located on the northeast side of Cyrus Way opposite wetland W3-1 (STA 39+75 to STA 41+50). This PFO wetland is located in a depressional area that appears to be isolated. It is likely this wetland was historically larger and connected to wetland W3-1. No culverts were observed connected the two wetlands. Wetland W3-2 meets The City's definition of a Category III wetland, which requires a 75-foot buffer.

Vegetation observed in wetland W3-2 includes cottonwood (*Populus balsamifera*), western red cedar, sitka willow, and reed canarygrass. Vegetation present meets the Corps requirements for evidence of wetland hydrophytic vegetation.

Hydrology of wetland W3-2 comes from a combination of overland runoff and precipitation. The wetland appears isolated with no evidence of surface water connections to any other waters.

Wetland W3-3

Wetland W3-3 is located on the southwest side of Cyrus Way (STA 33+00). This PFO wetland is located in a depressional area that is associated with Picnic Point Creek. Approximately 50 feet from Cyrus Way, several culverts were observed discharging water into the beginnings of a channel that is part of Picnic Point Creek. Wetland W3-3 meets The City's definition of a Category III, which requires a 75-foot buffer.

Vegetation observed in wetland W3-3 includes red alder, creeping buttercup, soft rush, yellow iris (*Iris pseudacorus*), bentgrass (*Agrostis* spp.), salmonberry, and western red cedar. Vegetation present meets the Corps requirements for evidence of wetland hydrophytic vegetation.

Hydrology of wetland W3-3 comes from a combination of overland runoff, precipitation, and stormwater discharge. The wetland is connected to Picnic Point Creek.

Wetland W3-4

Wetland W3-4 is located on the northeast side of Cyrus Way in a narrow depression between a parking lot and steep hill (STA 32+60). This palustrine emergent (PEM) wetland discharges into a culvert under Cyrus Way and eventually, through stormwater pipes, discharges from the culverts described in wetland W3-3. The wetland appears as a drainage feature with flowing

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water but does not possess true bed and bank. Wetland W3-4 meets The City's definition of a Category III wetland, which requires a 75-foot buffer.

Vegetation observed in wetland W3-4 includes creeping buttercup, soft rush, yellow iris (*Iris pseudacorus*), salmonberry, reed canarygrass, and Himalayan blackberry. Vegetation present meets the Corps requirements for evidence of wetland hydrophytic vegetation.

Hydrology of wetland W3-4 comes from a combination of overland runoff and precipitation. Water flows through the wetland and eventually to Picnic Point Creek.

Stream S1-1

Stream S1-1 is an unnamed ephemeral drainage that drains to Picnic Point Creek(STA 22+50). At the time of the reconnaissance, the channel was dry with evidence of scour. Flow likely occurs during large rain events and during continued rains in the winter months. The Ordinary High Water Mark (OHWM) is approximately 2 feet wide. The riparian area is dominated by an upland forested habitat comprised of red alder and western red cedar, with a sword fern and vine maple (*Acer circinatum*) understory. Several narrow riparian wetlands occur adjacent to the stream channel. These wetlands were not mapped at the time of this reconnaissance, but are assumed to be Category II wetlands using the City of Mukilteo Municipal Code Draft Chapter 17.52C. Stream S1-1 meets The City's definition of a Type 5L stream using the WDNR's rating system. Type 5L streams in Mukilteo require a 75-foot buffer.

Streams S1-2 and S3-1

Streams S1-2 and S3-1 are the northern fork of Picnic Point Creek. At the Alignment 3 (S3-1) crossing (STA 33+00), the stream is not well defined and does not show true bed and bank characteristics until a distance of approximately 50 feet on the southwest side of Cyrus Way.

At the Alignment 1 and 2 crossing (S1-1, Alignment 1 STA 44+00; Alignment 2 STA 49+50), the stream exhibits defined bed and bank characteristics with riffle and pool habitat features, however no fish are present due to a downstream blockage. The OHWM is approximately 3 feet in width. Water depth averages 5 inches. The substrate is dominated by silt. Riparian areas are dominated with red alder and salmonberry. One salmonid, coho salmon, are documented in the creek downstream and outside of all the alignment project areas (Streamnet 2004). Picnic Point Creek at the Alignment 3 crossing meets The City's definition of a Type 4L stream, while at the Alignment 1 crossing it meets the definition of a Type 4H stream. Type 4L streams in Mukilteo require a 75-foot buffer, while Type 4H streams require a 100-foot buffer.

Fish and Wildlife Habitat Conservation Areas

No fish or wildlife habitat conservation areas are present within 1-mile of the proposed project alignments (WDFW 2004).

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CONCLUSIONS AND RECOMMENDATIONS

Based upon our inventory of critical areas, and the preliminary plan drawings provided by OTAK, Inc., the construction of Alignment 1 would result in the least amount of impact to wetland and stream resources. Alignment 3 would result in the greatest amount of wetland fill impacts. Alignment 2 would result in the greatest amount of impact to the Picnic Point Creek Native Growth Protection Area.

All three of the proposed alignments would require the removal of regulated wetland or stream buffer vegetation, and the hydraulic modification or filling of wetland and/or stream resources. Thus, all three alignments will require federal, state, and local environmental permits (See Environmental Permitting Considerations below). In general, in order to satisfy the environmental permitting requirements, the greater amount of impact to critical areas results in a greater amount of compensatory mitigation.

The following sections outline the environmental advantages and disadvantages of each of the proposed alignments. Advantages are generally associated alignment characteristics that avoid or minimize impacts to critical areas, while disadvantages identify potential impact locations. References to environmental permitting considerations are made throughout this discussion; please refer to the Environmental Permitting Considerations section that follows for greater detail.

Alignment 1 Advantages

- The proposed alignment utilizes portions of existing road right-of-way, which will prevent impacts to Wetlands W1-2, W1-3, and W1-4 and associated buffers (STA 29+00 to STA 36+00). This assumes that the existing retaining walls will remain within their current footprint.

- Wetland W1-1 and Picnic Point Creek (Stream S1-2) would be spanned with a bridge structure thus avoiding wetland and stream fill impacts.

Alignment 1 Disadvantages

- The crossing of Stream S1-1 would require a culvert and subsequently, compensatory mitigation. This impact would trigger Section 404 and 401 permitting requirements, as well as state and local (City of Mukilteo) permitting requirements (See Environmental Permitting Considerations below).

- The spanning of Picnic Point Creek (Stream S1-2) would require the removal of forested riparian buffer areas as regulated by the City of Mukilteo.

Alignment 2 Advantages

- Road crossing at Wetland W1-1 and Picnic Point Creek (Stream S1-2) would be spanned with a bridge structure thus avoiding wetland and stream fill impacts.

Alignment 2 Disadvantages

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- Alignment 2 runs parallel to W1-1 and Picnic Point Creek (Stream S1-2) at the top of the ravine. This alignment would result in buffer impacts along approximately 1,400 linear feet of Picnic Point Creek which is considered a Native Growth Protection Area. Wetland fill would also occur adjacent to station 38+00 (W1-1).

- The crossing of Wetland W2-1 would result in approximately 150 linear-feet of wetland fill, and would also impact wetland buffers. Compensatory mitigation would be required to satisfy federal, state, and local permit requirements.

Alignment 3 Advantages

- Utilizes existing road (Cyrus Way) right-of-way, thus minimizing potential critical area impacts.

Alignment 3 Disadvantages

- The existing road will need to be widened which will incur fill impacts to Wetlands W3-1, W3-2, W3-3, W3-4. Wetland W2-1 will also be impacted just as it is in Alignment 2. Compensatory mitigation would be required to satisfy federal, state, and local permit requirements.

ENVIRONMENTAL PERMITTING CONSIDERATIONS

The discussion below presents conclusions related to potential federal, state, and local environmental permitting requirements associated with the proposed road alignments. This discussion is based upon assumed impacts to wetlands, streams, or fish and wildlife resources that could result from construction as outlined in the Conclusions and Recommendations section above.

Federal Permits

Filling or dredging activities within wetland areas and other Waters of the U.S. (i.e. streams) would trigger Section 404 and 401 permit requirements, administered by the U.S. Army Corps of Engineers, Seattle District (Corps) and the Washington State Department of Ecology (Ecology) respectively. Both of these permits can be applied for using the Joint Aquatic Resource Permit Application (JARPA). Several supporting documents would need to be provided as part of these permit applications; including:

- Biological Assessment the Corps would be required to complete ESA Section 7 consultation with NOAA Fisheries and U.S. Fish and Wildlife Service prior to issuing a Section 404 permit. It is also required if the project is being funded partially or wholly with federal funds regardless of a Section 404 permit nexus;

- Wetland and Stream Delineation and Report; and

- Wetland Mitigation Report.

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The Corps may require the preparation of an Environmental Assessment (EA) for National Environmental Policy Act (NEPA) compliance, or the Corps may elect to utilize an internal process to satisfy NEPA requirements. If impacts to cultural resources are suspected, the Corps may require Section 106 National Historic Preservation Act compliance, in which case a technical report investigating potential impacts to cultural resources would be required.

State Permits

All alignments would require State permits including:

- Hydraulic Project Approval (HPA)
- State Environmental Policy Act (SEPA) Checklist

An HPA is required for any work that uses, diverts, obstructs, or changes the natural flow or bed of any water of the state. The HPA is issued by the Washington Department of Fish and Wildlife (WDFW) and is applied for using the JARPA. Information needed for an HPA includes general plans for the overall project, such as project alignment and construction typicals; detailed construction plans and specifications of the proposed work within waters of the state; detailed plans and specifications for the protection of fish life, including Best Management Practices (BMPs); and any proposed mitigation measures.

In the SEPA Checklist, project impacts are described, including all potential impacts to Geologically Sensitive Areas, wetlands, streams, vegetation, wildlife, air and water quality, and other natural resources. Land use, aesthetics, noise, light and glare, and other additional potential impacts are also detailed, along with measures to mitigate those impacts.

Local Permits – City of Mukilteo

All alignments would require compliance with The City's Critical Areas Ordinance, which includes the protection of wetlands and streams. Projects that incur impacts on wetlands, streams, and associated buffers would require a Wetland and Stream Delineation and Report and a Wetland Mitigation Report. Table 2 summarizes the potential permit requirements for the three alignments.

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Table 2. Summary of Potential Environmental Compliance Requirements

Alternative	Compliance Requirement	Regulatory Agency	Activity triggering requirement	Associated Plans, Reports, or Applications Required
Alignment 1	Section 404 Clean Water Act	U.S. Army Corps of Engineers (Corps)	Dredging or excavation in wetlands	Joint Aquatic Resources Permit Application Biological Evaluation Wetland and Stream Delineation and Report Conceptual Wetland Mitigation Report
	Section 401 Clean Water Act	Department of Ecology (Ecology)	Dredging or excavation in wetlands	JARPA
	National Environmental Policy Act (NEPA)	Corps	Federally funded or permitted project with potential environmental impacts	Categorical Exclusion, NEPA Environmental Assessment, or NEPA Environmental Impact Statement (EIS)
	Section 106 National Historic Preservation Act	Federal lead agency (Corps) or State historic Preservation Office (SHIPO)	Potential effects to cultural resources	Section 106 Cultural Resources Technical Report
	Endangered Species Act Section 7 Consultation	NOAA Fisheries and U.S. Fish and Wildlife Service (USFWS)	Required in conjunction with Corps Section 404 permit or federal funding	Biological Evaluation (BE)
	Hydraulic Project Approval (HPA)	Washington Department of Fish and Wildlife (WDFW)	Diversion of surface water flow	JARPA
	State Environmental Policy Act	City of Mukilteo	Project with potential environmental impacts	SEPA Checklist Environmental Assessment or EIS
	Critical Areas Ordinance	City of Mukilteo	Impacts to wetlands, streams, and associated buffers	Critical Areas Report, including a wetland and stream delineation and mitigation plan.
Alignment 2	Same as above			
Alignment 3	Same as above			

11820 Northup Way, Suite E300 • Bellevue, WA 98005-1946 • tel. 425 822.1077 • fax 425 822.1079
www.jonesandstokes.com

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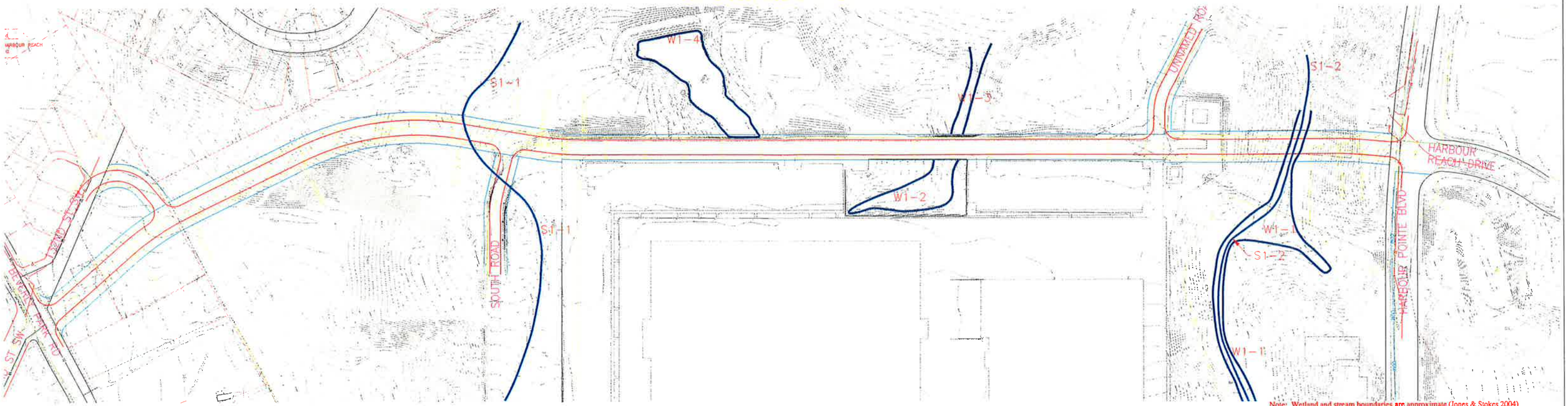

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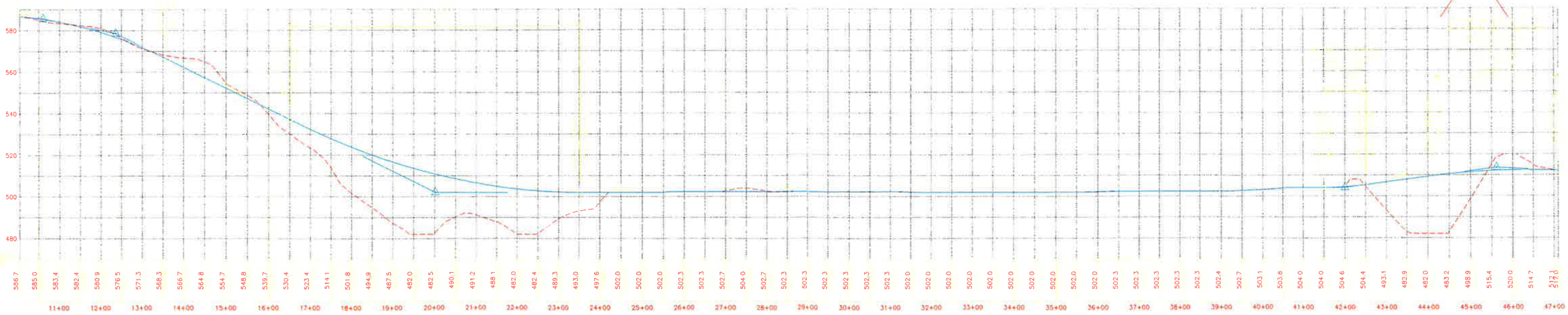
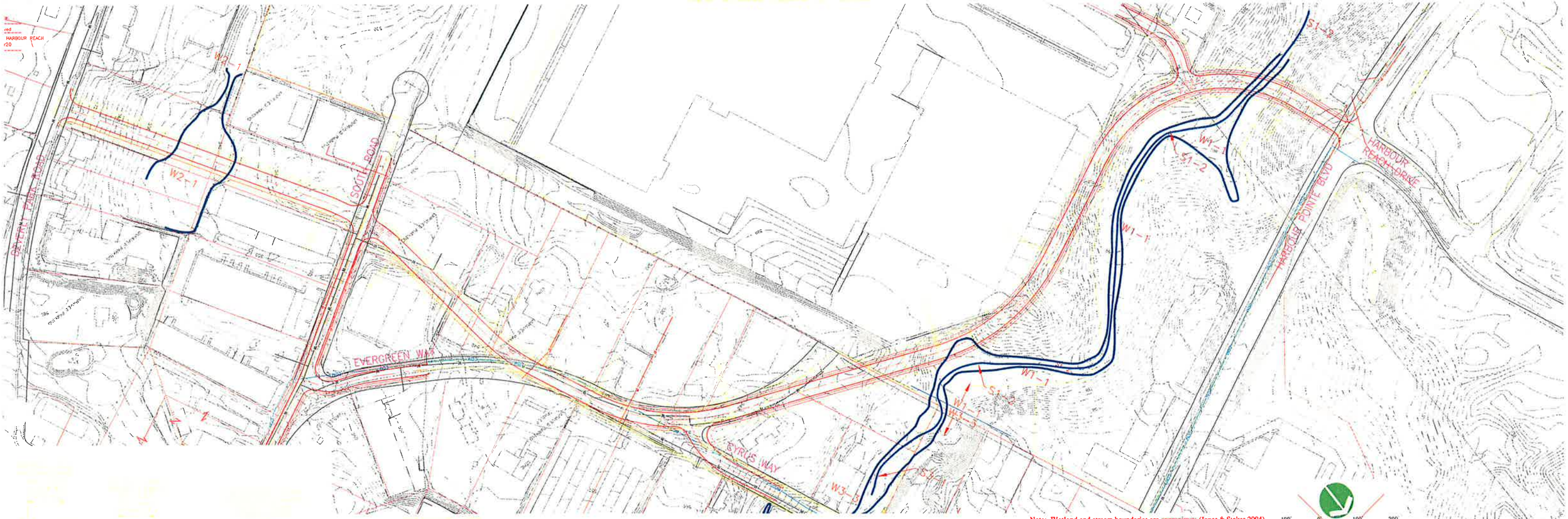
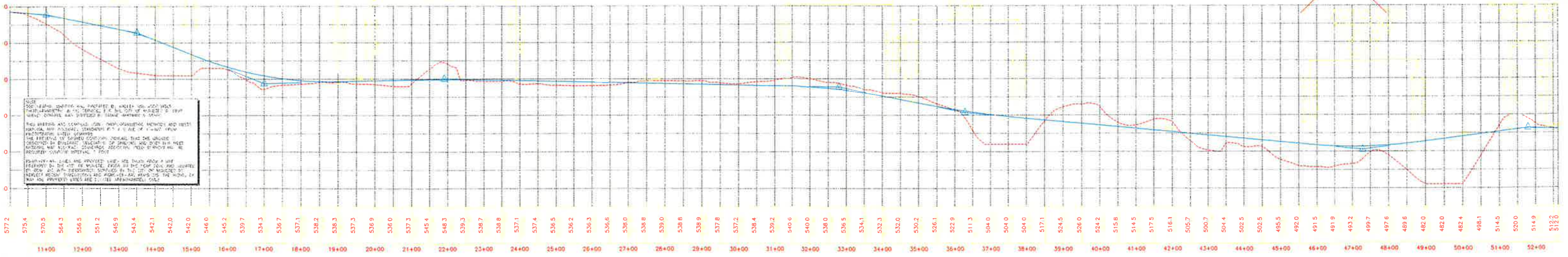


HARBOR REACH EXTENSION: ALIGNMENT 1



Note: Wetland and stream boundaries are approximate (Jones & Stokes 2004)



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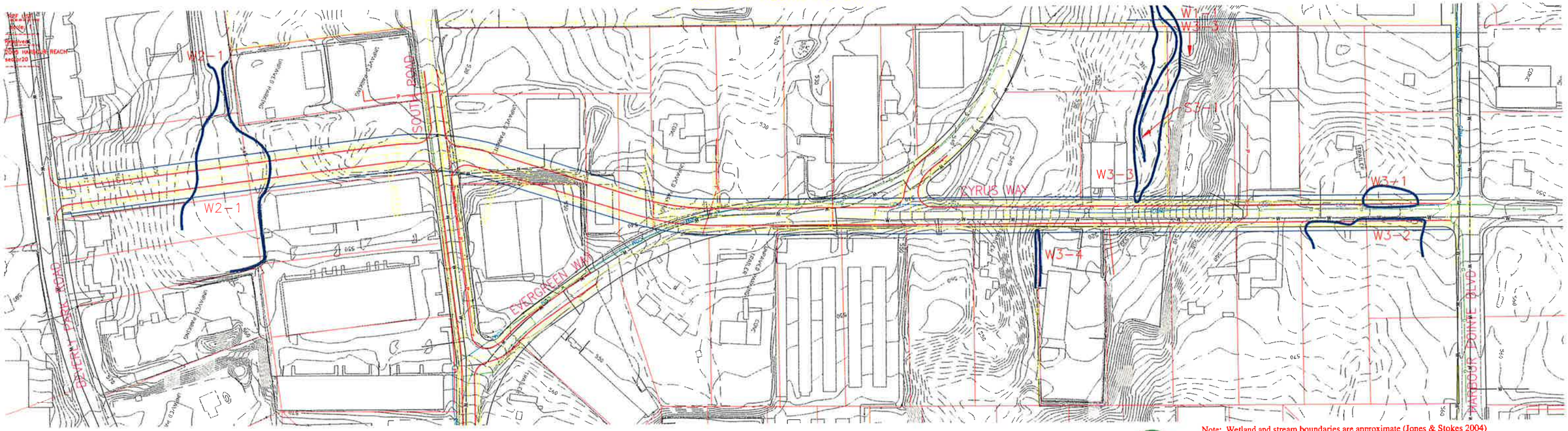
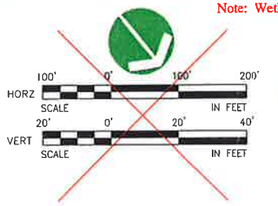


Note: Wetland and stream boundaries are approximate (Jones & Stokes 2004)

NOTE
TOPOGRAPHIC MAPPING WAS PREPARED BY WALKER AND ASSOCIATES PHOTOGRAMMETRIC & GIS SERVICES FOR THE CITY OF MUKILTEO IN 1998 SURVEY CONTROL WAS SUPPLIED BY DUANE MARTIKAN & ASSOC

THIS MAPPING WAS COMPILED USING PHOTOGRAMMETRIC METHODS AND MEETS NATIONAL MAP ACCURACY STANDARDS FOR A SCALE OF 1"=100' FROM PHOTOGRAPHY DATED: 08MAR98
THE PRESENCE OF DASHED CONTOURS INDICATE THAT THE GROUND IS OBSCURED BY BUILDINGS, VEGETATION OR SHADOWS AND DOES NOT MEET NATIONAL MAP ACCURACY STANDARDS. ADDITIONAL FIELD SURVEYS MAY BE REQUIRED CONTOUR INTERVAL 2 FOOT

RIGHT-OF-WAY LINES AND PROPERTY LINES ARE TAKEN FROM A MAP PREPARED BY THE CITY OF MUKILTEO PRIOR TO THE YEAR 2000 AND UPDATED BY OTAK, INC WITH INFORMATION SUPPLIED BY THE CITY OF MUKILTEO TO REFLECT RECENT SUBDIVISIONS AND RIGHT-OF-WAY REVISIONS. THE RIGHTS OF WAY AND PROPERTY LINES ARE LOCATED APPROXIMATELY ONLY



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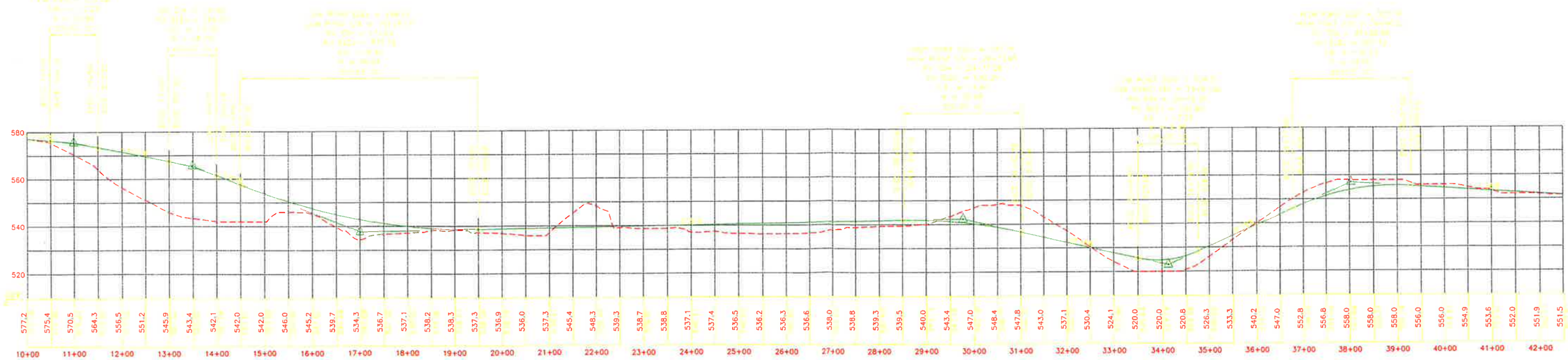


HARBOR REACH EXTENSION: ALIGNMENT 3

Appendix C — Memorandum
Harbour Reach Drive Extension
Traffic Operational Needs Analysis
TENW
December 16, 2004

Transportation Engineering NorthWest, LLC

Memorandum

DATE: December 16, 2004

TO: Lori McFarland, Otak

CC: Tom Hansen, City of Mukilteo

FROM: Michael J. Read, P.E., Transportation Engineering Northwest, LLC

RE: Harbour Reach Drive Extension – Traffic Operational Needs Analysis

This memorandum documents traffic operational analysis to identify intersection and channelization needs in support of alternative alignments for the Harbour Reach Drive Extension Project in Mukilteo, WA. The operational analysis was based upon three plan/profile alignments transmitted to Transportation Engineering Northwest, LLC (TENW) on May 6, 2004.

General Assumptions

The roadway alignments generally include:

Alignment 1 – Extension of Harbour Reach Drive generally south from its current intersection with Harbour Point Boulevard, through Sector 20 of the Harbour Point Master Plan, adjacent to existing light industrial buildings, and intersecting Beverly Park Road at 132nd Street SW. From a traffic distribution perspective, this alignment option provides the highest benefit in diverting traffic from SR 525 between Harbour Pointe Boulevard and Beverly Park Road. Initially, this alternative was evaluated with no restrictions to access between the roadway extension and 132nd Street SW.

Alignment 2 – Begins to the north as the same intersection as Alignment 1, but heads easterly on the north and east sides of existing light industrial buildings in Sector 20, touching Evergreen Drive/Cyrus Way for a short segment, intersecting with South Road, and then continues southwest intersecting Beverly Park Road approximately 1,000 feet west of SR 525. While this alignment does extend Harbour Reach Drive, its circuitous alignment easterly diminishes its ability to divert traffic off of SR 525 over Alignment 1.

Alignment 3 – This alignment uses Cyrus Way south from its intersection with Harbour Pointe Boulevard, and follows the southern portion of Alignment 2, intersecting Beverly Park Road approximately 1,000 feet west of SR 525. This alignment continues to provide some benefit in diverting traffic off of SR 525, although, less so than Alignments 1 and 2.

Figures 1 through **3** outline the basic configuration of these alternative roadway alignments and channelization assumptions applied in the traffic operational analysis. All roadway extension alignments and industrial road segments within the study assume a 3-lane cross-section.

Figure 1: Alignment 1 Conceptual Configuration/Channelization

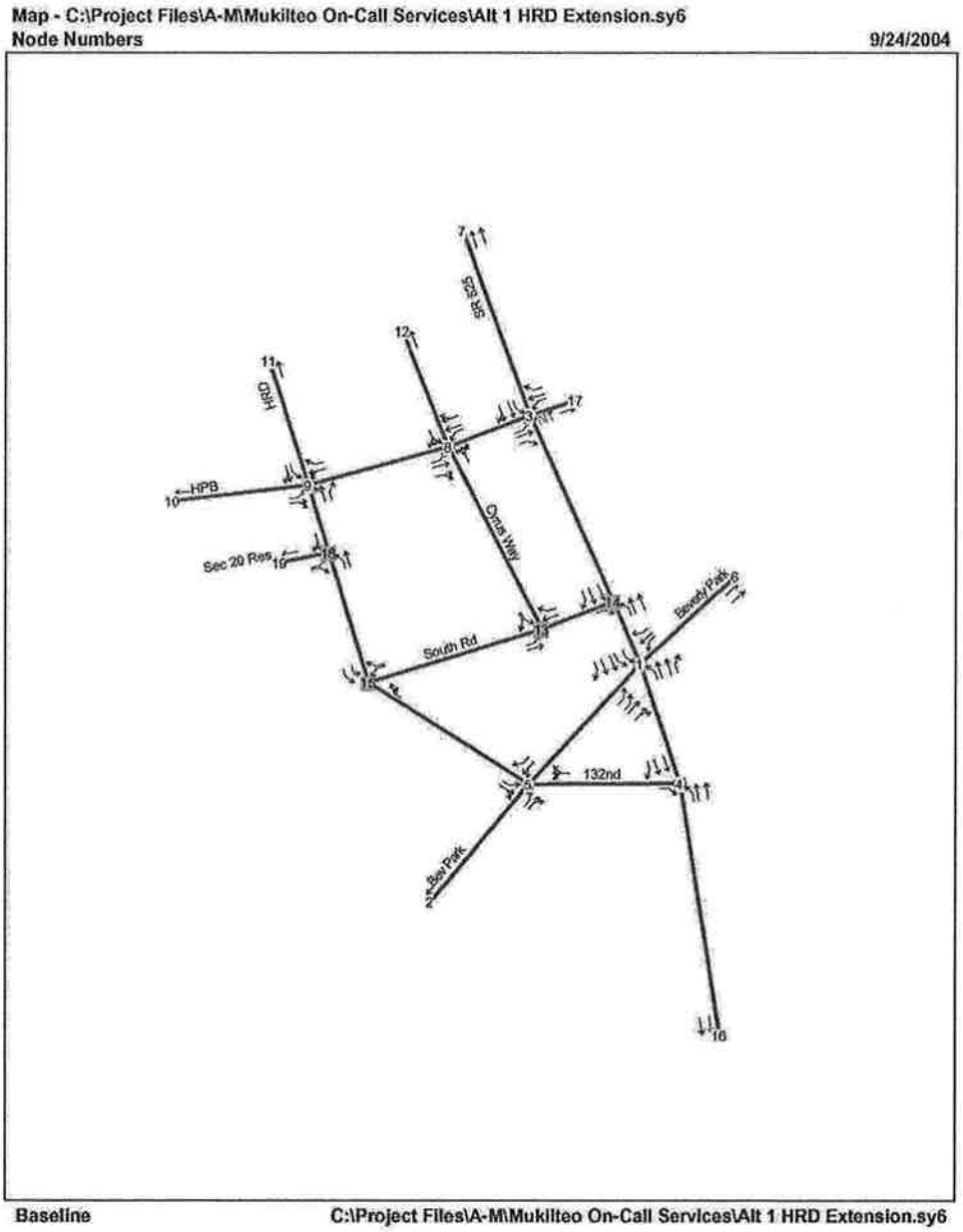


Figure 2: Alignment 2 Conceptual Configuration/Channelization

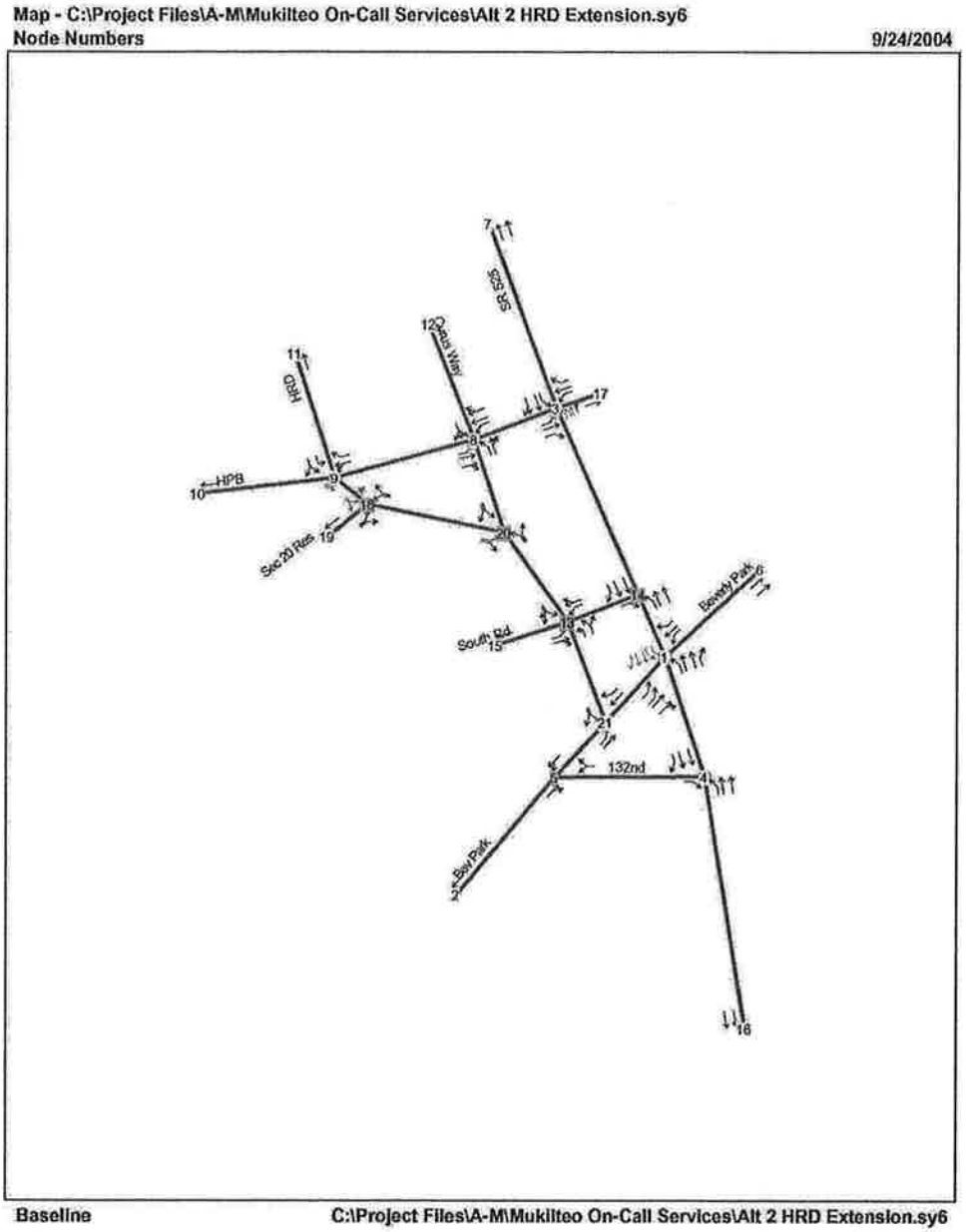
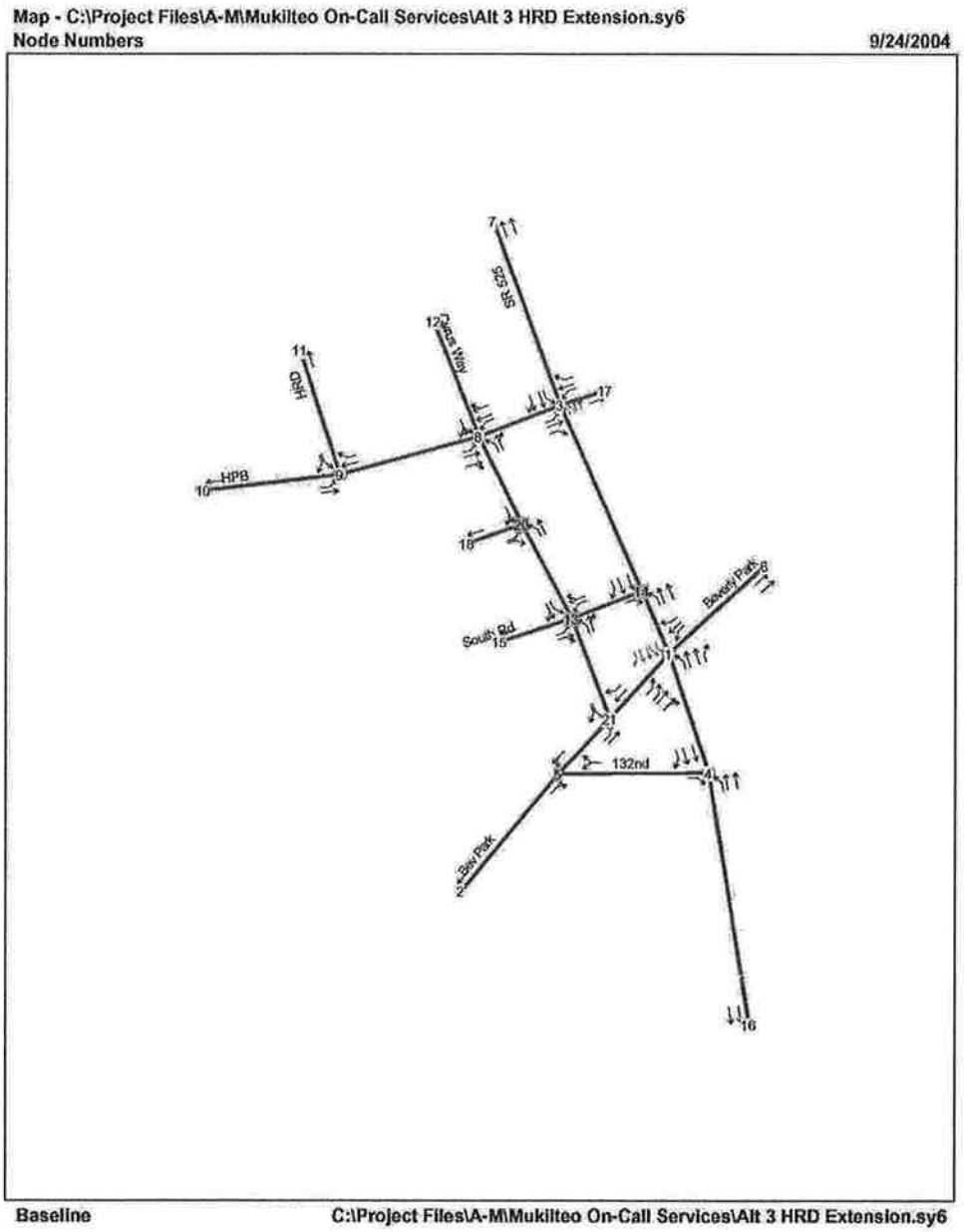


Figure 3: Alignment 3 Conceptual Configuration/Channelization



Traffic Forecasts/Operational Analysis

Traffic forecasts were based upon Sector 20 and Comprehensive Plan Update 2020 analyses prepared by Transportation Engineering Northwest in 2003, and consider roadway extensions of Harbour Reach Drive only. Future year trip generation at Sector 20, assumed 150 single-family homes and a total of 1.1 million square feet of light industrial uses, which translates into a p.m. peak hour trip generation of 960 vehicle trips (270 entering and 690 exiting).

A macrosimulation model was created representing each alternative roadway network. Refined 2020 traffic forecasts were prepared under each alignment option, and evaluated using Synchro 6.0. Intersection levels of service, traffic control parameters, and vehicle queuing were generated using methods and procedures consistent with the *2000 Highway Capacity Manual.* All future year signalized intersections were evaluated assuming optimized phasing and timing.

Table 1 summarizes intersection levels of service at key locations under each alignment option. As shown, as the diversion potential diminishes from Alignment 1 to 3, intersection levels of service at key locations on SR 525 experience increased congestion.

Table 1: 2020 Intersection Levels of Service by Alignment

Intersection	*Traffic Control*	No Action	Alignment 1	Alignment 2	Alignment 3
		LOS Delay	LOS Delay	LOS Delay	LOS Delay
SR 525 at Beverly Park	*Signalized*	F >100	D 51	D 55	E 55
SR 525 at Harbour Pointe Blvd	*Signalized*	F 98	E 57	E 65	E 77
Cyrus Way at Harbour Pointe Blvd	*Signalized*	D 42	C 29	C 28	C 30
Harbour Reach Drive at Harbour Pointe Blvd	*Signalized*	B 13	B 20	B 24	D 40
Harbour Reach Drive at Beverly Park Drive	*Signalized*	n/a	C 31	n/a	n/a
Cyrus Way at Beverly Park Drive	*Signalized*	n/a	n/a	D 40	C 30

Note: Analysis based on Synchro 6 and HCS 2000 results using HCM 2000 LOS and control delays.
All delays are expressed in seconds per vehicle.

Tables 2 through **7** summarize vehicle queuing estimates and recommended channelization storage for critical movements at signalized and unsignalized intersections along each roadway alignment evaluated. At two-way stop controlled T-intersections, median space was assumed to be available for refuge within the center lane for critical left turns onto the major street as well as to provide storage for left turning vehicles from the major street onto minor streets. In addition, separate left and right turning lanes were assumed on all minor stop controlled side streets or major private roadways serving Sector 20.

Table 2: Harbour Reach Drive and Harbour Point Boulevard

	Southbound	Northbound	Westbound	Eastbound
	Left	Right	Right	Left
Alignment 1				
95th-percentile Queue	6 vehicles	2 vehicles	4 vehicles	<1 vehicles
Recommended Storage Length	150 feet	100 feet	150 feet	100 feet
Alignment 2				
95th-percentile Queue	10 vehicles	5 vehicles	8 vehicles	<1 vehicles
Recommended Storage Length	250 feet	125 feet	200 feet	100 feet

Notes: As defined by the 2000 Highway Capacity Manual: Maximum Queue - 95th Percentile.
Average length between the front bumpers of two successive vehicles in a stationary queue was assumed to be 25 feet.
95th-percentile queuing estimates at unsignalized intersections were estimated using simulation runs of SimTraffic.

Table 3: Harbour Reach Drive Extension at Sector 20 Private Roadway (#18)

	Northbound	Eastbound
	Left	Left
Alignment 1		
95th-percentile Queue	2 vehicles	1 vehicles
Recommended Storage Length	100 feet	100 feet
Alignment 2		
95th-percentile Queue	3 vehicles	<1 vehicles
Recommended Storage Length	100 feet	100 feet

Notes: As defined by the 2000 Highway Capacity Manual: Maximum Queue - 95th Percentile.
Average length between the front bumpers of two successive vehicles in a stationary queue was assumed to be 25 feet.
95th-percentile queuing estimates at unsignalized intersections were estimated using simulation runs of SimTraffic.

Table 4: Harbour Reach Drive Extension at South Road (#15-A1, #13-A2/A3)

	Southbound	Westbound	Northbound	Eastbound
	Left	Left	Left	Left
Alignment 1				
95th-percentile Queue	<1 vehicles	4 vehicles		
Recommended Storage Length	100 feet	150 feet		
Alignment 2				
95th-percentile Queue	<1 vehicles	2 vehicles	<1 vehicles	4 vehicles
Recommended Storage Length	100 feet	100 feet	100 feet	150 feet
Alignment 3				
95th-percentile Queue	3 vehicles	2 vehicles	2 vehicles	3 vehicles
Recommended Storage Length	150 feet	100 feet	100 feet	150 feet

Notes: As defined by the 2000 Highway Capacity Manual: Maximum Queue - 95th Percentile.
Average length between the front bumpers of two successive vehicles in a stationary queue was assumed to be 25 feet.
95th-percentile queuing estimates at unsignalized intersections were estimated using simulation runs of SimTraffic.

Table 5: Harbour Reach Drive Extension at Cyrus Way (#20-A2)

	Southbound	Eastbound
	Left	Left
Alignment 2		
95th-percentile Queue	7 vehicles	2 vehicles
Recommended Storage Length	200 feet	100 feet

Notes: As defined by the 2000 Highway Capacity Manual: Maximum Queue - 95th Percentile.
Average length between the front bumpers of two successive vehicles in a stationary queue was assumed to be 25 feet.
95th-percentile queuing estimates at unsignalized intersections were estimated using simulation runs of SimTraffic.

Table 6: Harbour Reach Drive Extension at Cyrus Way (#20-A3)

	Eastbound	Northbound
	Left	Left
Alignment 3		
95th-percentile Queue	4 vehicles	2 vehicles
Recommended Storage Length	150 feet	100 feet

Notes: As defined by the 2000 Highway Capacity Manual: Maximum Queue - 95th Percentile.
Average length between the front bumpers of two successive vehicles in a stationary queue was assumed to be 25 feet.
95th-percentile queuing estimates at unsignalized intersections were estimated using simulation runs of SimTraffic.

Table 7: Harbour Reach Drive/Cyrus Way and Beverly Park Road

	Southbound	Eastbound	Westbound
	Left	Left	Right
Alignment 1			
95th-percentile Queue	16 vehicles	12 vehicles	1 vehicles
Recommended Storage Length	350 feet	300 feet	150 feet
Alignment 2			
95th-percentile Queue	8 vehicles	8 vehicles	1 vehicles
Recommended Storage Length	200 feet	200 feet	150 feet
Alignment 3			
95th-percentile Queue	8 vehicles	6 vehicles	1 vehicles
Recommended Storage Length	200 feet	150 feet	150 feet

Notes: As defined by the 2000 Highway Capacity Manual: Maximum Queue - 95th Percentile.
Average length between the front bumpers of two successive vehicles in a stationary queue was assumed to be 25 feet.
95th-percentile queuing estimates at unsignalized intersections were estimated using simulation runs of SimTraffic.

Notes:

Under Alignment 3, the 4-way intersection of Cyrus Way and South Road is recommended to be controlled with all-way stops. The intersection would operate at LOS B under this traffic control configuration.

No vehicle back-queuing between intersections would result if these storage lengths are provided. Adequate spacing shown on the alignments plans is provided between signalized intersections and new unsignalized public intersections/private roadways.

Alternative 1 – Potential Secondary Traffic Impacts and Mitigation Options

The preferred alignment (Alignment 1) would extend Harbour Reach Drive from its current intersection with Harbour Pointe Boulevard to Beverly Park Road at its intersection with 132nd Street SW. Connecting this proposed arterial roadway at this particular location along Beverly Park Road could have potential secondary impacts of diverting existing and future traffic onto 132nd Street SW between Beverly Park Road and SR 525. In our initial evaluation of the alignment alternative, no turning restrictions were assumed between Harbour Reach Drive and 132nd Street SW.

The existing 132nd Street SW is within unincorporated Snohomish County and is classified as a local street, serving a mixture of single-family residential lots, multifamily homes, and commercial/industrial uses. It intersections SR 525 in a T-intersection, and has restricted left turning movements from 132nd Street SW onto SR 525. All other movements are allowed. Although no current traffic count data is available, it is estimated that existing traffic volumes are low on 132nd Street SW, with less than 1,000 average daily vehicles, and likely around 50 or less p.m. peak hour trips.

Three mitigation options were considered to address potential secondary impacts of the Alternative 1 Harbour Reach Drive extension on 132nd Street SW:

Mitigation Option 1: Would allow full traffic movements at both of its main intersections with Beverly Park Road and SR 525. This option would require reconstruction and widening of the 132nd Street SW roadway to current standards and install signals at both main intersections. Conclusions: This mitigation option would be very expensive and not result in much benefit to traffic circulation in the study area. This option would also have the largest impact to property owners along 132nd Street SW.

The new signalized intersection of Harbour Reach Drive/132nd Street SW and Beverly Park Road would operate at LOS C, while stop controlled/yield turning movements from 132nd Street SW onto SR 525 would operate at LOS D or better. However, this mitigation option was discarded from further consideration given likely impacts to properties along 132nd Street SW and costs of roadway reconstruction. Between 150 and 200 vehicles per hour are estimated to utilized 132nd Street SW under this configuration.

Mitigation Option 2: Would restrict turning movements to minimize potential secondary traffic impacts from Harbour Reach Drive Extension. Two sub options were considered, with the preferred option as 2A:

> *Mitigation Option 2A.* In constructing a new signalized intersection of Harbour Reach Drive and Beverly Park Road, restrict through movements from Harbour Reach Drive and 132nd Street SW. To maximize benefit of Harbour Reach Drive extension, northbound and westbound left turning movements at the intersection would be restricted (i.e., left turning movements from 132nd Street SW onto Beverly Park Road and left turning movements from Beverly Park Road onto SW 132nd Street). The 132nd Street SW approach to Beverly Park Road would act as a

right-in, right-out only. A conceptual configuration of the intersection is provided in **Figure 4**.

Under Mitigation Option 2A, turning movement conflicts would be reduced slightly at the new signalized intersection of Harbour Reach Drive/132nd Street SW and Beverly Park Road over Mitigation Option 1. Estimated 2020 signalized operations would remain at LOS C, while delay of stop controlled/yield movements at 132nd Street SW and SR 525 would improve to LOS C or better.

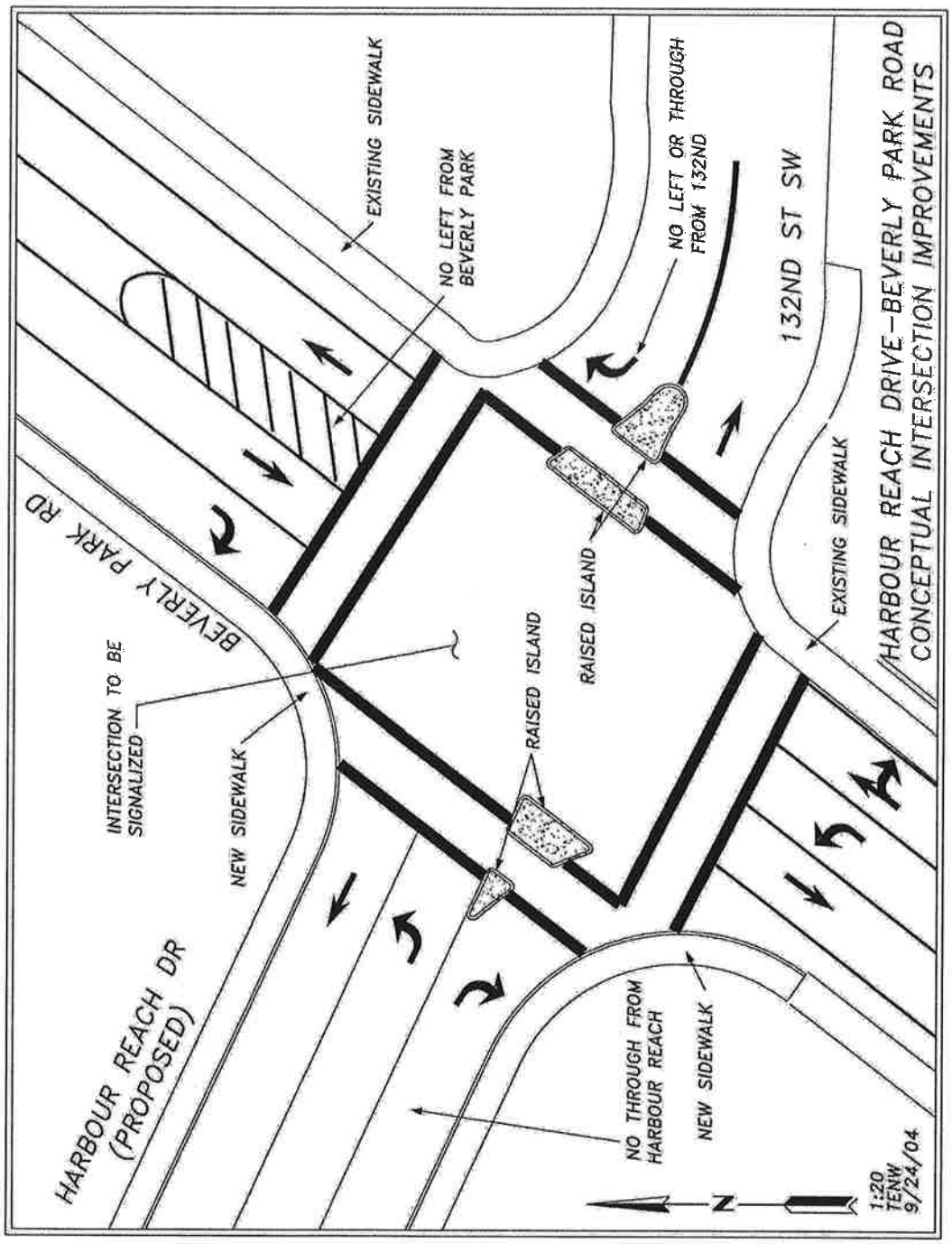
Mitigation Option 2B. Restrict all movements to/from 132nd Street at SR 525. This would require street closure with a turnaround at the end of 132nd Street SW. Full turning access would be provided at the signalized intersection onto Beverly Park Road. Signalized operations would remain at LOS C at the Harbour Reach Drive/132nd Street SW and Beverly Park Road intersection.

Vehicle trips that would have otherwise used 132nd Street SW between SR 525 and Harbour Pointe would utilize SR 525, and result in similar operations at key signalized intersections of Beverly Park Road and Harbour Reach Boulevard as Alignment 2.

Mitigation Option 3: Would allow existing movements at 132nd Street SW and SR 525 and full movements at the new signalized intersection with Beverly Park Road and Harbour Reach Drive/132nd Street SW. Traffic calming measures would be installed along 132nd Street SW to manage traffic speeds and discourage cut-thru traffic along this local road, such that turning movement restrictions would not be required at either end of the roadway. The potential for cut-thru traffic would remain, albeit at a reduced level to Mitigation Option 1. Allowing full access under this mitigation option would be a tradeoff with turning restrictions under Mitigation Options 2A/2B versus encountering physical devices along 132nd Street SW and some reduced level of cut-through traffic over Mitigation Option 1. Signalized operations would remain at LOS C at Beverly Park Road, while stop controlled/yield movements at its intersection with SR 525 would remain similar to Mitigation Option 2A, or LOS C.

Based upon our evaluation of potential mitigation options under Alignment 1, Mitigation Option 2A (turning movement restrictions at a new signalized intersection of Harbour Reach Drive/132nd Street SW and Beverly Park Road) is recommended as it would be the most cost effective alternative that provides a maximum level of mitigating possible secondary traffic impacts of extending Harbour Reach Drive.

Figure 4: Mitigation Option 2A under Alignment 1
New Signalized Intersection of Harbour Reach Dr/132nd St SW and Beverly Park Rd



Appendix D — Geotechnical Reconnaissance Report
Zipper Zeman Associates, Inc.
August 12, 2004

Zipper Zeman Associates, Inc.
Geotechnical and Environmental Consulting

J-1861
13 August 2004

City of Mukilteo
4480 Chennault Beach Road
Mukilteo, Washington 98275

Attention: Mr. Tom Hansen, P.E.
Director of Public Works

Subject: Geotechnical Reconnaissance Report
Harbour Reach Drive Extension Project
Mukilteo, Washington
Task Order No. 3

Dear Mr. Hansen:

Zipper Zeman Associates, Inc. (ZZA) is pleased to present our *Geotechnical Reconnaissance Report* regarding the Harbour Reach Drive Extension Project. The report presents the results of our document review, field reconnaissance, and preliminary geotechnical analysis relative to the three prospective road alignments. These services have been provided in general accordance with our agreement with the City of Mukilteo for on-call geotechnical consulting services and our *Task Order No. 3 Scope of Services and Fee Estimate* (dated 20 April 2004).

We appreciate the opportunity to provide these services. Please call if you have any questions.

Respectfully Submitted,

ZIPPER ZEMAN ASSOCIATES, INC.

JAMES B. THOMPSON
STATE OF WASHINGTON
19409
REGISTERED
PROFESSIONAL ENGINEER

8/13/04

EXPIRES 4/3/2006

David C. Williams, L.E.G.
Associate

James B. Thompson, P.E.
Principal

Distribution: Addressee (10)
Otak (1)
Jones & Stokes, Inc. (1)

18905 33rd Avenue West #117, Lynnwood, WA 98036 (425) 771-3304 Fax: (425) 771-3549

Zipper Zeman Associates, Inc.
Geotechnical and Environmental Consulting

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Figure 3	Alignment 2: Plan & Profile (in pocket)
Figure 4	Alignment 3: Plan & Profile (in pocket)
Figure 5	Alignment Comparison Table

Zipper Zeman Associates, Inc.
Geotechnical and Environmental Consulting

GEOTECHNICAL RECONNAISSANCE REPORT
HARBOUR REACH DRIVE EXTENSION PROJECT
MUKILTEO, WASHINGTON

1.0 SUMMARY

Presented below is a summary of the principal conclusions and recommendations contained within this report. This summary is presented for introductory purposes only, and should be used in conjunction with the full text of this report.

- Three alternative alignments for the Harbour Reach Drive Extension are under consideration by the City of Mukilteo. Each prospective alignment will provide connectivity between Beverly Park Road at the south and Harbour Pointe Boulevard at the north;

- Alignment 1, the westernmost alignment, crosses two ravines, passes through wooded terrain, and also follows an existing road on Boeing property. Alignment 2, the intermediate alignment, crosses a ravine and a ravine sideslope at the north, follows an existing road in the middle and passes through developed properties at the south. Alignment 3, the easternmost alignment, follows an existing road at the north and passes through developed properties at the south ;

- The site vicinity is predominantly underlain at shallow depths by Vashon lodgement glacial till. Secondary surficial recessional outwash deposits and fill material have been documented along the alignments. Recent alluvium is present within the ravine features. Granular advance outwash deposits underlie the glacial till at depths of 10 to 60 feet;

- Discontinuous groundwater perched above or within the glacial till has been documented at variable depths in the project vicinity. The regional groundwater table is generally within the advance outwash deposits below the glacial till;

- The alignments lack evidence of significant erosion or landsliding, including the ravine features located at the southern and northern portions of the site vicinity;

- The lodgement glacial till will be well suited for support of bridge, retaining wall, and culvert foundations;

- Road subgrade improvement is likely to be required in areas underlain by recent alluvium, significantly weathered glacial till, and in areas of undocumented fill;

- It would be feasible from the geotechnical perspective to use the native glacial till and outwash deposits as structural fill borrow, although the till is moisture-sensitive and

grading with the till soils will only be feasible during periods of extended dry weather unless soil amendments such as cement or kiln dust are used during wet weather.

2.0 SITE AND PROJECT DESCRIPTION

The City of Mukilteo is evaluating three alternative routes for constructing a new road that will connect Beverly Park Road on the south with Harbour Pointe Boulevard on the north. The routes roughly parallel each other and are bounded by Harbour Reach Drive on the west and Cyrus Way on the east. The new road will be constructed within an 80-foot right-of-way. The proposed alignments of the Harbour Reach Drive Extension are summarized below. The alignments are shown on the enclosed *Project Location Map,* Figure 1.

The City has retained OTAK as lead consultant in the alternative route evaluation process, providing civil, structural, and permitting assistance. Jones & Stokes, Inc. is providing environmental review services, and ZZA is providing geotechnical and engineering geology review services. Our understanding of the project is based upon information provided during a 14 April 2004 scoping meeting held at the City offices, as well as review of undated preliminary plan and profile drawings prepared by OTAK.

2.1 Alignment 1

The western route, Alignment 1, will extend from the intersection of Harbour Reach Drive and Harbour Point Boulevard at the north to the intersection of Beverly Park Road and 132nd Street S.W. at the south. The alignment is approximately 3,700 feet long. Alignment 1 will incorporate an existing road located along the west side of a Boeing-owned commercial facility and will include two ravine crossings, one at the north end of the alignment (North Ravine) and one immediately south of the Boeing property (South Ravine). Construction of an open-bottom metal arch culvert is anticipated for the South Ravine crossing, and construction of a three span bridge with a center section on the order of 150 feet long is anticipated for the North Ravine crossing, according to the City of Mukilteo The southern portion of the alignment passes through undeveloped wooded terrain adjacent to the South Ravine and through existing residential property located west of Beverly Park Road.

2.2 Alignment 2

The middle route, Alignment 2, will extend from the intersection of Harbour Reach Drive and Harbour Point Boulevard at the north, cross the North Ravine, and then extend to the east along the south slope of the North Ravine to the eastern end of the Boeing property. The alignment follows Evergreen Drive to Cyrus Way for a short distance, then extends southward through partially developed commercial property to South Road. The alignment then passes through an undeveloped field that abuts a developed residential property located on the north side of Beverly Park Road. Alignment 2 is approximately 4,250 feet long.

2.3 Alignment 3

Alignment 3, the eastern route, will follow the existing Cyrus Way right-of-way south from Harbour Pointe Boulevard to the intersection with Evergreen Drive. The alignment will then extend south of Evergreen Drive along the same southerly portion as Alignment 2. Alignment 3 is approximately 3,250 feet long.

3.0 SITE CONDITIONS

Site conditions were evaluated by reviewing published geologic maps, reviewing geotechnical reports prepared by ZZA and others that describe conditions in the site vicinity, and by observing surface conditions during a field reconnaissance. We referred to plan and profile drawings for the three alternative alignments during our reconnaissance, and the centerline stationing on the plans is referenced in the sections below.

Documents referenced as part of our review included:

- Washington Department of Natural Resources, Division of Geology and Earth Resources, Preliminary Surficial Geologic Map of the Mukilteo and Everett Quadrangles, Snohomish County, Washington, Map GM-20, 1976;
- U.S. Geological Survey, The Ground-Water System and Ground-Water Quality in Western Snohomish County, Washington, Water Resources Investigation 96-4312, 1996;
- U.S. Geological Survey, Seismotectonic Map of the Puget Sound Region, Washington, Map I-1613, 1985;
- City of Mukilteo, Critical Areas and Landslide Hazard Map, 30 June 2000;
- U.S. Department of Agriculture, Soil Conservation Service, *Soil Survey of Snohomish County Area Washington*, July 1983;
- GeoEngineers, Inc., Report – Geotechnical Feasibility Study, Boeing Harbour Pointe Sector 20 Development, dated 27 November 2004;
- GeoSource Engineering, Inc., Subsurface Exploration, Slope Stability and Drainage Options Report – Pacific Point Division 2, Mukilteo, Washington, dated 6 August 1999.

3.1 Geology

3.1.1 Geologic Units

The project site vicinity is mantled by Vashon lodgement glacial till, locally overlain by recessional outwash deposits and, in isolated areas, peat. Recent alluvium is present along

drainage corridors that have relatively wide bottoms. Fill material resultant from logging, mining, and development activity is present as well. The nature and distribution of these soils is described below. The general distribution of these soils, with the exception of peat, is shown on Figures 2, 3, and 4.

Vashon Lodgement Till

The Vashon till is a glacially consolidated, heterogeneous deposit consisting of clay, silt, sand, gravel, cobbles, and boulders. A relatively high density, shear strength, and resistance to erosion by surface water characterize the till. The till is capable of maintaining relatively steep slope inclinations and is well suited for support of substantial foundation loads. The upper 3 to 5 feet of undisturbed till is typically weathered to a less dense state than the underlying unweathered material. Groundwater may perch above the till due to its relatively low permeability, and laterally discontinuous groundwater zones may be present within the till. Till can be utilized as structural fill borrow, although its moisture sensitivity typically limits its use to favorable weather conditions. Weathered glacial till was observed in shallow excavations made along the sides of the North Ravine and the South Ravine, and it has been documented to mantle much of the site vicinity. Published geologic maps indicate that the till is on the order of 10 to 60 feet thick and is generally underlain at depth by advance outwash deposits below approximately elevation 400 feet.

Recessional Outwash

Recessional outwash comprises loose to medium dense sand and gravel that was deposited by water flowing above the Vashon till. The recessional outwash maintains moderate slope inclinations, may be susceptible to erosion by flowing surface water, and can accommodate light to moderate foundation loads. The recessional deposits are frequently chosen as receptor soils for surface water infiltration systems due to the material's favorable permeability characteristics. Recessional outwash is frequently mined for general fill borrow applications given its relatively low silt and clay content, which facilitates its use under a variety of weather conditions. Explorations completed by GeoEngineers on the commercial property located immediately northeast of the Alignment 1 intersection with Harbour Pointe Drive disclosed laterally discontinuous deposits of recessional outwash.

Recent Alluvium

Recent alluvial deposits in the site vicinity are found on the floors of drainage features, including the North Ravine and South Ravine. The alluvium consists of silt to gravel size particles, frequently with intermixed organic materials. The alluvium is generally soft or loose and easily eroded by flowing surface water. The alluvium is generally not well suited for support of foundations or embankments.

Peat

Peat is accumulated organic material that may have secondary silt, clay, and sand content. Peat deposits are generally in a very soft to soft condition. Published geologic reports indicate

that peat deposits have historically been mapped in depressions in the underlying till surface. We have also interpreted site conditions to suggest that peat may be present in the North Ravine and the South Ravine. Peat previously mapped in upland areas may have been removed during historical development activity, or may have been buried under fill material. Peat is inadequate for support of structures or embankments due to the load sensitivity of the material.

Fill Material

Fill material comprises soil and other materials used to construct embankments, roads, and other features as part of land development, mining, or logging activity. The composition of fill can vary widely, as can its density, stability on hillsides, and permeability. Fill material is present along developed portions of the alignments, and may be present in the wooded area between approximately STA 19+50 and STA 21 near the South Ravine on Alignment 1.

3.1.2 U.S.D.A. Soil Units

The Soil Conservation Service has mapped almost the entire project site vicinity as mantled by Everett series soils. The Everett series soils area derived from glacial outwash and are considered relatively permeable. The far southern portion of the site area in the vicinity of the southern end of Alignment 1 has been mapped as Alderwood soils, derived from glacial till. Smaller areas associated with developed property and roads have been mapped as the Alderwood Urban Land Complex. Based upon our review of maps published by U.S.G.S. and the Washington State Department of Natural Resources, as well as geotechnical reports prepared for a several properties in the area, it appears that the Alderwood soils (derived from glacial till) are far more common in the project site vicinity than shown on the Soil Conservation Service mapping.

3.2 Groundwater

The project site vicinity is characterized by laterally discontinuous occurrences of groundwater within the native sediments and fill material that overlie the Vashon till. Groundwater within these materials may be found at variable depths and is typically perched above the unweathered glacial till. A shallow aquifer is present within the alluvium that mantles the floor of both the North Ravine and the South Ravine. Discontinuous water-bearing zones within the till have been documented as well. A regional aquifer is found within the advance outwash deposits that underlie the glacial till. Groundwater measurements taken in wells installed in the site vicinity have shown the elevation of the regional aquifer to be in the range of 270 to 360 feet. It should be noted that groundwater conditions and soil moisture contents are expected to vary with changes in season, precipitation, site utilization, and other on- and off-site factors.

3.3 Seismic Conditions

Figure 16-2 presented in the 1997 Uniform Building Code classifies the subject site as being within Seismic Zone 3. Based on the subsurface conditions encountered at the site and published geologic literature, it is our opinion that a Soil Profile Type of S_C should be used to

describe average properties of soil within the upper 100 feet beneath the site. This designation describes soils that are considered very dense with shear wave velocities in the range of 1,200 to 2,500 feet per second, Standard Penetration Test values greater than 50, and an undrained shear strength greater than 2,000 psf.

The underlying glacially consolidated soils (glacial till, advance outwash) are quite dense and would not be susceptible to liquefaction during a seismic event. The normally consolidated alluvium may liquefy during a seismic event, and this could result in settlement of structures or embankments built above these soils. The susceptibility of the recessional outwash and existing fill material to liquefaction would be a function of grain size distribution, moisture content, and density.

The largest earthquakes that have occurred in the Puget Sound region are generally sub-crustal events with epicenters ranging from about 30 to 42 miles deep. For this reason, surficial faulting, or earth rupture, as a result of deep seismic activity is typically not observed in the Puget Sound Region. The project site is located approximately 1 mile south of the projected trace of the South Whidbey Island fault. The recurrence interval of movement along this fault system is still unknown, although it is hypothesized to range from hundreds of years to several thousand years. Due to the suspected long recurrence interval, the potential for surficial ground rupture at the site is considered to be low during the expected life of the project. Recent research suggests that from 1 to 2 meters of near-vertical displacement may have occurred on Whidbey Island approximately 3,000 years ago. Evidence of similar displacement in the Mukilteo vicinity has not been identified to date.

3.4 Surface Conditions – General

Conditions observed along the alignments during our surface reconnaissance are referenced to the centerline stationing shown on the plan and profile drawings provided by OTAK. The feature locations should be considered approximate as the alignments had not been field staked prior to our reconnaissance.

3.4.1 Alignment 1

From STA 10+00 at Beverly Park Road to approximately STA 14+50, the alignment passes through previously graded residential properties. The property nearest Beverly Park Road has been developed and contains a residence and associated outbuildings. The adjoining property to the north consists of a grass-covered field that slopes downward at an inclination of 10 percent or less.

From STA 14+50 to approximately STA 19+50, the alignment descends a moderately to densely wooded slope on the Boeing property that forms the southern border of the South Ravine. The slope lacks evidence of significant erosion or instability. We did not observe groundwater seepage on the slope. The alignment borders a graded slope along this interval; the grass-covered slope has an inclination of approximately 50 percent (2H:1V) and lacks surficial evidence of erosion or instability. Groundwater seepage was absent as well during our reconnaissance. The slope was reportedly graded in the early 1990s.

The alignment passes through an irregularly surfaced, moderately wooded area between STA 19+50 and STA 21+00. The presence of irregular topography, nested boulders, and numerous saplings suggests that this area had been graded in the not too distant past.

The portion of the alignment between approximately STA 21+00 and STA 23+00 comprises the lowermost portion of the South Ravine. The sideslopes are relatively gentle, on the order of 15 percent, and are moderately to densely wooded. The slopes lack evidence of erosion or instability, and groundwater seepage was absent during our site visit. Weathered glacial till was observed in shallow excavations. The ravine floor contains two shallow drainage pathways, one of which was dry at the time of our site visit. The flow paths are only mildly incised into recent alluvial deposits of sand, silt, fine gravel, and some organic materials. We understand that Jones & Stokes, Inc. has indicated on a preliminary basis that wetlands are not present in the South Ravine.

North of the South Ravine, the alignment passes through a graded and sparsely wooded slope and level area that abut the existing access road that extends along the west side of the Boeing complex. We observed sand and gravel on the surface in this area; topography suggests that it is likely fill material. The alignment follows the existing Boeing access road as far north as approximately STA 42+00. The existing road spans drainages and the grade separation is achieved by high concrete walls that extend below the road on both sides. The walls lack evidence of distress and we did not observe evidence of erosion at the bottoms of the walls.

North of the Boeing access road, the alignment climbs a moderately sloping landscaped area near the entrance to the Boeing facility and then enters the North Ravine. The ravine slopes and floor are moderately to densely wooded. The slope inclinations on the south side are on the order of 20 percent, and are slightly steeper on the north side – on the order of 30 percent. Shallow excavations on the slopes disclosed weathered glacial till. Both the north and south side slopes lack evidence of significant erosion, instability, and groundwater seepage. We observed a moderately sized alder grove on the north side of the ravine, and the presence of these trees may be indicative of some past shallow instability, in our opinion. However, the ground surface does not reflect soil movement of significant depth. The ravine floor contains a well-defined flow path (Picnic Creek) that is only mildly incised into the recent alluvium and underlying glacial till that mantle the ravine floor. We understand that Jones & Stokes, Inc. has indicated on a preliminary basis that wetlands are present adjacent to Picnic Creek in the North Ravine. The North Ravine terminates at approximately STA 45+60, at which point the alignment crosses a graded and landscaped area adjacent to Harbour Pointe Boulevard.

3.4.2 Alignment 2

From STA 10+00 at Beverly Park Road to approximately STA 19+00 at South Road, Alignment 2 follows a descending path through graded and grass-covered residential and commercial properties. The slope has a maximum inclination of approximately 13 percent. The graded nature of the properties suggests that some fill material may be present, but this was not verified during our reconnaissance. We understand that Jones & Stokes has indicated that wetlands are present along this portion of the alignment.

North of South Road, the alignment passes through developed commercial properties that have been subject to past grading; this developed portion of the alignment extends to the intersection with Evergreen Way at approximately STA 25+00. A steep slope approximately 10 to 16 feet high is located between approximately STA 20+25 and STA 22+50 alongside one of the commercial buildings within the alignment. The topography in the developed area suggests the presence of fill material.

Alignment 2 follows Evergreen Way to near its western terminus at the east end of the Boeing property at approximately STA 35+00. The alignment passes through areas that have been cut and filled in the past. Weathered glacial till soils were observed in cut exposures along the north side of Evergreen Way. The alignment passes through a gently sloping wooded rise between approximately STA 33+00 (where the alignment leaves Evergreen Way) and STA 35+00 (the east side of the Boeing property).

Alignment 2 skirts the north side of the Boeing property, passing through a moderately to densely wooded area between approximately STA 33+00 and STA 47+50. The south side of the right-of-way shown on the plans passes through cut and fill sections on the Boeing property, including a high concrete wall located on the property line between approximately STA 36+20 and STA 38+80. The concrete wall lacks evidence of distress. Topography and stands of young alder saplings between approximately STA 38+50 and STA 43+20 suggest that portions of the alignment were graded in the not too distant past, most likely in association with construction of the Boeing facility. Much of this portion of the alignment slopes down toward the North Ravine at inclinations ranging from approximately 18 to 36 percent. The slopes lack evidence of significant erosion or instability, and also lack groundwater seepage.

Between approximately STA 47+50 and STA 51+90, Alignment 2 crosses the North Ravine in essentially the same location as the north end of Alignment 1. Please see the North Ravine description in Section 3.4.2.

3.4.3 Alignment 3

The southern portion of Alignment 3 is the same as Alignment 2 from Beverly Park Road to the intersection with Evergreen Way at approximately STA 26+00. Farther to the north, Alignment 3 follows the existing Cyrus Way to the intersection with Harbour Point Boulevard. The Cyrus Way portion of the alignment passes through a substantial dip before climbing to a relatively level area that extends to the intersection with Harbour Point Boulevard. The dip slopes are inclined at approximately 12 to 13 percent. Developed commercial properties line both sides of the road and there is no surficial evidence of significant erosion, instability, or groundwater seepage along the alignment.

4.0 CONCLUSIONS AND RECOMMENDATIONS

Based upon our document review, field reconnaissance, and experience with other projects of a similar nature, it is our opinion that construction of Harbour Reach Extension along any of the three potential alignments would be feasible from the geotechnical perspective. Soil

and groundwater conditions are generally favorable for grading, as well as for support of structure foundations. The existing slopes along portions of the alignments are not anticipated to present particular difficulties in terms of stability, and in most cases the slopes are not so steep as to present challenges to the operation of construction equipment. Presented below is a summary of geotechnical aspects of the alignments. Figures 2, 3, and 4 present plan and profile drawings of the alignments, along with pertinent surface features, soil types, and notes that are pertinent to this discussion. Figure 4, the Alignment Comparison Table, summarizes the information presented below.

4.1 Environmentally Critical Areas Considerations

Chapter 17.52, *Critical Areas Regulations*, of the Mukilteo Municipal Code defines regulated geologic hazard sensitive areas in terms of "critical slopes". Critical slopes are characterized in terms of the potential risk of erosion or landsliding based upon the combination of soil type, slope inclination, and the presence or absence of groundwater seepage. The Code requires geotechnical evaluation of potentially critical slopes (slopes with inclinations 20 percent or greater) depending upon these factors, as illustrated in Table A, *Decision Flow Chart*, in Chapter 17.52.

Presented below is a summary of critical slopes along the three alignments, based upon our site observations and understanding of soil types from the information sources described earlier in this report. It should be noted that although the Code may not specifically call for site-specific geotechnical evaluations in some locations in regard to evaluating critical slopes, such evaluations would be warranted during the road design phase in order to evaluate subgrade conditions and soil types as part of an overall geotechnical evaluation.

4.1.1 Alignment 1

Slopes with inclinations of 20 percent are present at the south end of the alignment between approximately STA 14+50 and STA 19+50. Given the anticipated presence of glacial till soils, and the absence of groundwater seepage, specific geotechnical evaluation related to the slopes would not be required by the Code. Given the proximity of the apparently graded 50 percent slope adjacent to the alignment between approximately STA 15+50 and STA 19+50, the Code could require a location-specific geotechnical evaluation. The sideslopes of the South Ravine are less than 20 percent and are anticipated to be underlain by glacial till; the Code would not require a site-specific geotechnical evaluation. The North Ravine sideslope inclinations ranged from approximately 20 to 30 percent and are also anticipated to be underlain by till; the Code would not require a site-specific geotechnical evaluation.

The *City of Mukilteo Critical Areas Landslide Hazard Map* indicates that the portion of Alignment 1 extending from Beverly Park Road to approximately STA 14+50 has been mapped as a *Moderate Landslide Hazard* area, while the interval from approximately STA 14+50 to STA 24+00 (the intersection of Alignment 1 with the access road along the west side of the Boeing complex) has been mapped as a *High Landslide Hazard* area. More recent U.S.G.S. mapping designates these same areas as having a low landslide hazard risk.

4.1.2 Alignment 2

The Code would require a site-specific geotechnical evaluation of the steep slope located between approximately STA 20+25 and STA 22+50 given that its inclination exceeds 40 percent. The remainder of the slopes are inclined at less than 40 percent, are anticipated to be underlain by glacial till, and would not require site-specific evaluations relative to critical slopes according to the Code criteria.

4.1.3 Alignment 3

The only critical slope area along Alignment 3 is the steep slope located between approximately STA 20+25 and STA 22+50 on the commercial property at this location. The Code would require a site-specific geotechnical evaluation of this slope.

4.2 Soil Material Advantages and Disadvantages

Our site observations and document review lead us to conclude that the proposed road alignments are underlain principally by glacial till, with secondary recessional outwash, alluvium, fill material, and possibly peat. Presented below is a summary of advantages and disadvantages presented by these soil materials.

4.2.1 Glacial Till

Advantages

- The relatively high density and shear strength of intact, unweathered glacial till are favorable for support of structure foundations. Foundation loads in the range of 4,000 to 8,000 pounds per square foot for spread foundations can be supported by the very dense unweathered till. These same characteristics are favorable for the use of drilled shaft and pile foundations as well. Lower foundation bearing pressures can be achieved within the less dense upper weathered zone.

- Provided that grading takes place during the drier time of the year, glacial till can be used as structural fill borrow.

- Unweathered glacial till can maintain relatively steep temporary and permanent cut slope inclinations.

- Unweathered glacial till has a relatively high resistance to flowing surface water.

Disadvantages

- The surficial weathered horizon is less dense than the underlying unweathered material. Consequently, the weathered zone is capable of supporting comparatively low foundation bearing pressures. The weathered horizon is also susceptible to erosion by flowing water, and the till is a substantial source of fine sediment when eroded.

- The fines content of glacial till makes it moisture-sensitive. Wet weather or wet site conditions can limit or preclude the use of glacial till as structural fill borrow. Amending wet-of-optimum glacial till with kiln dust or cement can facilitate use of till as borrow under wet conditions, but the amendment process increases grading costs. It is difficult, if not impossible, to operate construction equipment on untreated, wet glacial till without disturbing the material.

- In some cases, it is necessary to utilize rippers to effectively loosen unweathered glacial till during grading.

- The weathered horizon's low density may require improvement, such as additional compactive effort, in order to mitigate potential road embankment settlement.

- The weathered horizon may contain groundwater perched above the less permeable and denser underlying unweathered till. The presence of perched groundwater can limit the use of the till as structural fill and may require special drainage provisions during construction.

- It is generally not feasible to construct surface water infiltration facilities within glacial till soils due to the material's relatively low permeability. The low permeability may also require road embankment drainage provisions.

4.2.2 Recessional Outwash

Advantages

- Recessional outwash generally has a low fines content (soil fraction passing the U.S. No. 200 sieve). Consequently, the material can typically be used as structural fill borrow under a relatively wide range of weather and site moisture conditions.

- Recessional outwash is capable of supporting light to moderate foundation loads.

- Recessional outwash generally has a relatively high permeability, making it a good receptor soil for surface water infiltration facilities.

Disadvantages

- Recessional outwash may not be capable of supporting relatively high foundation bearing pressures without significant settlement.

- Recessional outwash typically offers little resistance to erosion by flowing water. However, the typically low fines content of the outwash is such that little fine sediment is generated when the deposits are eroded.

- Recessional outwash cannot maintain cut slope inclinations steeper than approximately 1.75H:1V without raveling and sloughing.

4.2.3 Alluvium

Advantages

- There are no particular advantages to the alluvium present in the North Ravine and South Ravine relative to the proposed road construction.

Disadvantages

- The alluvium's low density and organic content may render it unsuitable for support of foundations or road embankments due to its load sensitivity, compressibility, and probable unfavorable organic content.

- The fines content and organic material content render the alluvium unsuitable for use as structural fill borrow.

4.2.4 Peat

Advantages

- There are no advantages of peat relative to the project other than, if present, it could be excavated and possibly utilized for landscaping purposes.

Disadvantages

- Peat is highly compressible and load-sensitive. Structures or embankments constructed above peat will typically experience unacceptable settlement, the magnitude of which may be a function of the peat thickness and its density. Should peat be disclosed by explorations along the project, it would need to be removed during grading, or foundations would need to extend through the peat to adequate bearing materials below the peat.

4.2.5 Existing Fill Material

Advantages

- If the existing fill material was placed in an engineering-controlled manner and lacked organics, deleterious debris, or regulated environmental contaminants, it may be feasible to construct the new road above the fill. Verification of the existing fill's character and underlying material is necessary to evaluate the feasibility of leaving the material in place or to determine whether or not the material should be removed or improved.

Disadvantages

- Existing fill may contain organics, deleterious debris, or regulated environmental contaminants that could render it unsuitable for incorporation into the new road.

- Existing fill that was placed in an uncontrolled manner may be of inadequate density to support the new road or structures, thereby requiring its improvement or removal.

- Fill material may mask underlying deposits of load-sensitive peat or other materials that would be inadequate for support of the new road or structures.

4.3 Alignment Advantages and Disadvantages

Presented below is a summary of the advantages and disadvantages presented by each of the three alignments from the geotechnical perspective.

4.3.1 Alignment 1

Advantages

- The sloping portions of the alignment lack evidence of significant instability and erosion, and appear to be underlain at relatively shallow depths by glacial till. Therefore, mitigation of existing problematic slope conditions will not be required.

- The glacial till soils will be capable of accommodating substantial foundation loads imparted by walls, culverts, and bridges.

- With the exception of the fill section required immediately downstation of the South Ravine, minimal grading would be required.

- There would appear to be little if any effort required for utility relocation and its associated earthwork.

Disadvantages

- A substantial fill section would be required immediately downstation of the South Ravine. It would likely be necessary to obtain off-site fill for this portion of the road.

- In the event that a bridge is not required to cross the South Ravine and a culvert of some type could be installed, it may be necessary to strip the subgrade of the alluvium that mantles the ravine floor prior to installing culverts, wing walls, or approach fill embankments.

4.3.2 Alignment 2

Advantages

- As is the case with Alignment 1, the sloping portions of Alignment 2 lack evidence of significant instability and erosion, and appear to be underlain at relatively shallow depths by glacial till. Therefore, mitigation of existing problematic slope conditions will not be required.

- It would likely be feasible to construct mechanically stabilized earth embankments with facing walls to reduce the amount of fill material required to built the Alignment 2 interval that traverses the sloping ground adjacent to the north side of the Boeing complex.

- The glacial till soils will be capable of accommodating substantial foundation loads imparted by walls and bridges.

Disadvantages

- It would likely be necessary to obtain off-site fill to complete Alignment 2 as substantial fill sections are proposed for the interval between Beverly Park Road and STA 16+00, as well as for the interval that skirts along the north side of the Boeing facility.

- Extra stripping and subgrade rehabilitation may be required where the alignment passes through the developed commercial properties between approximately STA 14+60 and STA 33+00 along Evergreen Way.

- Some utility relocation and its associated earthwork would likely be required.

4.3.3 Alignment 3

Advantages

- It would appear that no significant structures, such as bridges, would be required. Consequently, earthwork would be limited to grading the alignment and installing underground utilities.

- There would be minimal wall construction.

Disadvantages

- Extra stripping and subgrade rehabilitation may be required where the alignment passes through the developed commercial properties between approximately STA 14+60 and STA 33+00 along Evergreen Way.

- It would likely be necessary to obtain off-site fill to complete Alignment 3.

- Utility relocation and associated earthwork would be required.

4.4 Environmental Considerations

Both Alignment 2 and Alignment 3 pass through developed commercial properties. It would be prudent to complete Phase I Environmental Site Assessments of the affected properties as a means of evaluating the presence of regulated environmental contaminants on or in close proximity to the future road. The presence of regulated environmental contaminants could have a substantial impact on project design, permitting, schedule, and construction. It would be in the City's best interests to identify such impacts prior to construction.

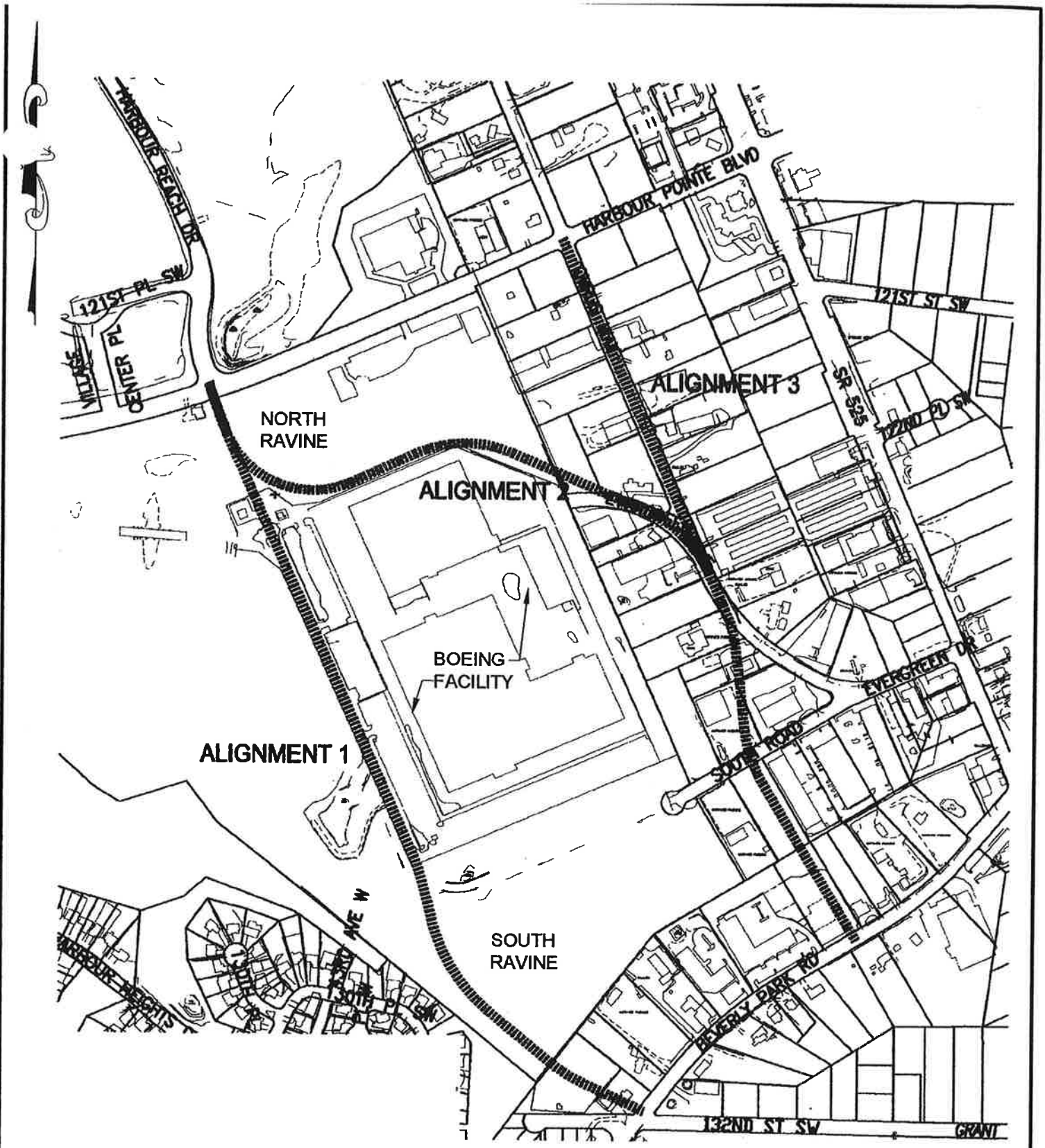
4.5 Additional Considerations

Alignment 1 will incorporate the existing access road along the west side of the Boeing facility. Portions of the road are supported by fill embankments contained by concrete walls of considerable size, and culverts pass below the road as well. It would be prudent to review the design and construction records for the retaining walls in order to verify that the walls' integrity is adequate for the intended future purpose and to verify that they do not possess some shortcomings that the City may be required to rectify. In addition, there would be value in assessing the condition of the culverts below the road in order to verify their condition and to identify potential future maintenance requirements or capacity shortcomings. The existing wall located along the north end of the Boeing facility should be evaluated as well, given its proximity to Alignment 2.

The conclusions presented herein in regard to subsurface conditions are based upon information gathered from the referenced sources. Conditions encountered in explorations in the site vicinity, but not actually on the preferred alignment, may vary from those described herein. The design phase portion of the project should include location-specific geotechnical explorations as a means of characterizing subsurface conditions. A design phase geotechnical evaluation should include advancing exploratory borings at the locations of bridge, wall, and large culvert foundations as well as in cut sections that may extend deeper than depths of approximately 15 feet. The boring explorations should be supplemented by the excavation of test pits along the alignment at regular intervals. The explorations will allow subsurface characterization at structure or feature-specific locations, a critical step in the design process.

5.0 CLOSURE

The conclusions and recommendations presented in this report are based on the referenced information sources and the site conditions observed during our reconnaissance. Subsurface exploration, other than shallow hand-dug excavations, was not within our approved scope of services. This report should be considered preliminary in nature, and should not be used for design purposes. We would be pleased to assist the City of Mukilteo with design phase geotechnical and Phase I Environmental Site Assessment services for the preferred alignment.



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Project No. J-1861
Date: Aug., 2004
Drawn by: J. Duncan
Scale: NTS

Harbour Reach Drive Extension
Mukilteo, Washington

FIGURE 1: PROJECT LOCATION MAP

Base map provided by OTAK.

Alignment	Critical Slopes	Geotechnical Advantages	Geotechnical Disadvantages
No. 1	The MMC would require evaluation of the graded slope adjacent to the alignment between STA 15+50and STA 19+50. The MMC may require evaluation of the moderate and high landslide areas shown on the City hazards map.	Sloping portions of the alignment lack evidence of instability and erosion. The underlying glacial till soils are well suited for culvert, bridge, and wall foundation support. No grading will be required for the portion of the alignment that incorporates the existing Boeing facility access road. There would appear to be little effort required for underground utility relocation.	It appears that imported material will be required to construct the fill section downstation of the South Ravine, and also to fill the South Ravine crossing if it is not bridged. It will be necessary to either bridge the South Ravine, or install a culvert and fill embankment. The existing alluvium may need to be removed prior to constructing the culvert and fill section alternative. A bridge will be required at the North Ravine. The glacial till soils are moisture-sensitive and grading would be limited to favorable weather conditions unless the soils are treated. The probable fill material near the South Ravine may require removal or rehabilitation. Peat, if present, would need to be removed. The condition of the retaining walls supporting the existing Boeing facility access road will need to be evaluated.
No. 2	The MMC would require evaluation of the steep slope between STA 20+25 and STA 22+50.	Sloping portions of the alignment lack evidence of instability and erosion. The underlying glacial till soils are well suited for culvert, bridge, and wall foundation support. It would be feasible to use mechanically stabilized earth embankments to reduce structural fill quantities along the roadway segment north of the Boeing facility.	Substantial roadway embankment construction will be needed and imported fill will be required. A bridge will be required at the North Ravine. Greater than normal stripping depths may be required in the developed property areas and in wetlands at the south end of the alignment. Some underground utility relocation will likely be required. The glacial till soils are moisture-sensitive and grading would be limited to favorable weather conditions unless they are treated. Peat, if present, would need to be removed.
No. 3	The MMC would require evaluation of the steep slope between STA 20+25 and STA 22+50.	No bridges or significantly large structures will be required. Wall construction will likely be relatively minor. The underlying glacial till soils are well suited for wall foundation support.	The glacial till soils are moisture-sensitive and grading would be limited to favorable weather conditions unless they are treated. Greater than normal stripping depths may be required in the developed property areas and in wetlands at the south end of the alignment. Based on visual observation of the cut and fill balance, it appears that imported material will be required to construct the fill sections. Some underground utility relocation would likely be required.

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Project No: J-1861

Drawn by:J. Duncan

Date: Aug., 2004

Harbour Reach Drive Extension
Mukilteo, Washington

FIGURE 5: ALIGNMENT COMPARISON TABLE

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Appendix E — Technical Memorandum
Detention and Water Quality
Vault Sizes
Otak, Inc.
June 25, 2004

Technical Memorandum

otak

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Date: June 25, 2004

Subject: Detention and Water Quality Vault Sizes

Project #: 30442

This technical memo summarizes the method used to size the preliminary detention and water quality vaults for each of the three alternatives for the Harbour Reach Drive Extension Project. Each alignment will connect Beverly Park Rd to Harbour Pointe Boulevard. Generally, each alignment will have a proposed roadway section as follows:

- 2 – 12-ft travel lanes
- 1 – 12-ft turn lane/planted median
- curb/gutter
- 5-ft planter strip adjacent to the curb where space permits
- 6-ft sidewalks on both sides (7-ft when no planter)

Each alignment was broken into the amount of new impervious area and pollution generating impervious surface (PGIS) area added in each drainage basins. The amount of detention volume required is dependent on the new impervious area added. This includes the roadway, curb, gutter, and sidewalk. The required water quality volume is dependent on the amount of PGIS area added. The PGIS area only includes the area that is subject to vehicular use such as the roadway and gutter. (See Table 1 below)

Table 1 – New Impervious and PGIS Area

Alignment/Basin No.	Station	New Impervious Area (ac)	PGIS Area (ac)
Alignment 1	Entire alignment	2.76	1.96
Alignment 2 – Basin 2a	10+00 to 22+08	0.39	1.12
Alignment 2 – Basin 2b	22+08 to 52+01	1.49	2.36
Alignment 3 – Basin 3a	10+00 to 28+71	0.55	1.50
Alignment 3 – Basin 3b	28+71 to 38+96	0.43	0.29
Alignment 3 – Basin 3c	38+96 to 42+50	0.07	0.10

The detention and water quality requirements are based on the 1992 Stormwater Management Manual for the Puget Sound Basin from the Department of Ecology. The

required detention volume was approximated using a spreadsheet based on King County Runoff Time Series program. Detention vaults were sized according to the following design criteria:

- 0.5-ft depth sediment storage
- 0.5-ft freeboard
- 20% safety factor
- 7-ft minimum height

Table 2 – Detention Vault Sizing and Cost

Alignement/Basin No.	Length (ft)	Width (ft)	Height[2] (ft)	Cost[1]
Alignment 1	Existing pond will be utilized			
Alignment 2 – Basin 2a	250	15	7	$337,500
Alignment 2 – Basin 2b	380	15	7	$502,000
Alignment 3 – Basin 3a	270	15	7	$360,500
Alignment 3 – Basin 3b	50	15	7	$65,500
Alignment 3 – Basin 3c	40	12	7	$54,400

[1]Based on the delivered cost quoted by Utility Vault Company
[2]Assumes 9' depth to vault floor.

The required water quality volume was calculated using Stormshed. It is based on the month, 24-hour storm or 64% of the 2-year, 24-hour storm. The water quality vaults were sized based on the following criteria:

- 0.5-ft depth sediment storage
- 0.5-ft freeboard
- 7-ft minimum height
- Length to width ratio greater than 3 to 1

Table 3 – Water Quality Vault Sizing and Cost

Alignement/Basin No.	Length (ft)	Width (ft)	Height[2] (ft)	[1]Cost
Alignment 1	Existing pond will be utilized			
Alignment 2 – Basin 2a	70	10	7	$73,000
Alignment 2 – Basin 2b	130	10	7	$122,000
Alignment 3 – Basin 3a	90	10	7	$94,000
Alignment 3 – Basin 3b	35	5	7	$34,250
Alignment 3 – Basin 3c	15	5	7	$21,250

[1]Based on the delivered cost quoted by Utility Vault Company
[2]Assumes 9' depth to vault floor.

Appendix F — Technical Memorandum
Structures-Type, Size and Location
Otak, Inc.
August 10, 2004
Revised December 27, 2004

Technical Memorandum

otak

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To: Lori McFarland, PE

From: Kevin Kim, PE, SE

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Date: August 10, 2004 , Revised December 27, 2004

Subject: Structures — Types, Size and Location

Project #: 30442 — Mukilteo Harbour Reach Drive Extension

As part of a route study for the City of Mukilteo, a preliminary study was performed to identify the needs for structures on three alignment alternatives considered in the Harbour Reach Drive Extension Route Study. Specifically, types, sizes, and locations of structures for each alignment were identified and evaluated for their feasibility and probable construction costs. The results of the evaluation are summarized in the attached spreadsheets with approximate wall locations and heights, and estimated structures costs.

Retaining Walls

There are many design parameters to consider in determining the type, size, and locations of retaining walls, such as cost, topography, geotechnical conditions, right-of-way, and aesthetics. Depending on these design parameters, a number of wall types might be applicable for this project. However, for the purpose of this feasibility study, two types of walls are considered depending on site condition: mechanically stabilized earth (MSE) walls at fill areas (i.e., walls to retain the roadway fills) and reinforced concrete cantilever walls at cut areas (i.e., walls to retain the cuts).

MSE walls are very flexible and can tolerate large deformations. Where these types of walls are constructed and large amounts of settlement are expected, the fill is constructed first, allowed to settle, and then a final finish may be installed with a facing element for protection against erosion and aesthetic purposes. Many types of materials are available for the internal reinforcement and facing elements. Some of the MSE wall types include Hilfiker, Reinforced Earth, VSL Retained Earth, and concrete modular block wall.

Reinforced concrete cantilever retaining walls can effectively retain soil, particularly well at cut areas. Compared to MSE walls, reinforced concrete walls require less excavation because the footing width is shorter than the length of geogrid reinforcements for MSE walls. Additionally, WSDOT standard plans are available and would simplify construction plan preparation.

Bridge

Selection of bridge type, size, and location is directly or indirectly affected by several factors, including but not limited to the following:

- Functionality
- Constructability
- Cost
- Maintainability
- Aesthetics

The location of the bridge is usually set by the roadway alignment, and the width of the bridge is established to match the roadway approaches at each end. The length of the bridge is usually determined based on topography of the site to achieve the optimum value of construction cost and constructability. For this project, the width of the bridge is to accommodate two 12-foot travel lanes, a 12-foot center turn lane and two 6-foot raised sidewalks, for a total width of 51 feet from edge-to-edge of the bridge deck, including bases for bridge barriers. For the safety of pedestrians, a safety railing such as BP Railing will need to be installed on the top of the concrete barriers.

Alignment 1

Retaining Walls — A significant amount of retaining wall on each side of the new roadway would be required at the south end of the project, between Beverly Park Road and the south road. Based on preliminary field reconnaissance, it was assumed that a retaining wall could be constructed providing a pipe culvert at the low point where seasonal minor flow is anticipated. A total of approximately 18,500 SF of fill wall has been identified in this area. An MSE wall type, such as Hilfiker, could be used for its cost-effectiveness and tolerance for potential long-term settlement due to construction of high new embankment up to 28 feet. Cut wall will also be required in this area and may also be needed at the front of the existing substation south of Harbour Pointe Boulevard.

Bridge — A bridge is proposed over the ravine just south of Harbour Pointe Boulevard, between Alignment Stations 42+50 and 45+50, for a total length of 300 feet. The bridge would include three spans, with the main span over the valley and an approach span at each end, for a configuration of 80 feet – 140 feet – 80 feet. A bridge with pre-cast, pre-stressed concrete WSDOT standard girders supported on intermediate column piers and abutments is recommended for its cost-effectiveness, ease of construction, and relative low long-term maintenance requirement. Based on the preliminary geotechnical investigation, the bridge could be supported on spread footings at each intermediate column and abutment.

Alignment 2

Retaining Walls — A significant amount of new wall would be required along the north side of the proposed road, at the north of the existing warehouse building. The majority of the wall would be constructed in the sloped woody terrain; the construction would be difficult due to access to the bottom of the valley. Also, the existing utilities along the north side of the existing access road would need to be relocated for the construction. Because of its difficult access and existing site conditions, the wall construction cost is expected to be high. Similar to Alignment 1, the new roadway embankment at the south end of the alignment near Beverly Park Road would require fill wall on each side.

Bridge — A new bridge would be required over the ravine south of Harbour Pointe Boulevard, for a total length of approximately 320 feet. A three-span structure with a configuration of 90 feet – 140 feet – 90 feet would be feasible. As with the bridge for Alignment 1, the bridge superstructure would be supported on intermediate concrete column piers and abutments with spread footing foundation.

The proposed alignment in this area is on a horizontal curve, and the new bridge will need to fit the curvature. A bridge with pre-cast, pre-stressed concrete WSDOT standard girders may be feasible if the girders are laid in flared pattern and cast-in-place concrete deck is placed to fit the curvature. However, if the pre-cast girders cannot accommodate the required curved sections, then the bridge would need to be a cast-in-place structure. Due to the curvature on the bridge, the unit price of bridge construction would be higher than Alignment 1.

Alignment 3

Retaining Walls — This alternative requires substantially less retaining walls, since the proposed alignment is developed to fit the existing alignment as much as possible. Approximately 16,500 SF of wall in fill areas and 9,000 SF of wall in cut areas would be required for this alternative.

Bridge — No bridge is required for this alternative.

Harbour Pointe Reach Drive Extension

Structure Needs

Item of Work	Unit	Estimated Quantity	Unit Price	Amount
Alignment 1				
Total Area of Fill Wall	SF	19,109	$ 25.00	$ 477,713
Total Area of Cut Wall	SF	3,702	$ 45.00	$ 166,568
Shoring or Extra Excavation (Cut Walls)	SF	3,702	$ 7.00	$ 25,911
Concrete Barrier/Ped Railing on Fill Walls	LF	1,320	$ 110.00	$ 145,200
Concrete Moment Slab for Barrier - Fill	LF	1,320	$ 160.00	$ 211,200
Chain Link Fence on Cut Walls	LF	400	$ 15.00	$ 6,000
Bridge (300' long x 51' wide)	SF	15,300	$ 125.00	$ 1,912,500
Structures Cost				**$ 2,945,091**
Alignment 2				
Total Area of Fill Wall	SF	26,124	$ 25.00	$ 653,088
Total Area of Cut Wall	SF	6,857	$ 45.00	$ 308,576
Shoring or Extra Excavation (Cut Walls)	SF	6,857	$ 7.00	$ 48,001
Concrete Barrier/Ped Railing on Fill Walls	LF	1,990	$ 110.00	$ 218,900
Concrete Moment Slab for Barrier - Fill	LF	1,990	$ 160.00	$ 318,400
Chain Link Fence on Cut Walls	LF	1,100	$ 15.00	$ 16,500
Bridge (320' long x 51' wide on curve)	SF	16,320	$ 140.00	$ 2,284,800
Structures Cost				**$ 3,848,265**
Alignment 3				
Total Area of Fill Wall	SF	16,458	$ 25.00	$ 411,445
Total Area of Cut Wall	SF	9,080	$ 45.00	$ 408,589
Shoring or Extra Excavation (Cut Walls)	SF	9,080	$ 7.00	$ 63,558
Concrete Barrier/Ped Railing on Fill Walls	LF	1,470	$ 110.00	$ 161,700
Concrete Moment Slab for Barrier - Fill	LF	1,470	$ 160.00	$ 235,200
Chain Link Fence on Cut Walls	LF	1,400	$ 15.00	$ 21,000
Structures Cost				**$ 1,301,492**

Assumptions

1. The unit prices for this cost estimate are based on the WSDOT Bridge Design Manual (2002).
2. The unit price of fill walls is based on MSE Wall with precast concrete panels.
3. The unit price of cut walls is based on reinforced concrete retaining wall.
4. Estimate for shoring or extra excavation is based on average wall height.
5. Assumes concrete barrier will be required at fill walls based on City's clear zone policy.
6. Concrete moment slab takes the place of concrete sidewalk.
7. Chain link fence is used only at cut walls.
8. Total width of the bridge is 51 feet.
9. Roadway excavation and fills are not included in this estimate. See Roadway Estimate.

Harbour Pointe Reach Drive Extension

Alignment 1

Structure Needs

Wall at Left								Wall at Right					
Cut/ Fill	Length, ft.	Exist Grd. Elev.	Height, ft.	Avg. Height, ft.	Wall Area	Sta.	Profile Elev.	Length, ft.	Exist Grnd. Elev.	Height, ft.	Avg. Height, ft.	Wall Area	Cut/ Fill
						13+50	569.0						
						14+00	564.0						
						14+50	559.0						
						15+00	554.0						
						15+50	549.0						
Cut Wall		552	-8.0			16+00	544.0		552	-8			
	50	546	-7.0	-7.5	(375)	16+50	539.0	50	550	-11	-9.5	(475)	
	50	536	-1.9	-4.4	(222)	17+00	534.1	50	550	-15.9	-13.5	(672)	Cut Wall
	20		0.0	-0.9	(19)	17+20							
	30	525	4.6	2.3	69	17+50	529.6	50	544	-14.4	-15.2	(757)	
	50	513	12.4	8.5	425	18+00	525.4	50	535	-9.6	-12.0	(600)	
	50	503	18.5	15.5	772	18+50	521.5	50	530	-8.5	-9.1	(453)	
						18+80		30		0.0	-4.3	(128)	
	50	495	23.0	20.8	1,038	19+00	518.0	20	514	4.0	2.0	40	
	50	488	26.9	25.0	1,248	19+50	514.9	50	502	12.9	8.4	422	
	50	484	28.1	27.5	1,375	20+00	512.1	50	493	19.1	16.0	800	
Fill Wall	50	490	19.6	23.9	1,193	20+50	509.6	50	500	9.6	14.4	718	Fill Wall
	50	491	16.5	18.1	903	21+00	507.5	50	504	3.5	6.6	328	
	50	490	15.8	16.2	808	21+50	505.8	50	493	12.8	8.2	408	
	50	486	18.4	17.1	855	22+00	504.4	50	491	13.4	13.1	655	
	50	482	21.4	19.9	995	22+50	503.4	50	486	17.4	15.4	770	
	50	489	13.7	17.6	877	23+00	502.7	50	488	14.7	16.1	802	
						23+20	502.5	20	490	12.5	13.6	272	
	50	491	11.3	12.5	625	23+50	502.3						
	50	492	10.0	10.7	533	24+00	502.0						
	50	497	5.0	7.5	375	24+50	502.0						
	50	502	0.0	2.5	125	25+00	502.0						
				Station 23+20		60' R	502.1		490	12.1			
				Station 23+20		100' R	502.4	40	480	22.4	17.3	690	
				Station 23+20		160' R	502.6	60	492	10.6	16.5	990	
								Tie into existing wall on south side of South Rd					
				Begin Bridge		42+50	505.4						
	300			End Bridge		45+50	512.1	300					
	120				**616**	**Cut Wall Totals**		**280**				**3085**	
	780				**12214**	**Fill Wall Totals**		**540**				**6895**	
	300					**Bridge Totals**							

Assumptions:

1. All geometric information is based on 10% feasibility design level accuracy.
2. Length of walls and structure are based on the profile alignment not considering curvature effect.

Harbour Pointe Reach Drive Extension

Alignment 2

Structure Needs

Wall at Left								Wall at Right					
Cut/ Fill	Length, ft.	Exist Grd. Elev.	Height, ft.	Avg. Height, ft.	Wall Area	Sta.	Profile Elev.	Length, ft.	Exist Grnd. Elev.	Height, ft.	Avg. Height, ft.	Wall Area	Cut/ Fill
		576	0.4			10+40	576.4		576	0.4			
	60	570	5.2	2.8	169	11+00	575.23	60	570	5.2	2.815	169	
	50	564	9.5	7.4	369	11+50	573.52	50	564	9.5	7.4	369	
	50	556	15.5	12.5	626	12+00	571.52	50	556	15.5	12.5	626	
Fill Wall	50	550	19.5	17.5	876	12+50	569.52	50	552	17.5	16.5	826	Fill Wall
	50	547	20.5	20.0	1001	13+00	567.52	50	547	20.5	19.0	951	
	50	543	22.0	21.3	1064	13+50	565.02	50	544	21.0	20.8	1039	
	50	542	19.5	20.8	1039	14+00	561.52	50	542	19.5	20.3	1014	
	50	540	17.5	18.5	926	14+50	557.52	50	542	15.5	17.5	876	
	50	542	10.5	14.0	701	15+00	552.52	50	542	10.5	13.0	651	
	50	546	3.8	7.1	357	15+50	549.78	50	546	3.8	7.1	357	
						20+00	539.02		540	-1.0			
						20+50	539.23	50	546	-6.8	-3.9	-194	
						21+00	539.38	50	552	-12.6	-9.7	-485	
						21+50	539.48	50	552	-12.5	-12.6	-629	
						22+00	539.51	50	550	-10.5	-11.5	-575	Cut Wall
						22+50	539.50	50	540	-0.5	-6.5	-326	
						36+00	523.07		520	3.1			
						36+50	521.59	50	508	13.6	8.3	417	
						37+00	520.29	50	504	16.3	14.9	747	
						37+50	519.18	50	503	16.2	16.2	812	
		520	-1.8			38+00	518.22	50	502	16.2	16.2	810	Fill Wall
	50	524	-6.8	-4.3	-214	38+50	517.23	50	512	5.2	10.7	536	
	50	524	-7.6	-7.2	-360	39+00	516.37	50	518				
	50	524	-8.6	-8.1	-405	39+50	515.43	50	526				
	50	524	-9.5	-9.0	-451	40+00	514.52	50	518				
Cut Wall	50	522	-8.4	-8.9	-447	40+50	513.58	50	513	0.6			
	50	520	-7.3	-7.9	-394	41+00	512.66	50	510	2.7	1.6	81	
	50	519	-7.3	-7.3	-365	41+50	511.73	50	510	1.7	2.2	110	
	50	517	-6.2	-6.7	-336	42+00	510.81	50	506	4.8	3.3	164	
	50	514	-4.1	-5.2	-258	42+50	509.88	50	500	9.9	7.3	367	
	50	512	-3.0	-3.6	-179	43+00	508.96	50	490	19.0	14.4	721	
	50	510	-2.0	-2.5	-125	43+50	508.03	50	494	14.0	16.5	825	
	50	508	-0.9	-1.4	-72	44+00	507.11	50	492	15.1	14.6	729	
	50	506	0.2	-0.4	-18	44+50	506.18	50	492	14.18	14.6	732	
						45+00	505.25	50	488	17.3	15.7	786	
						45+50	504.33	50	486	18.3	17.8	890	
						46+00	503.44	50	486	17.4	17.9	894	
						46+50	502.86	50	486	16.9	17.2	858	
						47+00	502.65	50	488	14.7	15.8	788	
						47+50	502.82	50	492	10.8	12.7	637	
					Begin Bridge	47+70	503.00	20	492	11	10.91	218	Fill Wall
	320				End Bridge	50+90	510.50	320					
						Cyrus	538.0		540	-2.0			
						Cyrus	540.0	100	548	-8.0	-5.0	-500	Cut Wall
						Cyrus	534.5	100	537	-2.5	-5.3	-525	
	650				**3625**	**Cut Wall Totals**		**450**				**3233**	
	510				**7127**	**Fill Wall Totals**		**1480**				**18996**	
	320					**Bridge Totals**		**320**					

Assumptions:

1. All geometric information is based on 10% feasibility design level accuracy.
2. Length of walls and structure are based on the profile alignment not considering curvature effect.

Harbour Pointe Reach Drive Extension

Alignment 3

Structure Needs

Wall at Left								Wall at Right					
Cut/ Fill	Length, ft.	Exist Grd. Elev.	Height, ft.	Avg. Height, ft.	Wall Area	Sta.	Profile Elev.	Length, ft.	Exist Grnd. Elev.	Height, ft.	Avg. Height, ft.	Wall Area	Cut/ Fill
		576	0.4			10+40	576.4		576	0.4			
	60	570	5.2	2.8	169	11+00	575.23	60	570	5.2	2.8	169	
	50	564	9.5	7.4	369	11+50	573.52	50	564	9.5	7.4	369	
	50	556	15.5	12.5	626	12+00	571.52	50	556	15.5	12.5	626	
Fill Wall	50	550	19.5	17.5	876	12+50	569.52	50	552	17.5	16.5	826	Fill Wall
	50	547	20.5	20.0	1001	13+00	567.52	50	547	20.5	19.0	951	
	50	543	22.0	21.3	1064	13+50	565.02	50	544	21.0	20.8	1039	
	50	542	19.5	20.8	1039	14+00	561.52	50	542	19.5	20.3	1014	
	50	540	17.5	18.5	926	14+50	557.52	50	542	15.5	17.5	876	
	50	542	10.5	14.0	701	15+00	552.52	50	542	10.5	13.0	651	
	50	546	3.8	7.1	357	15+50	549.78	50	546	3.8	7.1	357	
						20+00	539.02		540	-1.0			
						20+50	539.23	50	546	-6.8	-3.9	-194	
						21+00	539.38	50	552	-12.6	-9.7	-485	
						21+50	539.48	50	552	-12.5	-12.6	-629	Cut Wall
						22+00	539.51	50	550	-10.5	-11.5	-575	
						22+50	539.50	50	540	-0.5	-6.5	-326	
						27+00	541.22		544	-2.8			
						27+50	541.40	50	544	-2.6	-2.7	-135	
						28+00	541.57	50	544	-2.4	-2.5	-126	
						28+50	541.64	50	546	-4.4	-3.4	-170	
						29+00	541.71	50	546	-4.3	-4.3	-216	
						29+50	541.19	50	548	-6.8	-5.5	-277	Cut Wall
						30+00	540.19	50	550	-9.8	-8.3	-415	
		542	-3.3			30+50	538.71	50	550	-11.3	-10.6	-527	
	50	545	-8.3	-5.8	-288	31+00	536.75	50	550	-13.3	-12.3	-613	
Cut Wall	50	543	-8.5	-8.4	-418	31+50	534.53	50	544	-9.5	-11.4	-568	
	50	540	-7.7	-8.1	-404	32+00	532.31	50	536	-3.7	-6.6	-329	
	50	534	-3.9	-5.8	-290	32+50	530.09		530	0.1			
	50	530	-2.1	-3.0	-151	33+00	527.86	50	522	5.9	3.0	149	
	50	524	1.6	-0.3	-13	33+50	525.64	50	521	4.6	5.3	263	Fill Wall
		520	4.7			34+00	524.74	50	520	4.7	4.7	235	
Fill Wall	50	520	6.5	5.6	281	34+50	526.49	50	526	0.5	2.6	131	
	50	520	10.6	8.5	426	35+00	530.55		530				
	50	526	8.9	9.7	487	35+50	534.94		534				
	50	534	5.3	7.1	357	36+00	539.33		540	-0.7			
	50	544	-0.3	2.5	126	36+50	543.72	50	550	-6.3	-3.5	-174	
						37+00	548.01	50	556	-8.0	-7.1	-357	
						37+50	551.45	50	560	-8.55	-8.3	-413	
						38+00	553.88	50	560	-6.1	-7.3	-367	
						38+50	555.31	50	562	-6.7	-6.4	-320	Cut Wall
						39+00	555.74	50	558	-2.3	-4.5	-224	
						39+50	555.23	50	556	-0.8	-1.5	-76	
	300				**1564**	**Cut Wall Totals**		**1100**				**7515**	
	760				**8804**	**Fill Wall Totals**		**710**				**7654**	

Assumptions:

1. All geometric information is based on 10% feasibility design level accuracy.
2. Length of walls and structure are based on the profile alignment not considering curvature effect.