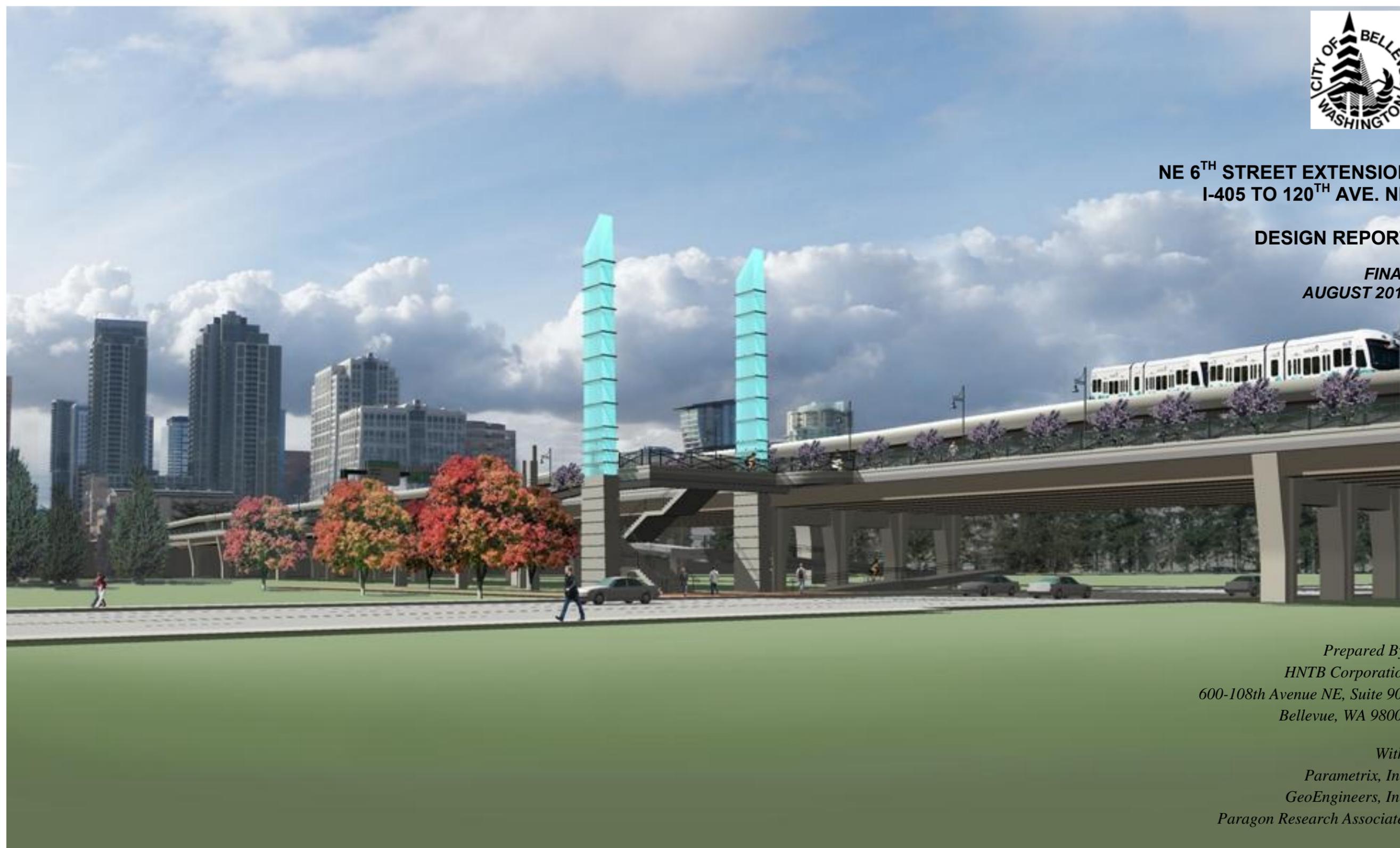




**NE 6TH STREET EXTENSION
I-405 TO 120TH AVE. NE**

DESIGN REPORT

*FINAL
AUGUST 2012*



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This Design Report was prepared under the supervision of:



August 28, 2012

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Date

EXECUTIVE SUMMARY

The City of Bellevue Transportation Department Capital Program Services Division proposes to extend NE 6th Street east from its current terminus in the median of I-405, over the northbound lanes of I-405 and over 116th Avenue NE to a new intersection with 120th Avenue NE. The project would provide a new corridor between I-405 and 120th Avenue NE for transit, HOV, and non-motorized users. It would complement existing transportation infrastructure on NE 6th Street, including the pedestrian corridor between Bellevue Way NE and 112th Avenue NE, and the Bellevue Transit Center located on NE 6th Street between 108th and 106th Avenues NE.

The NE 6th Street Extension project is part of the City's Mobility and Infrastructure Initiatives (M&I) package of projects that also includes an extension of NE 4th Street from 116th Avenue NE to 120th Avenue NE, and improvements to NE 120th Street. By providing increased connectivity between downtown Bellevue and points east of I-405 for transit, HOV, and non-motorized modes of travel, the NE 6th Extension project would support the Wilburton commercial area as a regional growth center, and the Bel-Red transit-oriented development node.

The Washington State Department of Transportation's (WSDOT) I-405, NE 6th to I-5 Widening and Express Toll Lanes project, currently under construction, will convert the existing HOV lanes on I-405 north of NE 6th Street to express toll lanes, allowing single-occupancy vehicles (SOV) paying a toll to use the express toll lanes. This conversion could also revise the HOV eligibility requirement to HOV 3+, and would allow use of the existing NE 6th Street transit/HOV direct access ramps by express toll lane users.

Sound Transit's East Link light rail project will be constructed generally within and north of the NE 6th Street corridor between 110th Avenue NE and the BNSF Corridor. The design of the NE 6th Street Extension reflects the 30% design of the East Link project. Several areas and issues will require coordination with the East Link project as it progresses through final design. These are primarily related to the location of the aerial guideway structure that will parallel NE 6th Street between 112th Avenue NE and the BNSF corridor.

The project proposes to modify the existing "Texas T" transit/HOV direct access interchange on I-405 at NE 6th Street (Figure 1) to provide connections east to 120th Avenue NE. The NE 6th Street extension would be elevated above existing grade from I-405 east to the BNSF Corridor, where the extension would match existing grade east to 120th Avenue NE (Figure 2).

Three design alternatives for the NE 6th Street Extension project were evaluated and are described in this design report. These include one alternative with a four-lane basic section for motorized traffic, and two alternatives with a two-lane basic section for motorized traffic. All three alternatives would provide a multi-use path on the south side of NE 6th Street between 112th Avenue NE and 120th Avenue NE.

Design options that have been evaluated include intersection configurations at 112th Avenue NE, the I-405 transit/HOV ramps, 119th Avenue NE, and 120th Avenue NE. Options have also been evaluated for the multi-use path width and for non-motorized connections to 116th Avenue NE and to a future regional trail in the BNSF Corridor.

The estimated cost for the project is \$73 to \$93 million (year 2011 dollars), including right-of-way, construction, and design engineering and City administrative costs. The project is unfunded beyond the current phase of work. It is anticipated that WSDOT would act as lead agency for implementation of the NE 6th Street Extension project as a part of their I-405 Corridor Program. Specific roles and responsibilities of WSDOT and the City of Bellevue are yet to be determined, including sources of funding and cost-sharing.

The purpose of this Design Report is to document the preliminary design process (5% design level) for the NE 6th Street Extension project, and to provide the information needed to recommend a project scope to the Bellevue City Council. The preliminary design process for the NE 6th Street Extension project has included coordination with the project Stakeholder Advisory Group, which consists of various stakeholders, individuals, and special interest groups within the community, and with a Technical Review Team, consisting of staff from the various agencies comprising the project stakeholders. Feedback from the Stakeholder Advisory Group, the Technical Review Team, and the City of Bellevue engineering staff was integrated into the development of the preliminary design alternatives to incorporate the goals, concerns, and needs of both the City of Bellevue and other stakeholders.

This design report also provides summaries of analyses of the affected environment, permit requirements, traffic operations, structure types and configurations, geotechnical considerations, stormwater facilities, roadway illumination, and urban design issues and opportunities. These areas are covered in more depth in technical memorandums covering these topics. The technical memorandums are included as appendices to this design report. Right-of-way and utility impacts, and construction staging issues and concepts are also summarized.

The appendices also include an Urban Design Master Plan for the NE 6th Street Extension project. The Master Plan documents the preliminary urban design process. It includes summaries of a stakeholder input received in a survey, two design charrettes, and two technical review team meetings. Recommendations are provided for design options to support the City's urban design objectives, way finding and/or gateway elements, site furnishings and details, railings, plantings, and architectural treatments and finishes for structural elements.

Figure 1
Existing NE 6th Corridor at I-405



Source: HNTB Corporation, 2010

Figure 2
Proposed NE 6th Street Extension



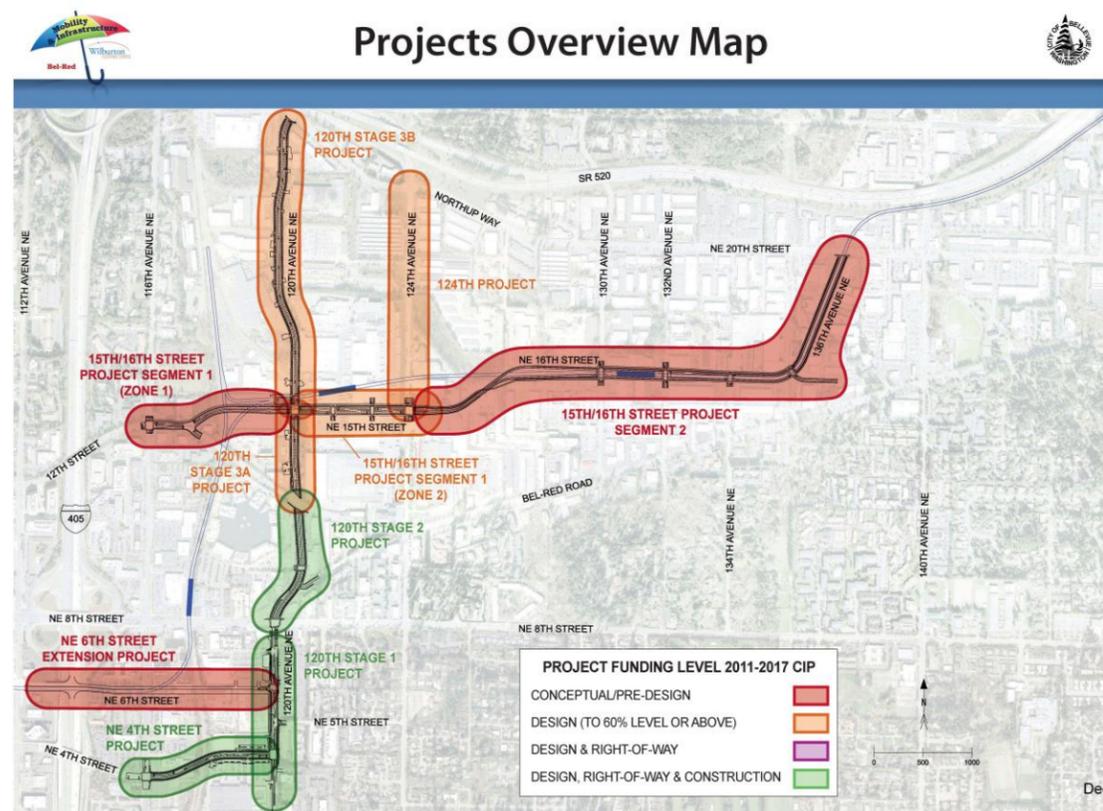
Source: HNTB Corporation, 2011

PROJECT BACKGROUND

Mobility & Infrastructure Initiative

In January 2009, the City of Bellevue City Council endorsed a Mobility and Infrastructure Initiative Finance Plan that included a financial strategy to address high priority capital needs in the community by supplementing the City's existing Capital Improvement Plan. The initiative is intended to fund transportation and other capital improvements needed in the downtown, west Wilburton and Bel-Red areas. The initiative addresses growth in travel demand caused by Downtown development and provides early investments to plan for anticipated growth in the Bel-Red area due in part to the future Sound Transit East Link light rail line and private development. Transportation investments included in the initiative were selected based on their effectiveness in reducing traffic congestion in these areas and improving connectivity throughout the City of Bellevue. The Mobility and Infrastructure Initiative transportation projects (Figure 3) are separated into two groups of projects, the Wilburton Connections Projects and the Bel-Red Projects.

Figure 3
City of Bellevue Mobility & Infrastructure Projects



Source: City of Bellevue, December 2010

Wilburton Connections Projects

The Wilburton Connections projects include three roadway projects in the west Wilburton area that will improve connections between the downtown, Wilburton, Bel-Red and Overlake areas (Figure 4). These include widening of 120th Avenue NE and extensions of NE 4th Street and NE 6th Street. It also includes a study of traffic calming provisions for NE 5th Street. The NE 4th Street Extension and the 120th Avenue NE Stage 1 projects are expected to be built by 2017. The NE 6th Street Extension project has not yet been funded beyond the current preliminary design effort.

NE 4th Street Extension

The NE 4th Street Extension project will extend an existing five-lane arterial street from 116th Avenue NE to 120th Avenue NE. This project supports general traffic circulation between downtown Bellevue, I-405, and the Wilburton areas. The project will primarily serve single occupant vehicles and will include bike lanes, curb, gutter and sidewalk on both sides, and illumination, landscaping and irrigation, and storm drainage and detention facilities. Where the NE 4th Street extension crosses the BNSF corridor, the design of the extension includes provisions for an at-grade crossing of potential future rail or high-capacity transit service, and a grade-separated crossing of a future regional non-motorized trail. The NE 4th Street Extension project is in the final design/PS&E phase of project development. Construction is anticipated to start in the year 2013 for Phase 1 and 2014 for Phase 2.

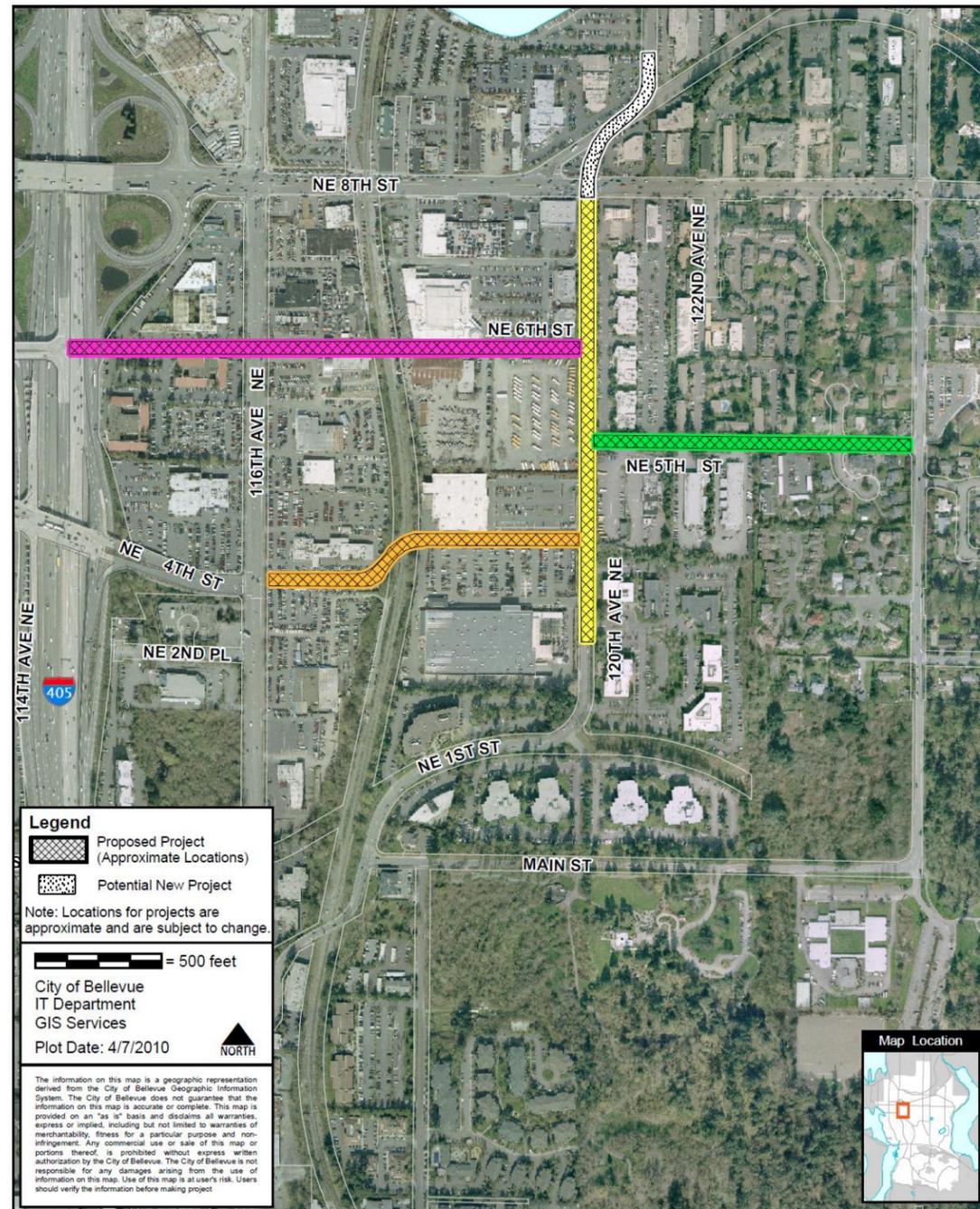
NE 6th Street Extension

The NE 6th Street Extension project will provide a new arterial street crossing over I-405, supporting increased connectivity between Downtown Bellevue, the Wilburton area, and the Bel-Red area via 120th Avenue NE. The extension will primarily serve transit, HOV, and non-motorized modes of travel. The NE 6th Street Extension will also provide an alternative to and relieve congestion at key intersections on parallel arterial streets in the vicinity of I-405, particularly NE 8th Street at 112th Avenue NE and NE 8th Street at 116th Avenue NE. As such, the project is expected to improve travel times and enhance mobility options for passenger car, transit, freight, pedestrian, and bicycle modes.

120th Avenue NE Improvements, NE 4th to NE 8th Street

The 120th Avenue Northeast Widening Stage 1 project will widen this existing street from three lanes to five lanes between NE 4th and NE 8th Streets. The project will improve, or install where missing, bike lanes, curb, gutter and sidewalk on both sides, a traffic signal at the NE 6th Street intersection, illumination, landscaping, irrigation, and storm drainage and detention. Intersection improvements will accommodate the NE 4th and NE 6th Street Extension projects and future realignment of 120th Avenue NE north of NE 8th Street. The latter project was advanced into the design process as Stage 2 by the City Council in late 2010. The 120th Avenue NE Extension project is in the final design/PS&E phase of project development. Construction is anticipated to start in the year 2013.

Figure 4
Conceptual Layout for Wilburton Connections Projects



Note: 120th Avenue NE Stage 2 project is shown as "Potential New Project"
Source: City of Bellevue, 2010

NE 5th Street Study

The main purpose of this project is to study and understand how to calm traffic through the existing residential neighborhood east of 120th Avenue NE. With the Wilburton Connection projects increasing the connectivity of the adjacent roadways, the neighborhood surrounding NE 5th Street is concerned about the potential for increased through traffic along NE 5th Street. The ultimate goal is to moderate potential Wilburton Connections traffic impacts to the neighborhood.

Other Adjacent Projects

In addition to the City of Bellevue’s Wilburton Connections projects, WSDOT, Sound Transit, and King County have projects in the vicinity of the NE 6th Street Extension that will require design coordination.

I-405 – NE 6th to I-5 Widening and Express Toll Lanes Project

The I-405/SR 167 “Eastside Corridor” currently serves an estimated 1.1 million vehicle trips per day. Congestion on the corridor is increasing, and the existing High Occupancy Vehicle (HOV) lanes are so well utilized that they no longer meet their established performance standard of 45 mph during peak periods. NE 6th Street currently provides access to and from the west for the transit/HOV direct access ramp connections that serve downtown Bellevue. The ramps provide the primary connection to the Bellevue Transit Center for bus transit routes serving regional trips on I-405.

In May of 2009, the Washington State Legislature directed WSDOT to prepare a planning level traffic and revenue study for I-405 in King and Snohomish Counties. That study resulted in a plan to operate up to two High Occupancy Tolling (HOT) express toll lanes in each direction on a 40+ mile section of the Eastside Corridor, and includes the addition of capacity and other improvements to I-405.

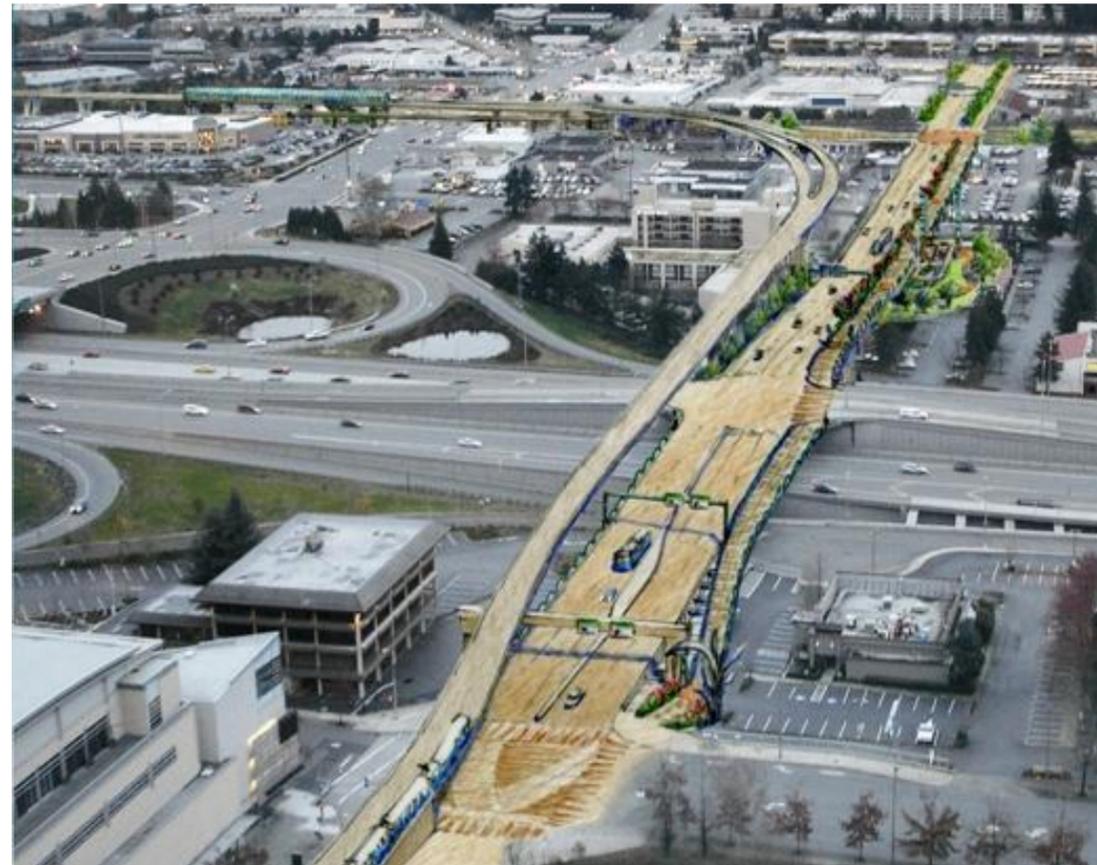
The first phase of the express toll lanes program will implement express toll lanes on I-405, starting at NE 6th Street in downtown Bellevue and running north to I-5 in Lynnwood. This first phase is proceeding through a design-build implementation process that is anticipated to open the express toll lanes to traffic in 2015. WSDOT is currently determining whether the direct access ramps at NE 6th Street and other locations in the corridor, and the I-405 mainline express toll lanes, should operate as a HOV2+ or a HOV3+ facility with the implementation of express toll lanes. This decision will be made as a part of the tolling policy decisions to be made by the State Transportation Commission. Signing, toll gantry, and channelization requirements associated with the express toll lanes implementation will need to be coordinated with WSDOT as the planning and design for the NE 6th Street extension project progresses.

Sound Transit East Link Light Rail

The Sound Transit East Link Project will expand light rail transit (LRT) from downtown Seattle to East King County. East Link will provide a new 14-mile extension to connect Mercer Island, Bellevue, and Redmond to the existing Sound Transit light rail network in the Seattle area. The project has completed 30% design and a NEPA EIS. Final design of the project is expected to start in September 2012. Construction of the project is anticipated to start in 2014 or 2015.

The 30% level design plan set for the East Link project shows two alternatives for the East Link alignment through Segment C: a tunnel option (C9T) which runs underneath 110th Avenue NE between Main Street and NE 6th Street; and an at-grade option (C11A) which runs along 108th Avenue SE between Main Street and NE 6th Street. The tunnel alignment alternative has been selected for implementation. Both alignment alternatives are identical east of 112th Avenue NE. Passing over the intersection of 112th Avenue NE and NE 6th Street, the LRT alignment shifts from the center to the north side of NE 6th Street. It stays in the NE 6th Street corridor, crossing over I-405 and 116th Avenue NE. East of 116th Avenue NE, the LRT alignment turns to the north, enters the BNSF corridor and crosses over NE 8th Street. A new Hospital Station will be located immediately north of NE 8th Street. Figure 5 is a rendering of the NE 6th Street Extension depicting these East Link project elements.

Figure 5
NE 6th Street Extension



Source: HNTB Corporation, 2011

The East Link 30% design plans include a straddle bent that spans across NE 6th Street just east of 112th Avenue NE. Sound Transit also plans to place a pier for the new LRT structure over I-405 in the gore area of the I-405 northbound collector-distributor roadway off-ramp to NE 8th Street. The off-ramp and collector-distributor roadway will need to be realigned to accommodate

this pier. These items will require design coordination with the NE 6th Street Extension project as described in more detail later in this document.

Sound Transit has purchased a 1.1 mile segment of the BNSF corridor between NE 6th Street and approximately NE 20th Street for use by the East Link project. In addition, Sound Transit has purchased an easement from the Port of Seattle, the current owner of the remainder of the BNSF corridor, for potential future high-capacity transit in the BNSF corridor. This easement runs from Renton north to Woodinville.

Areas or issues requiring coordination with the East Link project as it progresses through final design include:

- the configuration of the intersection of NE 6th Street with 112th Avenue SE, including the East Link straddle bent configuration and connections to the Lake Washington Trail;
- coordination of the East Link alignment with the future NE 6th Street extension alignment;
- revisions to the I-405 northbound collector-distributor roadway and off-ramp to eastbound NE 8th Street to accommodate proposed bridge piers for both the East Link bridge structure over I-405 and the future NE 6th Street extension bridge structure, including modifications to Sturtevant Creek in this vicinity; and
- the design of East Link structures within the BNSF corridor such that future regional multi-use trail grade separations over NE 8th Street are not precluded.

BNSF Corridor Non-Motorized Trail

The Burlington Northern Santa Fe (BNSF) Railway sold their Woodinville Subdivision to the Port of Seattle in December 2009. This north-south rail corridor extends from Renton to Snohomish via Woodinville and includes a spur to the City of Redmond. Rail service remains on the portion of the line between Snohomish and Woodinville. Concurrently with the Port's acquisition of the corridor, King County purchased a trail easement to preserve the rail-banked status of the corridor. The county is pursuing a non-motorized trail system using the BNSF corridor. They have not yet developed a master plan for this trail corridor. Funding for the master plan or implementation of a non-motorized trail has not been identified.

Notwithstanding the availability of funding, other agencies with interests in the BNSF corridor have recognized the desirability of the anticipated future regional non-motorized trail. King County Parks staff are participating in planning and design efforts for other projects within or crossing the BNSF corridor to assist in incorporating provisions for a future trail. These projects include the NE 6th Street Extension project.

Existing and Future Transit Service

Transit routes use NE 6th Street east of 110th Avenue NE to access the Bellevue Transit Center. The NE 6th Street direct-access ramp to I-405 is used by two King County Metro routes and three Sound Transit Regional Express routes.

King County Metro Transit

The King County Metro routes using the NE 6th Street direct-access ramps are weekday commuter routes from Woodinville (route 237) and the Shoreline park-and-ride (route 342). These two routes together have eight inbound trips between 5:15 and 8:15 AM and seven outbound trips between 3:30 and 6:00 PM. They operate to and from the north leg of the direct-access ramp intersection.

Transit information summarized in this section and in the *Traffic Operations Analysis Report* (see Appendix D) was current as of Fall 2010 and does not reflect the implementation of King County Metro Transit RapidRide service in Fall 2011. The RapidRide B Line replaced Metro Routes 230 and 253 shown on Figure 6. In the project vicinity, the B Line runs along NE 8th Street and accesses the Bellevue Transit Center via 108th Avenue NE inbound and via 112th Street outbound. The next stop on the B Line route is on NE 8th Street at 116th Avenue NE. The B Line runs on a 10-15 minute frequency between 6 AM and 10 PM, and a 30-minute frequency in the early morning and late night hours.

Sound Transit

The Sound Transit routes 532, 535, and 566 use the NE 6th Street direct-access ramps. Routes 532 and 535 provide service to Everett and Lynnwood, respectively. Route 532 is weekday commute period service only. Route 535 operates all day weekdays and on weekends, with connecting service to Everett from Lynnwood.

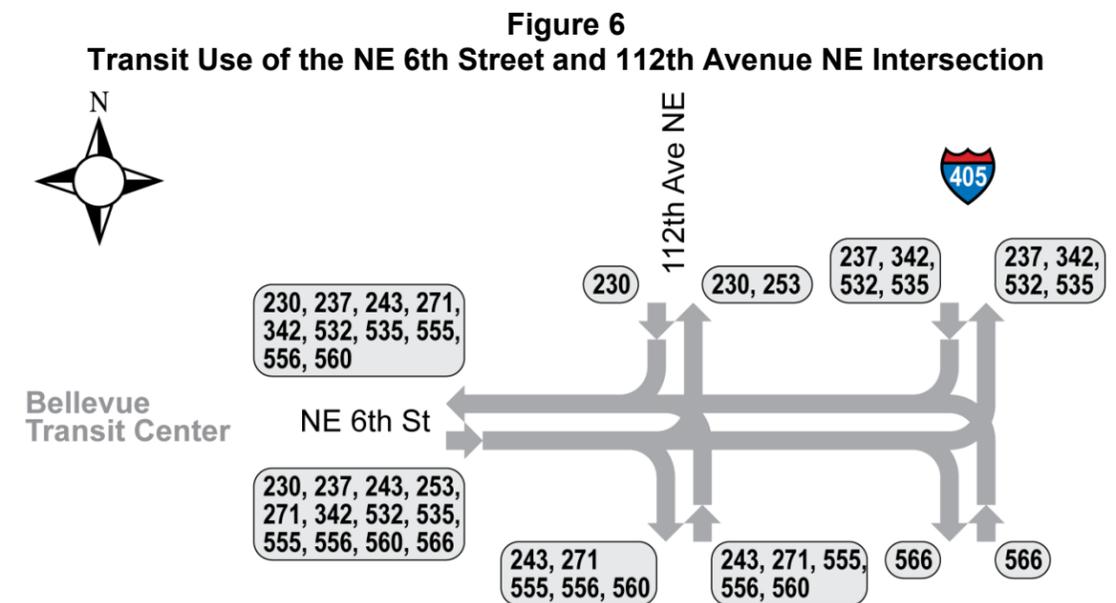
During the 5:30 to 8:30 AM peak period, 14 #532 trips and six #535 trips arrive at the Bellevue Transit Center. Morning peak departures from Bellevue are four #532 trips and six #535 trips. Route 535 operates two inbound and two outbound trips per hour between the morning and afternoon peak periods, and in the evening until 8:00 PM, and then operates hourly until about 11:00 PM. Weekend service on route 535 operates hourly both inbound and outbound.

Sound Transit route 566 operates weekdays between Auburn and the Overlake area of Redmond through Bellevue on I-405. The NE 6th Street direct-access ramp is used to and from the south (Auburn) while the NE 10th and NE 8th Street interchange ramps are used to and from the north (Overlake). During the AM peak period, there are 15 #566 arrivals at the Bellevue Transit Center and six departures using the NE 6th Street direct-access ramp.

In the afternoon peak, 3:30 to 6:30 PM, there are thirteen #532 and six #535 departures for northbound I-405 through the NE 6th Street direct-access ramp. There are five #532 and six #535 arrivals during this period. There are six #566 arrivals at the Bellevue Transit Center using the NE 6th Street northbound off-ramp and 14 departures to Auburn using the southbound on-ramp.

Transit Use of the NE 6th Street and 112th Avenue NE Intersection

All bus trips using the NE 6th Street direct-access ramps to I-405 must pass through the 112th Avenue NE intersection as westbound through vehicles for inbound trips and eastbound through vehicles for outbound trips. In addition to these trips, other Metro and Sound Transit routes use 112th Avenue NE for travel to and from the Bellevue Transit Center. Figure 6 shows the 12 transit routes passing through the 112th Avenue NE intersection and the five routes using the NE 6th Street direct-access ramps.



Note: Routes 230 and 253 replaced by RapidRide B Line.
Source: HNTB Corporation, 2010

During the weekday three-hour AM peak period, 122 buses travel through the NE 6th Street and 112th Avenue NE intersection. There are 130 buses traveling through this intersection during the PM peak three-hour period. On a typical weekday, 508 buses travel through this intersection.

Stakeholder Coordination Process

The NE 6th Street Extension project's preliminary design phase included coordination with key stakeholders to determine the optimal roadway configuration that would balance the needs of diverse stakeholders. The process included a stakeholder survey, two design charrettes with regional stakeholders, and several technical review team meetings. The design sessions provided an open forum format in which internal and external stakeholders could express their visions for the NE 6th Street Extension project, and provide feedback to the project team.

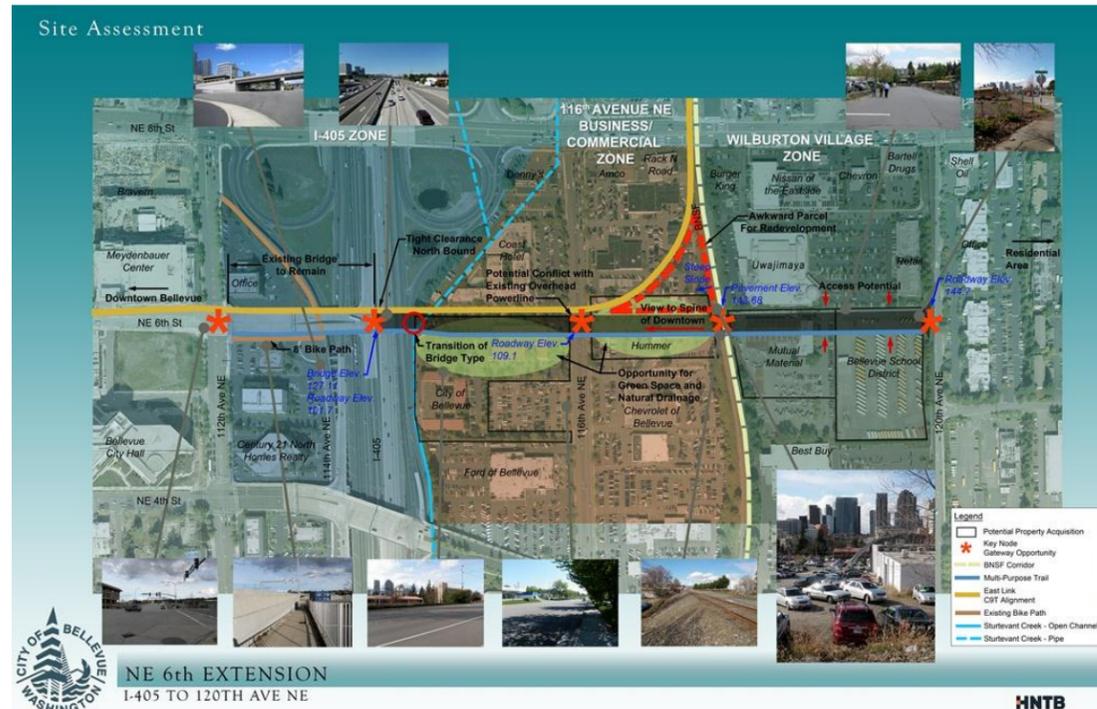
The stakeholder survey provided preliminary information to the design team to begin development of the roadway and urban design concepts for the corridor. The design charrette sessions solicited feedback from regional stakeholders outside of the City of Bellevue, including the goals, visions, uses, and recommended design guidance. The technical review team sessions provided a similar interactive forum in which City, WSDOT, Sound Transit, Port, and King County staff from various departments could discuss interdisciplinary needs and goals for the NE 6th Street corridor. The 5% preliminary design alternatives presented in this report are based on feedback from these two main stakeholder groups and blend the elements of urban design, traffic analysis and planning, and roadway, structures, and stormwater design.

For more information on the stakeholder process, and urban design elements and themes, see Appendix C for the *Urban Design Master Plan for NE 6th Street Extension* document.

EXISTING CONDITIONS

For the purpose of site analysis and design development, the project corridor was divided into three zones. These zones, depicted in Figure 7, are the I-405 Zone, the 116th Avenue NE Business/Commercial Zone, and the Wilburton Village Zone. These zones and key issues for each are further described in the Urban Design Master Plan (Appendix C).

Figure 7
NE 6th Street Site Analysis and Design Development Zones



Source: HNTB Corporation, 2010

I-405 Zone – 112th Street NE to I-405 Direct Access Ramps

The existing I-405 direct-access ramps at NE 6th Street provide transit and HOV access to the northbound and southbound I-405 HOV lanes from the west side of I-405 (Figure 8). These ramps were a joint WSDOT/Sound Transit/City of Bellevue project constructed in 2003-2004 as a part of the I-405 Bellevue Direct Access Project. The direct access interchange was funded by Sound Transit as a part of their Sound Move Regional Express program. The existing facility was a metric design, so dimensions listed in this design report are nominal dimensions converted from the metric contract documents.

Figure 8
Existing NE 6th Street Transit/HOV Direct Access Interchange



Source: HNTB Corporation, 2010

The existing NE 6th Street terminates at a tee intersection in the median of I-405. The intersection is controlled by a traffic signal. Opposing traffic on the direct access ramps is separated by a concrete traffic barrier. Each direction on the ramp is provided with a 20.5-foot wide travel way, allocated as one 12-foot wide lane, a 6.5-foot wide right shoulder, and a 2-foot wide left shoulder (Figure 9). The total width of the ramps is 43 feet, barrier to barrier, including the median barrier.

Figure 9
Existing NE 6th Street Transit/HOV Direct Access Ramps



Source: HNTB Corporation, 2012

NE 6th Street between the ramps and 112th Avenue NE is 66 feet wide, with two 12-foot-wide lanes and a 3-foot-wide shoulder in each direction (Figure 10). A raised median is provided at the ramp intersection, and a westbound to southbound left turn pocket at the intersection of 112th Avenue NE and NE 6th Street. The existing raised median is currently used by law enforcement to monitor compliance with HOV restrictions, and by WSDOT's incident response crews to facilitate incident response truck access to both directions of I-405 during peak periods. There are no existing bicycle or pedestrian facilities on NE 6th Street between 112th Avenue NE and the direct access ramp intersection.

Figure 10
Existing NE 6th Street, 112th Avenue NE to I-405 Direct Access Ramps



Source: HNTB Corporation, 2010

The existing NE 6th Street / I-405 direct-access ramps are supported on stabilized earth (SE) retaining walls located along the edge of the inside shoulders of northbound and southbound I-405 (Figure 11). The intersection traffic signal pole and ITS cabinets are located on a concrete deck that is cantilevered off the east side of the intersection.

NE 6th Street extends across southbound I-405 on a steel girder bridge (Figure 12). The bridge has a concrete deck with traffic barrier and pedestrian railings. Both ends of the steel girder bridge are supported on stabilized earth walls. A sign bridge is located at the west abutment on a bridge blister. Luminaire poles are attached to the concrete bridge rail on both sides of NE 6th Street.

Figure 11
Existing Retaining Walls – NE 6th Street Direct Access Interchange



Source: HNTB Corporation, 2010

Figure 12
Existing Structures – NE 6th Street Direct Access Interchange



Source: HNTB Corporation, 2010

116th Avenue NE Business/Commercial Zone

Between I-405 and the BNSF Corridor, the only existing public street is 116th Avenue NE. This portion of the NE 6th Street Extension corridor is a business/commercial zone dominated by auto dealerships. On the west side of 116th Avenue NE, the corridor is occupied by two-story office buildings on a property owned by the City of Bellevue (Figure 13 and Figure 14).

Figure 13
Existing NE 6th Street Corridor, Looking West from BNSF Corridor



Source: HNTB Corporation, 2010

Figure 14
116th Avenue NE, Looking South from NE 6th Corridor



Source: HNTB Corporation, 2010

Wilburton Village Zone

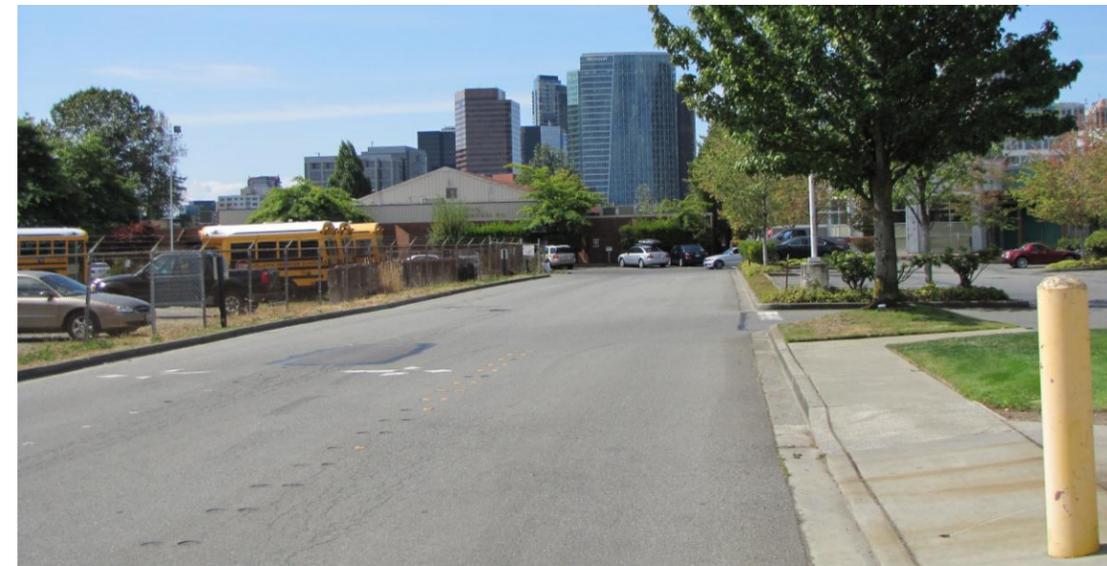
West of 120th Avenue NE to approximately 119th Avenue NE, NE 6th Street provides local access to adjacent properties, a shopping center to the north, a Bellevue School District school bus parking area to the south, and Mutual Materials to the west and south (Figure 15).

Figure 15
NE 6th Street, Looking East to 120th Avenue NE



Source: HNTB Corporation, 2010

Figure 16
NE 6th Street, Looking West from 120th Avenue NE



Source: HNTB Corporation, 2010

NE 6TH STREET EXTENSION DESIGN PARAMETERS

Roadway Design Criteria

The NE 6th Street Extension project is located partially within the jurisdiction of the City of Bellevue, and partially within the jurisdiction of WSDOT. As such, the NE 6th Street Extension project's preliminary design uses the following design criteria:

- **Within WSDOT Right-of-Way** – This segment of the project consists of extending NE 6th Street over the I-405 northbound lanes and any work on the existing portion of the corridor between 112th Avenue NE and the existing ramps. Design of this segment is in accordance with the Washington State Department of Transportation guidelines, with reference to AASHTO guidelines for selected parameters.
- **Within City of Bellevue Right-of-Way** – This segment is a continuation of NE 6th Street Extension proposed structure from the eastern limit of the WSDOT I-405 right of way to 120th Avenue NE. Design of this segment was in accordance with the City of Bellevue design guidelines. The WSDOT and AASHTO guidelines were used wherever the City of Bellevue standards did not include specific design guidance.

Key design criteria for the project are summarized in Table 1 for the portions of the project within WSDOT right-of-way, and in Table 2 for the portions of the project within City of Bellevue right-of-way. Any work affecting the I-405 mainline or ramps would be subject to WSDOT's I-1 (Interstate) design criteria. The NE 6th Street Extension would fall under WSDOT's criteria for an Urban Minor Arterial, M-5. A discussion of the rationale for the values selected for these parameters follows.

The design speed for the NE 6th Street Extension has been selected as 35 mph, reflecting an anticipated posted speed of 25-30 mph. The I-405 mainline design speed is 60 mph, consistent with the Corridor Analysis completed for the I-405 – NE 6th to I-5 Widening and Express Toll Lanes Project, which specifies a mainline design speed of 60 mph south of SR 520. The 25 mph design speed noted in Table 1 for ramps applies to geometric elements in proximity to the ramp terminal intersection. The ramp terminal intersection at NE 6th Street is anticipated to remain traffic signal controlled; as such, a stop condition would be appropriate for evaluating ramp deceleration requirements and a 15 mph speed for ramp acceleration, the latter reflecting turning movements onto the direct access ramps from NE 6th Street.

The AASHTO Intercity Bus (BUS-45) design vehicle was selected as the governing vehicle for use in establishing and evaluating horizontal geometry elements. WSDOT's *Design Manual* Chapter 1420 specifies an articulated bus (A-BUS) design vehicle for horizontal design elements of HOV direct access facilities. The BUS-45 vehicle has a larger turning radius than the A-BUS design vehicle; due to the proximity of Meydenbauer Center and periodic high volumes of intercity charter buses associated with events at Meydenbauer Center, it was selected as the "worst case" design vehicle for the project. We also note that one existing Sound Transit Regional Express route is now serving Bellevue Transit Center with intercity buses. The A-BUS design vehicle would still apply to evaluations of direct access ramp acceleration and deceleration distances.

Large trucks (i.e. AASHTO/WSDOT WB-40, WB-50, WB-67 combination vehicles) are currently prohibited from using the regional HOV system, including the direct access ramps. This prohibition would apply to the NE 6th Street Extension and to WSDOT's anticipated conversion of the I-405 HOV lanes to express toll lanes. Use of the BUS-45 design vehicle would accommodate use of the NE 6th Street Extension by a SU-30 design vehicle (single unit truck), the minimum specified in the City of Bellevue's *Design Manual*. These vehicles, if under 10,000 pounds gross vehicle weight, are allowed to use the regional HOV system.

Table 1
Design Criteria Within WSDOT Right-of-Way

Design Element	Standards	Source
Freeway Design Speed	60 mph	DM
Ramp Design Speed	25 mph	DM
NE 6th Street Design Speed	35 mph	DM, COB
Design Vehicle	Intercity Bus (BUS-45)	AASHTO, DM
Curb Radius	50 ft	DM
Lane Width	12 ft	DM, COB
Shy Distance (to barrier / bridge rail)	2 ft	DM, COB
Multi-Use Path Width	14 ft	AASHTO, DM, COB, ADA

Notes: ¹ DM Design Manual, Washington State Department of Transportation, July 2011
² COB Design Manual, Transportation Department City of Bellevue, April 2011

Table 2
Design Criteria Within City of Bellevue Right-of-Way

Design Element	Standards	Source
Design Speed	35 mph	COB
Design Vehicle	Intercity Bus (BUS-45)	AASHTO, DM, COB
Curb Radius	20-50 ft	COB, DM
Lane Width	12 ft	COB, DM
Shy Distance (to barrier / bridge rail)	2 ft	COB, DM
Clear Zone (face of curb to face of object)	3 ft	COB, DM
Planter Strip Width (not including curb width)	4 ft	COB
Sidewalk Width	8 ft	COB
Multi-Use Path Width	14 ft	AASHTO, DM, COB, ADA

Notes: ¹ DM Design Manual, Washington State Department of Transportation, July 2011
² COB Design Manual, Transportation Department City of Bellevue, April 2011

Lane widths are proposed to be 12 feet as noted in Tables 1 and 2. As described later in this design report, it may be necessary to reduce existing lane and shoulder widths on the I-405 direct access ramps to provide an additional lane for turning movements. If this is the case, a design deviation would be required for this condition.

A clear zone width is not specified in Table 1 for the portions of the project within WSDOT right-of-way, as it is assumed that continuous barrier/bridge rail would be provided and would protect any objects that would otherwise be in the clear zone. These objects would include sign bridges,

luminaire and/or traffic signal poles, and sign posts. The City's clear zone criterion of three feet minimum from the face of curb to face of object would apply to appurtenances at the ramp terminal intersection, and to portions of the corridor that are at-grade (i.e. east of the BNSF Corridor).

The Multi-Use Path (shared-use path per AASHTO/WSDOT or off-street path per City of Bellevue) will serve non-motorized users, primarily pedestrians and bicyclists. The width criterion of 14 feet is based on current practice as described in the City of Bellevue's 2009 *Pedestrian and Bicycle Plan* and WSDOT's *Design Manual* Chapter 1515, where "... *substantial use by both pedestrians and bicycles is expected...*" This proposed width reflects a travel way width of 10 to 12 feet with one to two feet of shy distance to the continuous bridge rails, barriers, or railings that would be present on the NE 6th Street Extension. As described later in this report, an option for a 16-foot wide path has also been identified.

Base Maps Used for Design

The current preliminary design effort utilized readily-available base maps from sources including:

- WSDOT I-405 Corridor Program
- City of Bellevue GIS
- City of Bellevue NE 4th Street Extension & 120th Avenue NE Stage 1 projects

Design for this phase of the project utilized WSDOT State Plane Coordinates. Information on existing structures at the I-405/NE 6th Street interchange was obtained from construction and as-built plans available from WSDOT. The existing interchange was constructed using metric units; dimensions shown in this design report are nominal English unit conversions from the metric design dimensions. The next phase of design will need to include topographic survey sufficient to verify critical clearances and dimensions, particularly in the vicinity of the existing I-405/NE 6th Street interchange.

Traffic Forecasts & Design Year Operations

The NE 6th Street Extension project between 112th Avenue NE and 120th Avenue NE would provide an additional east-west connection across I-405 in Bellevue. Traffic forecasts for years 2015 and 2030 PM peak hours conditions were prepared using City of Bellevue-provided forecasts for the Wilburton Connections projects and WSDOT forecasts for the I-405, Bellevue to Lynnwood Improvement Project (express toll lanes project). The WSDOT project would convert the existing HOV lanes on I-405 north of NE 6th Street to express toll lanes operation.

The City forecasts assume an HOV 2+ eligibility requirement for the NE 6th Street corridor and the regional HOV system. In contrast, the WSDOT express toll lanes project would allow single occupant vehicles (SOVs) and two-person carpools (HOV 2s) to pay a variable rate toll to access I-405 express toll lanes from the NE 6th Street direct access ramps. WSDOT's forecasts assume that by 2030 carpools would be required to have three or more occupants for free access to the express toll lanes. The City of Bellevue 2030 forecasts were adjusted to conform to the WSDOT HOV 3+ forecasts with SOV/HOV 2 buy-in access to the express toll lanes, using volumes predicted to use the NE 6th Street I-405 direct access ramps as control totals.

The traffic operations analyses evaluated all 11 signalized intersections on NE 4th Street, NE 6th Street, and NE 8th Street between 112th Avenue NE and 120th Avenue NE. The 2030 PM peak analysis assumed completion of the NE 4th Street/120th Avenue NE Corridor project and evaluated scenarios with and without express toll lane operation on I-405. In general, with the NE 6th Street Extension, there would be less intersection delay on NE 4th Street and NE 8th Street, either with or without I-405 express toll lane operation.

The year 2030 traffic operations analyses show that five lanes, consisting of two through lanes in each direction with a left-turn lane at the intersections, are needed on NE 6th Street at the 112th Avenue NE and I-405 direct access ramp intersections. Between I-405 and the BNSF corridor, only two lanes would be needed (one through lane in each direction) for year 2030 PM peak hour volumes. Five lanes are needed at the 120th Avenue NE intersection, consisting of two westbound through lanes and three eastbound lanes, configured as two left-turn lanes and a right-turn lane.

Table 3 shows 2030 PM peak hour operation at intersections along the NE 6th Street Extension for no build and build conditions, with and without I-405 express toll lane operation. The addition of the NE 6th Street Extension (build conditions) would improve operations at the 112th Avenue NE intersection by providing an alternate route for eligible vehicles accessing the I-405 direct access ramps from points east of I-405, reducing the overall volume of traffic at this intersection.

The added traffic volumes accessing the I-405 express toll lanes ("with ETL") would result in level of service (LOS) F operations at the I-405 ramp intersection with the existing lane configuration on the ramps. Reconfiguring the ramps to provide left turn lanes on the north and south intersection approaches would provide LOS C operation, and would significantly reduce the potential for queues backing up from the signalized intersection onto the I-405 mainline express toll lanes.

Table 3
NE 6th Street 2030 PM Peak Hour
Intersection Level of Service and Delay

Intersection	No Build		Build	
	Without ETL	With ETL	Without ETL	With ETL
NE 6th Street & 112th Avenue NE	E 69.1 secs	F 113.6 secs	E 58.1 secs	E 62.5 secs
NE 6th Street & I-405 Ramps existing, without left turn lanes on ramp	C 24.7 secs	E 56.3 secs	E 57.4 secs	F 83.9 secs
NE 6th Street & I-405 Ramps modified, with left turn lanes on ramp	N.A.	N.A.	N.A.	C 23.5 secs
NE 6th Street & 120th Avenue NE	B 15.1 secs	B 18.7 secs	C 30.7 secs	C 26.8 secs

N.A. = configuration not evaluated for this scenario.

ETL = Express Toll Lanes on I-405

Source: HNTB Corporation, 2011

For more information on the traffic operations of the NE 6th Street Extension project see the *Traffic Operations Analysis Report* (HNTB Corporation, 2011) in Appendix D.

DESCRIPTION OF THE ALTERNATIVES AND DESIGN OPTIONS

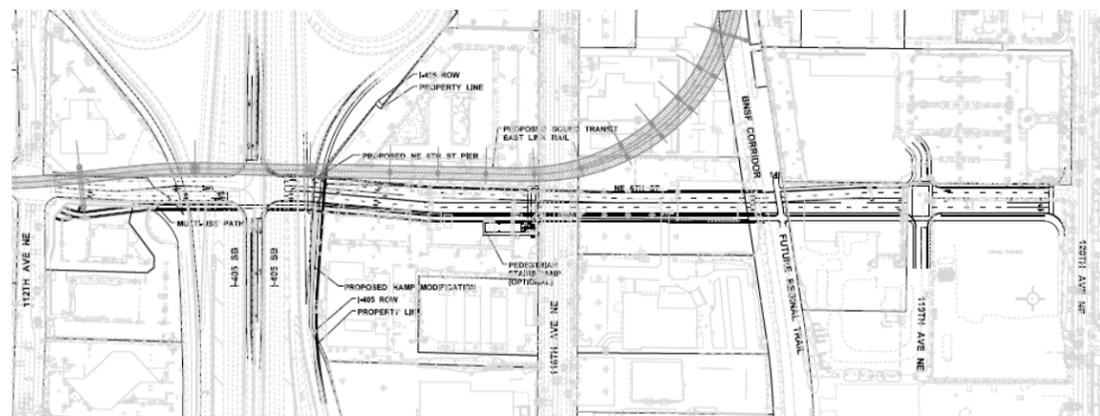
Overview of Alternatives

The City of Bellevue Transportation Facilities Plan describes the NE 6th Street Extension project as follows:

Extend NE 6th Street, as an HOV only facility, from the I-405 HOV interchange to the east over 116th Avenue NE, crossing BNSF right-of-way, and terminating at 120th Ave NE. Improvements include two lanes in each direction with left turn lanes at signalized intersections of I-405 and 120th Avenue NE, a 14' wide non-motorized pathway adjacent to and along the south side of the extension between 112th Ave NE and 120th Ave NE, I-405 corridor design standards, illumination system, retaining walls, landscaping for at-grade locations, underground utilities, detention/water quality treatment, and provisions that do not preclude future regional trail or other improvements within the BNSF corridor.

The initial design alternative developed as a part of this preliminary engineering effort assumed a four-lane basic section (two through lanes in each direction) on NE 6th Street from 112th Avenue NE to 120th Avenue NE. Turn lanes would be provided where needed at intersections, and a multi-use path would be located on the south side of the traffic lanes. This alternative is depicted in Exhibit EX01 found in Appendix A and is shown below in Figure 17.

Figure 17
Four-Lane Basic Section on Base Alignment

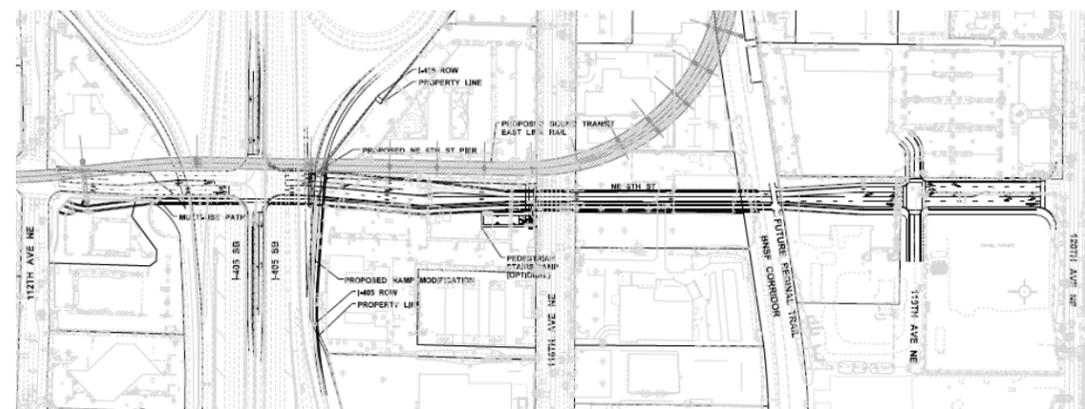


Source: HNTB Corporation, 2011

The results of the traffic operations analyses indicated that the design year traffic volumes east of I-405 would not require four lanes between the signalized intersections at the I-405 ramps and 120th Avenue NE. The majority of this portion of the corridor will be on elevated structure with an associated high cost relative to an at-grade facility. For these reasons, two-lane alternatives (one lane through in each direction) were developed for the portion of the corridor on elevated

structure between the I-405 right-of-way and the BNSF corridor. The initial two-lane basic section alternative assumed the same horizontal alignment and profile as the four-lane basic section alternative. This alignment is referred to as the “base” alignment and is depicted in Exhibit EX02 found in Appendix A and is shown below in Figure 18.

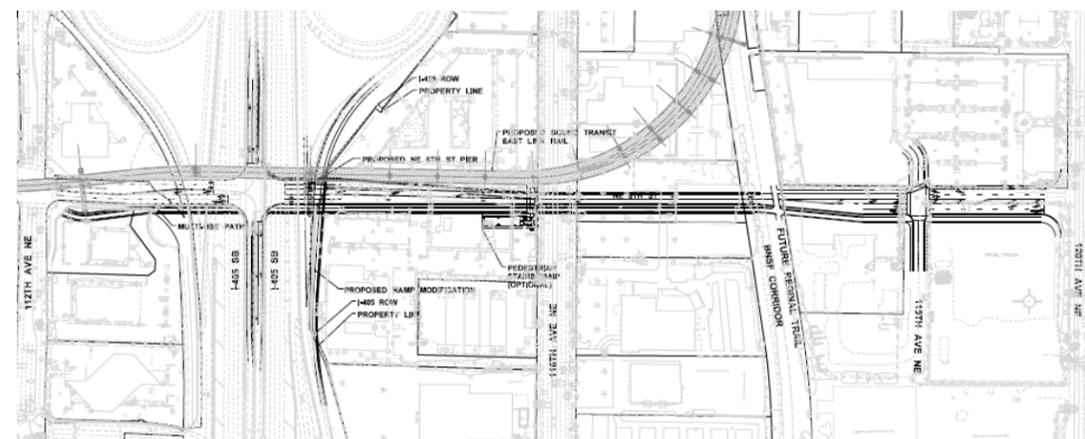
Figure 18
Two-Lane Basic Section on Base Alignment



Source: HNTB Corporation, 2011

A second two-lane alternative with a “refined” alignment was also developed. The refined alignment would have less horizontal curvature and would be located further north, immediately adjacent to the Sound Transit’s proposed East Link elevated guideway structure. This alternative is depicted in Exhibit EX03 found in Appendix A and is shown below in Figure 19.

Figure 19
Two-Lane Basic Section on Refined Alignment



Source: HNTB Corporation, 2011

Alignment & Profile Options

Base Alignment

The base alignment is depicted on Alignment and Right of Way Plan sheets AR01 and AR02 and Profile sheets PR01 and PR02 (Appendix B).

112th Avenue NE to I-405

The base horizontal alignment lines up symmetrically with the existing NE 6th Street and 112th Street intersection. It follows the existing roadway centerline to the I-405 ramps intersection on a profile grade of approximately 3.6%, cresting and flattening out at the I-405 ramps intersection.

I-405 to BNSF Corridor

East of the I-405 ramps intersection to the vicinity of the I-405 right-of-way line, the base horizontal alignment would be on a tangent. In this area, a minimum six-foot horizontal clearance would be maintained from the outside face of the NE 6th Street bridge rail to the near face of the proposed East Link elevated guideway bridge piers. The East Link guideway deck would overhang the NE 6th Street structure by one to four feet. A vertical clearance of 16.5 feet would be provided over the NE 6th Street structure.

In the vicinity of the I-405 east right-of-way line, the base alignment would shift to the south via two 510-foot radius horizontal curves, reducing the right-of-way impact to the Goldtrust Hotel property on the north side of NE 6th Street, and increasing the horizontal clearance to the proposed Sound Transit elevated guideway bridge piers to 28 feet.

The cross slope of NE 6th Street would be a constant 2% rate sloping down from north to south, matching the profile of the existing NE 6th Street ramps and improving vertical clearance over the northbound I-405 mainline. The 2% constant cross-slope is maintained on the proposed bridge east to the BNSF Corridor. This cross-slope would result in a negative superelevation or adverse crown on the second horizontal curve, but would meet AASHTO and WSDOT guidelines for a 35 mph design speed. The constant cross slope would also simplify drainage on the bridge structure.

The profile grade of the NE 6th Street Extension would be 1.4% from the I-405 ramps to the BNSF Corridor. The I-405 direct access ramps intersection would be reconstructed to eliminate an existing 4% grade break (2% on each side of the break), raising the roadway elevation by approximately two to six inches across the grade break. This would minimize the grade break between the existing and new structures and would provide the maximum possible vertical clearance to northbound I-405 lanes, approximately 23 feet between roadway profiles. This vertical separation would allow for a five to six foot structure depth on the NE 6th Street Extension while providing no less than the minimum required 16.5 feet of vertical clearance over the I-405 northbound mainline. Subsequent design activities will include topographical survey to verify the existing elevations and grading at the ramp intersection.

BNSF Corridor to 120th Avenue NE

The horizontal alignment would be on a tangent from a point west of 116th Avenue NE to 120th Avenue NE. The alignment was set to allow for a five-lane basic section at the 120th Avenue NE intersection, while matching the curb line for existing property improvements along the north side

of NE 6th Street in the vicinity of 120th Avenue NE, and the north curb return that will be constructed by the 120th Ave NE project. Crossing the BNSF Corridor, the profile grade flattens to 0.3%, matching the existing terrain east to 120th Avenue NE. The cross-slope of NE 6th Street would transition to a 2% normal crown section immediately east of the bridge structure and maintain a normal crown section east to 120th Avenue NE.

Refined Alignment

The refined alignment is depicted on Alignment and Right of Way Plan sheets AR03 and AR04 and Profile sheets PR07 and PR08 (Appendix B).

112th Avenue NE to I-405

The refined alignment would be identical to the base horizontal alignment in this segment.

I-405 to BNSF Corridor

East of the I-405 ramps intersection, the refined alignment shifts to the south via two 1°38" angle points. These angle points would desirably align with bridge structure pier locations to simplify design and construction. Relative to the base alignment, the refined alignment would be further north, paralleling the adjacent Sound Transit East Link elevated guideway bridge structure. This alignment would reduce structure area and right-of-way impact on the existing properties south of NE 6th Street. It would also allow the south side of the elevated structure, which includes the multi-use path, to be on a tangent, simplifying the design and construction of the elevated structure. As with the base alignment, the cross slope of NE 6th Street would be a constant 2% rate sloping down from north to south for the full length of the bridge structure. The profile grade of the NE 6th Street Extension would be 1.4% from the I-405 ramps to the BNSF Corridor.

BNSF Corridor to 120th Avenue NE

The horizontal alignment would be on a tangent from a point west of 116th Avenue NE to 120th Avenue NE. Relative to the base alignment, the refined alignment baseline would be approximately 17 feet further north at the intersection of NE 6th Street with 120th Avenue NE. With a five-lane basic section at the 120th Avenue NE intersection, the refined alignment alternative would impact approximately five additional feet of existing property improvements along the north side of NE 6th Street in the vicinity of 120th Avenue NE. The profile grade and cross-slopes would be identical to the base alignment.

Roadway Basic Section Options

As described earlier, both four-lane and two-lane basic section options have been developed for the portion of the NE 6th Street extension between I-405 and the BNSF Corridor. The basic sections for each alternative are shown in Table 4. A plan view of the lane arrangements are shown on Exhibits EX01, EX02, and EX03 in Appendix A.

The proposed roadway sections are shown on Conceptual Plans Sheet RS01 in Appendix B. As noted under Design Criteria, all traffic lanes on the NE 6th Street Extension are proposed to be 12 feet wide. The plans in Appendices A and B depict an edge line stripe along the exterior lanes. A shoulder or shy distance two to three feet in width would be provided between the exterior lanes in each direction and the adjacent bridge rail or curb. This would provide a total effective width of 14 to 15 feet for the two exterior lanes.

**Table 4
Roadway Basic Sections by Alternative**

Alternative / Alignment Option	112th to I-405 Ramps	I-405 Ramps to 116th	116th to BNSF Corridor	BNSF Corridor to 119th	119th to 120th
4-Lane / Base Alignment	5 lanes	5-4 lanes	4 lanes	4-5 lanes	5 lanes
2-Lane / Base Alignment	5 lanes	5-2 lanes	2 lanes	2-4 lanes	5 lanes
2-Lane / Refined Alignment	5 lanes	4-2 lanes	2 lanes	2-4 lanes	5 lanes

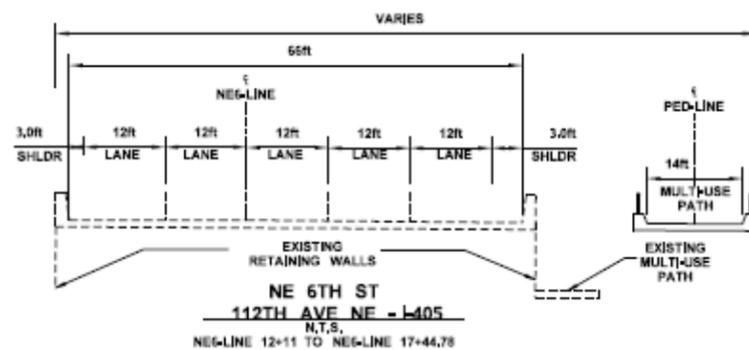
Source: HNTB Corporation, 2011

In addition to the four-lane and two-lane basic section options, a three-lane basic section option could be considered for the portion of the NE 6th Street Extension between 116th Avenue NE and the BNSF corridor. A third lane on NE 6th Street would allow access to a potential future parking structure associated with adjacent development, for example, a regional sports arena or events center that might attract large volumes of HOV traffic. The width of a three-lane roadway would be 40 feet, consisting of three 12-foot wide lanes and two-foot wide shoulders or shy distance on each side adjacent to the curb or bridge rail. An interim two-lane section could be striped on an ultimate three-lane facility as two 12-foot wide lanes with 8-foot wide shoulders.

112th Avenue NE to I-405 Ramps

All three alternatives described in this design report would be identical between 112th Avenue NE and the I-405 ramps intersection. NE 6th Street would have five 12-foot wide lanes, two westbound and two eastbound, with a left turn lane at each intersection. The existing three-foot wide shoulder would remain. The existing raised median separating the eastbound and westbound lanes on NE 6th Street at the ramps intersection would be removed and converted to an eastbound left-turn lane.

**Figure 20
Typical Section – 112th Avenue NE to I-405**



Source: HNTB Corporation, 2011

A multi-use path on separate structure to be located on the south side of NE 6th Street is proposed to carry the multi-use path between 112th Avenue NE and 114th Avenue NE. Between 114th

Avenue NE and the I-405 ramps intersection, the multi-use path could be on a separate structure or on a widening of the existing bridge structure, as described later in this report.

An option that would have provided a total of four traffic lanes in this segment was investigated but rejected due to poor levels of service that would have resulted at the 112th Avenue NE and I-405 ramp intersections. The advantage of this option is that it would have reduced project costs by eliminating the need for a separate and/or widened structure carrying the multi-use path from 112th over I-405. It would have allowed the multi-use path to be on the existing retained earth and bridge structures by converting the southern-most traffic lane to non-motorized uses, and reducing existing shoulder widths from three feet to two feet.

I-405 Ramps to 116th Avenue NE

All three alternatives would provide a westbound left-turn pocket at the I-405 ramps intersection. Traffic operations analyses with Year 2030 forecasts indicate that this left-turn pocket should provide 300 feet of storage as indicated on the channelization plans in Appendix B on Sheets CH01 (four-lane basic section with base alignment) and CH04 (two lane basic section with refined alignment). The taper to drop this lane would extend east to the west side of 116th Avenue NE at a 15:1 minimum taper rate.

The two-lane basic section alternative with the base alignment would carry two eastbound through lanes across the I-405 ramp intersection, dropping the second lane 300 feet east of the intersection. This alternative would also carry two westbound through lanes across the I-405 ramp intersection, providing 300 feet of storage for each lane upstream of the ramps intersection. These lanes would be dropped and added utilizing a 15:1 minimum taper rate.

In contrast, the two-lane basic section alternative with the refined alignment would carry one eastbound through lane across the I-405 ramp intersection. A 24-foot wide throat would be provided on the east side of the intersection to better accommodate right turn movements off of the northbound ramp. This section width would be carried 150 feet east of the intersection. This alternative would also carry two westbound through lanes across the I-405 ramp intersection, providing 150 feet of storage for each lane upstream of the ramps intersection. These lanes would be dropped and added utilizing a 15:1 minimum taper rate.

This portion of the NE 6th Street Extension would be carried on a bridge structure. The conceptual cross section shown in For all three alternatives, the begin and end points of the lane drop/add tapers would be coordinated with the bridge structure design such that the tapers would begin and end at even structural units such as at the bridge piers. The begin/end point of the lane tapers shown on the conceptual plans are approximate and will be refined in subsequent design phases.

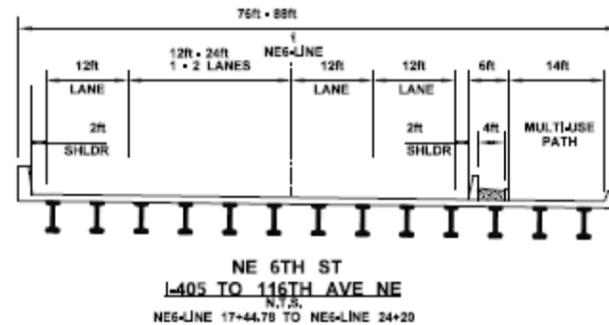
East of the I-405 right-of-way, a planter strip is proposed to separate the traffic lanes from the adjacent multi-use path. This planter strip would include a crash-rated barrier adjacent to the traffic lanes, a four-foot wide landscaping bed, and a concrete parapet between the landscaping bed and the multi-use path. Smooth wall finishes are recommended for the barriers and/or parapets immediately adjacent to motorized or non-motorized traffic. Textures or patterns could be considered for the portion of the barrier or parapet on the back side of the planter strip facing the multi-use path.

Figure 21 depicts the steel girder superstructure that is recommended between the I-405 ramps and the east I-405 right-of-way line. East of the I-405 right-of-way line, the recommended structure type is a concrete tub girder as shown on Figure 22.

For all three alternatives, the begin and end points of the lane drop/add tapers would be coordinated with the bridge structure design such that the tapers would begin and end at even structural units such as at the bridge piers. The begin/end point of the lane tapers shown on the conceptual plans are approximate and will be refined in subsequent design phases.

East of the I-405 right-of-way, a planter strip is proposed to separate the traffic lanes from the adjacent multi-use path. This planter strip would include a crash-rated barrier adjacent to the traffic lanes, a four-foot wide landscaping bed, and a concrete parapet between the landscaping bed and the multi-use path. Smooth wall finishes are recommended for the barriers and/or parapets immediately adjacent to motorized or non-motorized traffic. Textures or patterns could be considered for the portion of the barrier or parapet on the back side of the planter strip facing the multi-use path.

Figure 21
Typical Section – I-405 to 116th Avenue NE



Source: HNTB Corporation, 2011

The plantings in the landscaping bed are proposed to consist of drought tolerant species of shrubs and groundcovers, and small to medium sized street trees with a maximum height of 15 feet at maturity. Specific species of plantings will be determined in subsequent phases of project development. The proposed planting bed with street trees would be expected to include the following benefits that are consistent with the City's goals for the NE 6th Street Extension project^{1,2}:

- Greater separation of the motorized and non-motorized environments providing a physical and psychological buffer between the two, resulting in an improved walking environment that would encourage usage of the corridor by pedestrians and other non-motorized user modes of travel.

¹ 22 *Benefits of Urban Street Trees*, Dan Burden, Senior Urban Designer, Gladding Jackson and Walkable Communities, Inc.; May 2006.

² *The Street Tree Effect and Drive Safety*, Jody Rosenblatt Naderi, Byong Suk Kweon Ph.D. and Praveen Magehelal, ITE Journal on the Web, February 2008.

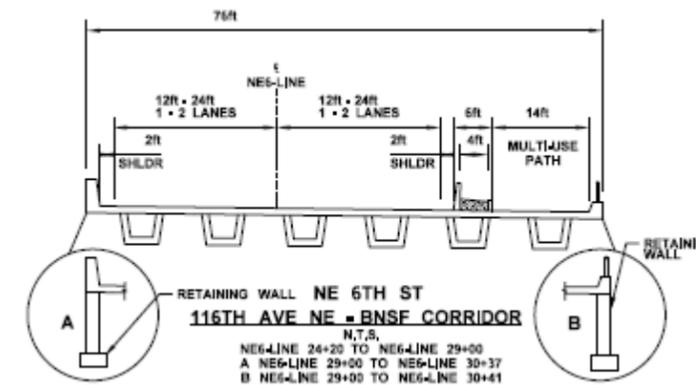
- Reduced traffic speeds by providing vertical elements (street trees) at the roadway edge that help motorists to gauge their speed, improve motorist attention and alertness, and provide a psychological calming effect, which in combination can result in speed reductions compared to similar locations without street trees.
- Lower pavement temperatures and reduced impacts from tailpipe emissions.

Other benefits typically attributable to street trees, such as shading and cooling the multi-use path, would be less pronounced, due to the location of the landscaping bed on the north side of the multi-use path. Landscaping and street tree provisions on the elevated structure would increase construction and maintenance costs.

116th Avenue NE to BNSF Corridor

The typical section would be of constant width from the west side of 116th Avenue NE to the BNSF Corridor. The NE 6th Extension would be supported on a bridge structure for most of its length in this segment, transitioning to retained fill as it approaches the BNSF Corridor. A planter strip and multi-use path would be provided on the south side of the traffic lanes as described for the previous segment (Figure 22).

Figure 22
Typical Section – 116th Avenue NE to BNSF Corridor



Source: HNTB Corporation, 2011

If a two-lane alternative is selected for implementation, the base alignment could be designed and constructed to allow for future widening to three or four lanes. The refined alignment would be less suited to future widening because of the configuration of the lane adds and drops at either end of this segment, and its proximity to the proposed Sound Transit East Link elevated guideway structure.

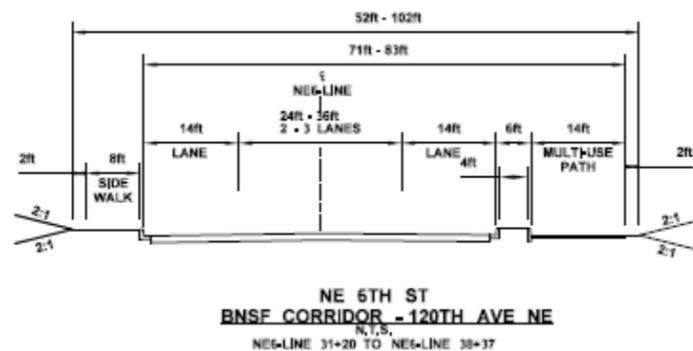
BNSF Corridor to 120th Avenue NE

This segment would be at-grade for all three alternatives. As described later in this design report, it is anticipated that a future regional trail in the BNSF Corridor would cross the NE 6th Street Extension at-grade. As indicated in Table 4, the basic roadway section would taper between the BNSF corridor and 119th Avenue NE, anticipated to be an intersection with a private

streets/driveways on adjacent properties, to provide an eastbound left-turn pocket at the 119th Avenue NE intersection.

All three alternatives would provide a total of five traffic lanes between the 119th Avenue NE and 120th Avenue NE intersections. As shown on Figure 23, the multi-use path would continue east on the south side of NE 6th Street to 120th Avenue NE. A four-foot wide planting area would be provided between the traffic lanes and the multi-use path. On the north side of NE 6th Street, an eight-foot wide sidewalk would be provided. It may not be possible to provide a planter strip on the north side of NE 6th Street between the BNSF Corridor and 120th Avenue NE, due to constraints represented by existing buildings and parking areas.

Figure 23
Typical Section – BNSF Corridor to 120th Avenue NE



Source: HNTB Corporation, 2011

Non-Motorized User Provisions

I-405 presents a barrier to non-motorized modes of travel. The barrier is created by both the distances involved in a crossing of I-405, primarily due to a lack of continuity of the street grid across I-405, and high volumes of traffic associated with the I-405 freeway ramps, particularly where loop ramps and free-flow turning movements occur. Pedestrian and bicycle crossings of I-405 in the project vicinity include Main Street, NE 4th Street, NE 8th Street, NE 10th Street, and NE 12th Street. The City of Bellevue’s Pedestrian & Bicycle Transportation Plan identifies Main Street, NE 4th Street, NE 8th Street, and NE 12th Street as primary elements of the existing pedestrian network. NE 12th Street is identified as a primary element of the bicycle network, with Main Street, NE 4th Street, NE 6th Street, and NE 8th Street as other elements of the bicycle network. The NE 6th Street extension is identified in the plan as the location for a 10 to 14 foot wide off-street path for use by pedestrians and bicycles.

The NE 6th Street Extension would provide a new east-west connector across I-405 for pedestrian and bicycles. It would provide an alternative to NE 8th Street and NE 4th Street, both arterials with high volumes of traffic. The high volumes of turning traffic associated with the I-405 interchange ramps that connect to these streets are of particular concern in regards to non-motorized user trips across the I-405 corridor. The NE 6th Street Extension would connect to the existing pedestrian corridor through downtown Bellevue from Bellevue Way NE to 112th Avenue

NE. It would also facilitate non-motorized access to a future regional trail along the BNSF corridor, and future mixed-use developments in the Wilburton Village area. Optional project provisions for connections to 116th Avenue NE are also described in this section.

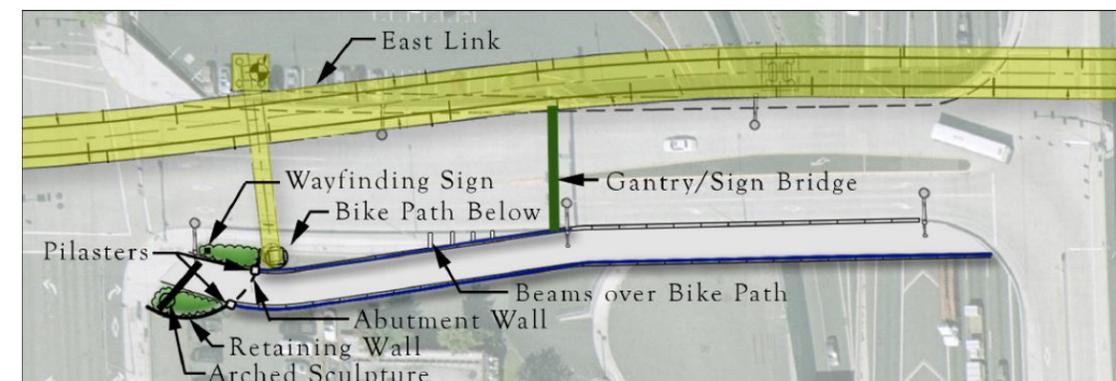
Multi-Use Path

The primary non-motorized user facility proposed for the NE 6th Street Extension is a multi-use path along the south side of the extension. The basic path would be 14-foot-wide with a 5% maximum profile grade, and would comply with the requirements of the American with Disabilities Act (ADA) accessibility guidelines. The non-motorized user experience would be enhanced by a 4-foot wide planter strip separating motorized vehicle traffic from multi-use path. Rest areas with benches are proposed to be provided on the elevated portion of the NE 6th Street Extension between the I-405 right-of-way and the BNSF Corridor, a distance of approximately 1,200 feet.

112th Avenue to I-405 Ramps

Between the 112th Avenue NE and 114th Avenue NE, the multi-use path would be on the south side of NE 6th Street on a new separate bridge structure (Figure 24). A plaza would be provided on the southeast corner of the intersection to facilitate the connection between the Lake Washington Loop (labeled “Bike Path Below” in Figure 24) and the NE 6th Street Extension multi-use path. A pedestrian/bike “scramble” traffic signal phase might be desirable at this location to enable bicyclists to transition from the NE 6th Street multi-use path and Lake Washington Loop facilities to on-street riding on 112th Avenue NE and/or NE 6th Street. Analysis of this phase indicated that it would degrade the peak-period intersection level of service from LOS E to LOS F with year 2030 forecast volumes.

Figure 24
Multi-Use Path, 112th Avenue NE to I-405 Ramps Intersection



Source: HNTB Corporation, 2011

Alternatives considered for the multi-use path between 112th Avenue NE and 114th Avenue NE included:

- **Path on Existing NE 6th Street** – The existing five-lane section would be reduced to four traffic lanes plus the multi-use path. This alternative was not carried forward because of traffic operations impacts at the 112th Avenue NE intersection with NE 6th

Street, where five lanes are needed on NE 6th Street to provide LOS E traffic operations during peak periods.

- **Path on Widened Retaining Wall Structure** – The existing retaining walls supporting NE 6th Street east of 112th Avenue NE would be widened to provide the multi-use pathway. This alternative was not carried forward because it would interfere with the straddle bent placement for the East Link elevated guideway structure.
- **Independent Path on Bridge Over Trail** – A new bridge structure would connect to the plaza at the southeast corner of the intersection, providing a relatively open view from the adjacent bike path to the parking lot. This alternative was carried forward and is discussed further in the structures section of this report.
- **Independent Path on Retaining Walls Adjacent to Trail** – Back-to-back retaining walls would carry the multi-use path from the plaza at the southeast corner of the intersection to the first bridge span. This alternative was carried forward and is discussed further in the structures section of this report, but was felt to be less desirable than the bridge option described above because the existing bike trail would be in a “trench” between the NE 6th Street and multi-use path retaining walls.

As noted above for the widened retaining wall structure option, the 30% design for the East Link project identifies a straddle bent to support the elevated guideway as it transitions from the median of NE 6th Street to an alignment immediately north of NE 6th Street. This configuration is depicted in Figure 24. The location and configuration of this bent will need to take into consideration the existing bike path connection to the Lake Washington Loop Trail and future NE 6th Street Extension multi-use trail connection.

The main route for the Lake Washington Loop passes under NE 6th Street, paralleling the adjacent southbound I-405 on-ramp from NE 8th Street (Figure 25). The alternate east-west connection between 112th Avenue NE and the Lake Washington Loop at NE 6th Street provides a means for cyclists to utilize the northbound through lane at the intersection of 112th Avenue NE and NE 8th Street, reducing conflicts with right-turn traffic from 112th Avenue NE to the I-405 on-ramp.

Figure 25
Lake Washington Loop at 114th Ave SE & NE 6th Street



Source: HNTB Corporation, 2010

I-405 Ramps Intersection

The multi-use path would cross the I-405 direct access ramps with a crosswalk on the south leg of the signalized intersection. On the east side of the intersection, a 20-foot-wide area would be provided between the crosswalk and the I-405 right-of-way line (Figure 26). This wider area would be created by the elimination of the planter bed between the NE 6th Street traffic lanes and the multi-use path. This wider raised area would be protected by bollards in the immediate vicinity of the curb return. This wider area would provide additional space for pedestrians and bicyclists to wait for a crossing signal. It could also be used by law enforcement officers on motorcycles to monitor for HOV compliance at the intersection. This area would likely be the location for traffic signal, ITS, and/or tolling equipment cabinets associated with the I-405 ramps intersection.

Figure 26
Multi-Use Path on East Side of I-405 Ramps Intersection



Source: HNTB Corporation, 2011

A potential operational concern is eastbound to southbound right-turn traffic turning across the multi-use path crosswalk. The two-lane basic section alternatives could be striped to provide a right-only lane at this location, allowing for a right-turn signal phase that could overlap with the north-south left-turn phase. This could reduce the volume of right turn traffic during the through phase that would include the “walk” phase for the crosswalk.

I-405 to BNSF Corridor

From the I-405 east right-of-way limit to the BNSF Corridor, the multi-use path would be on the NE 6th Street Extension bridge structure. A four-foot wide planter strip with rest areas would be provided in this section. Figure 27 depicts a view looking west from the vicinity of 116th Avenue NE. Smooth wall finishes are shown in the rendering, but textures or patterns could be considered for the portion of the walls on the back side of the planter strip. Textures or patterns, which could represent a snagging hazard for bicyclists, are not recommended for the concrete railing parapet or planter strip wall immediately adjacent to the multi-use path.

Figure 27
Multi-Use Path, I-405 to BNSF Corridor

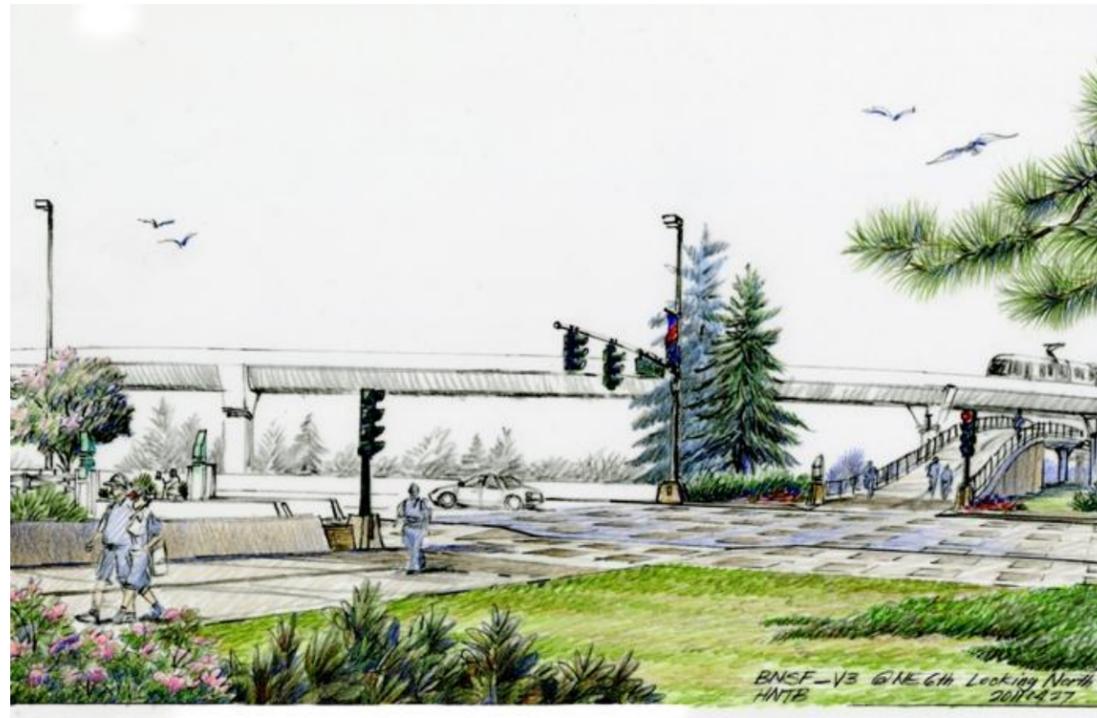


Source: HNTB Corporation, 2011

BNSF Corridor

At the BNSF Corridor, the multi-use path would include provisions for a connection with a future regional trail. This future regional trail would cross NE 6th Street at-grade, potentially with a traffic signal for the crossing as shown in Figure 28. Future design activities should evaluate this and other traffic control strategies for this crossing. This evaluation should take into consideration the number of traffic lanes on NE 6th Street (four versus two), a potential traffic signal installation at 119th Avenue SE (described later in this report), volumes of motorized traffic, volumes of non-motorized traffic, and technologies for detection of non-motorized traffic on the future regional trail. Pavement treatments to differentiate the crossing from the traffic lanes, such as currently provided in the NE 6th Street Pedestrian Corridor at the crossings of 108th Avenue NE, 106th Avenue NE, and at Bellevue Way, would be desirable at this location.

Figure 28
Multi-Use Path Connection to Future BNSF Corridor Regional Trail



Source: HNTB Corporation, 2011

BNSF Corridor to 120th

Between the BNSF Corridor and 120th Avenue NE, the multi-use path would be on the south side of the NE 6th Street Extension. An eight-foot wide sidewalk would be provided on the north side of NE 6th Street in this section. A pedestrian/bicycle scramble traffic signal phase could be considered at the intersection of NE 6th Street and 120th Avenue NE to facilitate the transition from the multi-use path to/from on-street bike facilities on 120th Avenue NE. This phase was not evaluated as it is likely that demand for this non-motorized user movement would be relatively low, assuming that a parallel north-south regional trail facility were provided in the BNSF Corridor.

Multi-Use Path Width Options

A 16-foot wide multi-use path has also been evaluated as a potential option. The additional width would accommodate a higher volume of non-motorized users and could potentially reduce conflicts between bicyclists and pedestrians or other slower users.

The elevated portion of the NE 6th Extension will be approximately 1,800 feet long, measured from the 112th Avenue NE intersection to the BNSF Corridor. Separation of non-motorized user groups is an emerging trend currently observed in the context of long-span bridges of similar and longer lengths. Examples include:

- **Willamette River Transit Bridge** – Tri-Met is building a new light rail bridge over the Willamette River immediately south of downtown Portland. The total length of the bridge will be about 1,700 feet, similar to the length of the elevated portions of the NE 6th Street Extension. Two bike/pedestrian paths will be provided on the Willamette River transit bridge, one on each side of the transit guideway. Each will provide a 14 foot width, designated as seven feet for one-way bicycle traffic and seven feet for two-way pedestrian traffic. The two modes will be separated by a painted line.
- **San Francisco-Oakland Bay Bridge East Span** – The new self-anchored suspension bridge and associated approach spans are providing a 15'-6" wide non-motorized pathway, consisting of one 5'-3" wide bicycle lane in each direction and a 5'-0" wide two-way pedestrian path.
- **I-80 Pedestrian Bridge, Berkeley, CA** – This non-motorized path bridge over I-80 is providing a 10-foot wide two-way bicycle pathway (one four-foot lane in each direction with one foot shy to railing or curb) and a five-foot wide two-way pedestrian pathway. The bicycle and pedestrian portions of the trail are separated by a raised curb.
- **I-5 Columbia River Crossing** – Design has not been finalized but the project's Pedestrian and Bicycle Advisory Committee has recommended that provisions be made to separate higher-speed bicycle traffic from slower recreational traffic. The committee has suggested that a pair of six-foot wide bike lanes, one in each direction, with a 12-foot wide two-way recreational trail would be appropriate.

These proposed separated bike/pedestrian facilities are in contrast to "legacy" non-motorized path facilities on longer-span bridges in the Puget Sound Region, including:

- **Tacoma Narrows Bridge (2004)** – 10-foot wide shared-use path, no designations.
- **I-90 East Channel Bridge (ca. 1985)** – 8-foot wide shared-use path, no designations.
- **I-90 Floating Bridge (1989)** – 10-foot wide shared-use path, no designations.

Future design development activities should take into consideration the anticipated volumes and mix of users for the NE 6th Street Extension. These will be in large part dependent on provisions for a future regional trail on the BNSF Corridor and how properties adjacent to the corridor redevelop. Consistency with other regional trail/multi-use facilities would also be desirable. At present, most of these do not designate specific lanes for bicyclists or pedestrian use.

Pedestrian Overlook/Rest Areas

If a wider multi-use path with designated lanes for bicyclists and pedestrians were provided, the pedestrian/sidewalk area would be located on the south side of the structure, adjacent to the south bridge rail. In this case, rest areas would desirably be located on the south side of the multi-use path, rather than incorporated into the landscaped areas as is shown on Figure 27.

An option for combination overlook/rest areas has been developed (Figure 29). These overlook rest areas would be located at bridge piers to minimize additional structural costs. Benches at these overlook rest areas would be located away from the bridge rail, adjacent to the multi-use trail, to reduce the potential for users utilizing the benches to climb the railings. The overlook rest areas could be used with any multi-use path width option.

Figure 29
Pedestrian Overlook/Rest Area Option



Source: HNTB Corporation, 2011

Other Considerations for Bicycles

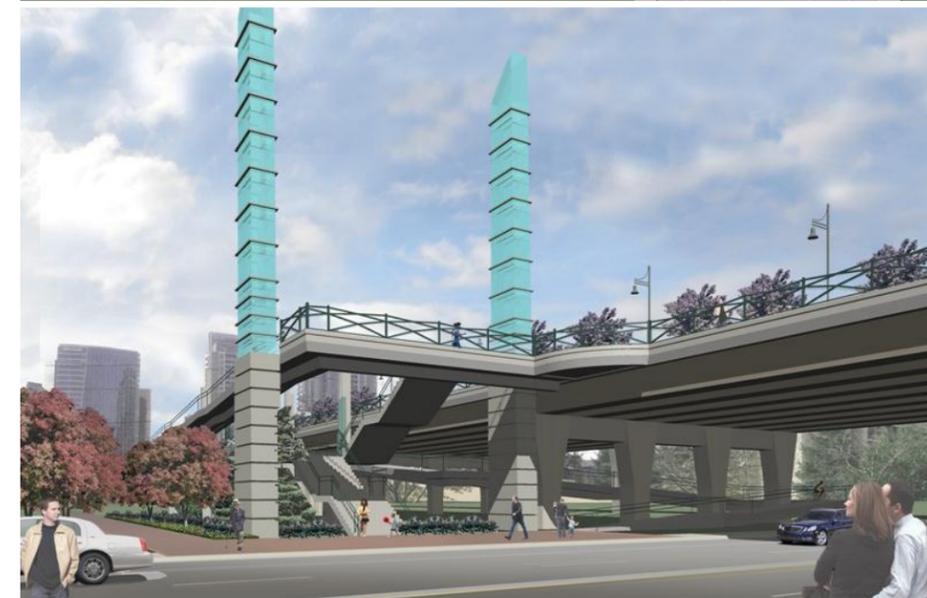
The project proposes a multi-use (off-street) path, consistent with the City's pedestrian and bicycle plan. Higher-speed bicyclists may prefer to ride on the street. With the proposed provision for 12-foot wide traffic lanes with a two-foot wide shy distance to the adjacent bridge rail, barrier, or curb, a total of 14 feet of usable width would be provided in the external lanes of the NE 6th Street Extension. This width is consistent with provisions for shared wide outside lanes as identified in the City's bicycle facility descriptions.

Connection to 116th Avenue NE

The NE 6th Street Extension would not include an intersection with 116th Avenue NE. The proposed bridge structure would carry NE 6th Street over 116th Avenue NE. A connection to 116th Avenue NE would be desirable, however, for pedestrians and other non-motorized users. A concept for a stairway and ramp connection has been developed and is included an optional item in estimates of probable project cost.

The connection is proposed to be located in the southwest quadrant of the NE 6th Street crossing over 116th Avenue NE, as shown in Figure 30. The ramps would parallel NE 6th Street to the west, and then wrap under the NE 6th Street bridge structure. Ramp gradients and landing spacing would be compliant with ADA criteria. The total length of the ramps would be approximately 600 feet.

Figure 30
Connection to 116th Avenue NE – Plan & Elevation Views

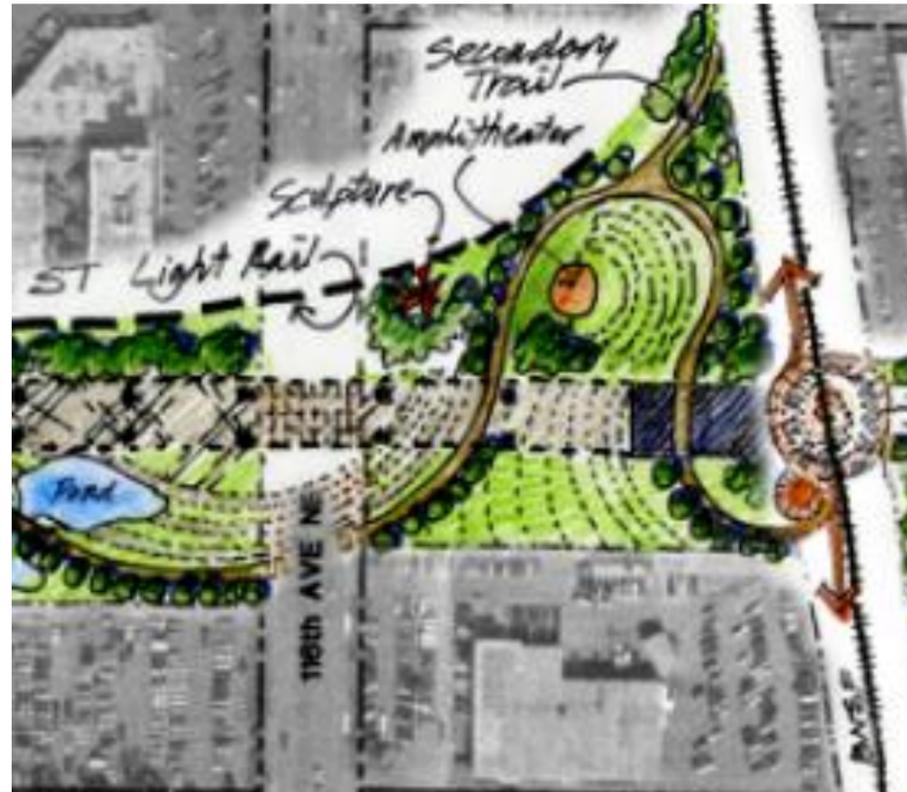


Source: HNTB Corporation, 2011

The renderings shown in Figure 30 also depict glass towers that would provide a way-finding or gateway element for the NE 6th Street Corridor. They are further described in the Urban Design Master Plan report. This concept is intended to reflect the City's downtown skyline, but could be modified to reflect future adjacent development along 116th Avenue NE.

Alternative at-grade non-motorized user connections to 116th Avenue NE from the BNSF corridor were considered. These were focused on at-grade pathways connecting 116th Avenue NE to the BNSF corridor. One concept is shown below in Figure 31. These concepts would require additional right-of-way and were not carried forward in the project cost estimates. They could, however, be re-visited as adjacent properties are redeveloped in the future.

Figure 31
Concept for At-Grade Connection to 116th Avenue NE



Source: HNTB Corporation, 2011

Transit Provisions

Extending NE 6th Street across I-405 could provide an alternate access for transit buses traveling between the Bellevue Transit Center and the NE 8th Street corridor and destinations east of I-405. Transit trips could be re-routed from adjacent arterials to utilize NE 6th Street. Service for these trips is currently provided by King County Metro. The October 2011 restructuring of Bellevue to Redmond transit service eliminated routes that could have utilized the extension, including King County Metro's Routes 230 and 261. Metro's RapidRide "B" Line service replaced these routes. It utilizes NE 8th Street, including stops serving the Hospital District, so would not likely be a candidate to reroute across I-405 via NE 6th Street. Future Sound Transit East Link light rail service will also provide a transit connection between downtown Bellevue and the Hospital District.

None of Sound Transit's Regional Express routes that provide service on I-405 would be likely candidates to use NE 6th Street extension east of I-405. These routes are oriented to the Bellevue Transit Center rather than destinations immediately east of I-405 in the Wilburton area. The existing NE 6th Street direct access ramps to and from I-405 do not include freeway flyer stop provisions, and could not easily be retrofitted for flyer stops due to width constraints in the median of I-405.

The baseline project design does not include bus stop provisions on NE 6th Street between 112th Avenue NE and the BNSF corridor. The possibility of providing bus stops on the elevated structure was discussed with the project's Technical Review Team. Two potential locations were discussed: at the NE 6th Street direct access ramps intersection; and in the vicinity of 116th Avenue NE. In either case, bus stops could be included on the south side of NE 6th Street. Bus stops on the north side of the street, would, however, require an at-grade crosswalk of NE 6th Street.

At the direct access ramp intersection, a far-side bus stop on the south side of the intersection for eastbound buses could be accommodated relatively easily within the 20 feet of width that would be available. A near-side stop on the north side of the intersection for westbound buses could be accommodated with the two-lane option by eliminating the through lane adjacent to the curb and creating a 12-foot wide waiting area. A north-south cross walk of NE 6th Street at this location could be problematic for traffic signal timing and has not been analyzed to date. A bus stop at this location would have limited or no utility because "flyer stop" service along I-405 is not anticipated. Routes along I-405 would be expected to continue to be oriented to the Bellevue Transit Center and there are not any pedestrian destinations readily accessible from this intersection. For these reasons, future consideration of a bus stop at the direct access ramps intersection does not appear to be warranted.

In the vicinity of 116th Avenue NE, a bus stop could be created relatively easily on the south side of NE 6th Street by creating an opening in the landscape strip adjacent to the optional non-motorized connection to 116th Avenue NE (see Figure 29, above). A stop on the north side could be created by incremental widening of the structure similar to that associated with overlook/rest areas. A pedestrian crossing of NE 6th Street would be required at this location to connect the north side bus stop to 116th Avenue NE. A grade-separated pedestrian connection, passing under the NE 6th Street bridge, would not be recommended as these types of facilities tend to be perceived as less secure and hence uncomfortable by users, and have been known to attract undesirable activities. An unsignalized crossing of the four-lane option would not be recommended due to safety concerns related to stopping four lanes of traffic in response to pedestrian activity. Future consideration of a bus stop and pedestrian cross-walk could be considered with a two-lane or three-lane option, particularly if a median refuge could be provided. The need for a bus stop at this location would depend on the nature and intensity of future development activities along 116th Avenue NE.

I-405 Modifications

The NE 6th Street Extension project would not modify the configuration of the mainline merge/diverge points for the existing transit/HOV direct access ramps. The I-405 program will, however, modify the merge/diverge configuration as described below.

- **Existing Conditions** – The transit/HOV direct access ramps merge or diverge from the existing I-405 mainline HOV lane using left-side connections.
- **I-405, NE 6th to I-5 Widening and Express Lanes Project (Bellevue – Lynnwood Improvement Project)** – The direct access ramps will add/drop an express toll lane to/from the north. Two express toll lanes will be provided on I-405 north of NE 6th Street. The existing condition will remain in place to/from the south, with the one existing HOV lane in each direction remaining as a through lane.
- **I-405, Renton to Bellevue Project** – Currently unfunded, this project would widen I-405 south of NE 6th Street to add one additional mainline lane in each direction. This lane could be an express toll lane. If so, it is likely that this lane would add/drop to/from the south at the NE 6th interchange, with the existing HOV lane remaining as a through lane.

The conversions of the existing I-405 mainline HOV lanes to express toll lanes, and the addition of a second express toll lane, as described above, are subject to final approvals by the Legislature.

The NE 6th Street Extension project would require modifications to portions of I-405 in the immediate vicinity of the interchange:

- Modify direct access ramps to add left turn lanes.
- Modify the northbound collector distributor off ramp to NE 8th Street to accommodate bridge piers for NE 6th Street Extension and Sound Transit East Link structures.

These modifications and design options are described below.

I-405 Direct-Access Ramp Intersection

The existing NE 6th Street direct access ramps provide one lane in each direction, as shown in Figure 32. Under existing conditions, or with the NE 6th Street Extension and the existing ramp channelization, the traffic signal at the ramp terminal intersection utilizes a split-phase operation to reduce overall delay and conflicts for turning traffic. With the addition of east-west through movements associated with the NE 6th Street Extension, this split-phase operation combined with the single lane on the ramp approaches to the intersection would be inefficient and would limit the capacity of the existing intersection.

As noted earlier in this report (see Table 3), year 2030 PM peak hour levels of service would degrade to LOS F with the NE 6th Street Extension and express toll lane traffic on the ramps. Perhaps of more concern, peak period queues would extend beyond the diverge point of the ramps into the mainline express toll lanes as noted on Table 5.

Table 5
Queue Lengths on I-405 Off-Ramps to NE 6th Street

Ramp	Queue Length with Existing Channelization	Queue Length with Left-Turn Channelization
Northbound Off-Ramp	> 2,000 feet	230 feet
Southbound Off-Ramp	> 2,000 feet	180 feet

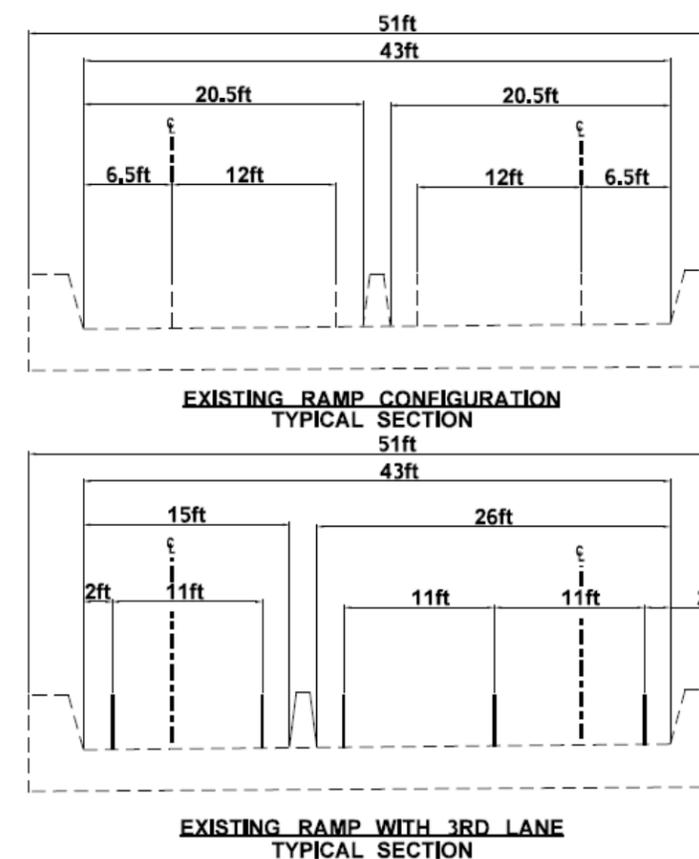
Source: *Traffic Operations Analysis Report*, HNTB Corporation, 2011.

The addition of a third lane on the ramps, which would be configured as a left-turn lane, would improve year 2030 PM peak hour levels of service to LOS C (see Table 3), and would reduce 95th-percentile queue lengths from over 2,000 feet to less than 300 feet. This improvement results from providing left-turn signal phases overlapped with through/right-turn phases for the ramp approaches. This phasing plan would make more efficient use of signal green time, leading to the improved levels of service and reduced queue lengths.

Proposed Channelization

The total width of the I-405 Direct-Access ramps is 43 feet, with an existing width of 20.5 feet for each ramp as shown on the top portion of Figure 32. This existing condition represents a deviation from the WSDOT full design level value of 24 feet for a transit/HOV direct access ramp on a tangent horizontal alignment. The existing shoulder widths of 6.5 feet and two feet, or 8.5 feet total, also represent a deviation from the full design level value of 10 feet for total shoulder width. The minimum ramp width to accommodate an articulated bus, allowing passing of a disabled vehicle, is 21 feet, slightly more than the existing ramp width of 20.5 feet.

Figure 32
I-405 at NE 6th Street Ramp Channelization Modifications



Source: HNTB Corporation, 2011

To provide left-turn lanes on the ramps at the ramp terminal intersection, this project proposes to reallocate the existing ramp channelization as shown on the bottom portion of Figure 32. The resulting ramp widths in the vicinity of the ramp terminal intersections would be 15 feet for the on-ramps and 26 feet for the off-ramps. Ramp lane widths would be reduced from 12 feet existing to 11 feet, and shoulder widths reduced to two feet. This proposed channelization would represent a deviation from WSDOT's full design level criteria for HOV direct access ramps.

Exhibit EX04 depicts the proposed channelization with the addition of left-turn lanes at the ramp terminal intersection. The existing concrete median barrier would be relocated as shown to facilitate turning movements to the on-ramps. The proposed channelization would provide WSDOT full design level acceleration and deceleration distances for passenger cars, as shown on Exhibit EX05. With express toll lanes on both directions of I-405, the on-ramps would add lanes to the I-405 mainline, which would reduce the need for the additional acceleration length and gap acceptance distances for articulated buses. With express toll lanes only to and from the north, the acceleration and gap acceptance distances for the southbound off-ramp would represent deviations from WSDOT full design level distances.

I-405 Ramp Terminals AutoTURN Analysis

The proposed ramp terminal intersection channelization with the addition of left turn pockets on the ramps would reduce the width of the throat of the on-ramp receiving lanes from the existing 20.5-foot width to 15 feet. AutoTURN analyses were conducted to determine if this would be adequate for the AASHTO Intercity Bus (BUS-45) design vehicle, and for the right-turn movements, the WSDOT A-BUS (articulated bus) design vehicle.

Exhibits EX06–EX10 in Appendix A depict the movements described in Table 6. If made from the outside lanes (lane adjacent to the curb or barrier), design vehicle buses turning right would encroach or nearly encroach on the two-foot wide shoulder adjacent to the curb returns, and potentially on the curb return.

Bus movements on the NE 6th Street direct access ramps are predominantly oriented towards the Bellevue Transit Center, located two blocks west of the I-405 corridor on NE 6th Street. An assessment of the ability for the predominant bus movements to navigate through the revised intersection is as follows:

- **Northbound to Westbound** – Left-turning buses from the northbound off-ramp to NE 6th Street would need to utilize both westbound lanes on the receiving leg of the intersection.
- **Eastbound to Northbound** – Left-turning buses from NE 6th Street to the northbound on-ramp would have adequate space to make the turn.
- **Eastbound to Southbound** – Right-turning BUS-45 buses from NE 6th Street to the southbound on-ramp would likely use both eastbound lanes to execute the turn without encroaching on the curb return. Articulated buses could make the turn without encroaching.
- **Southbound to Westbound** – Right-turning buses from the southbound off-ramp to NE 6th Street would partially utilize both westbound lanes on the receiving leg of the intersection.

Of these four movements, only the eastbound to southbound turns would represent a potential safety concern. While the maneuver to use both lanes off of the entering approach for right-turns is commonly utilized by large vehicles in urban areas, it would have the potential to “trap” a vehicle. It may be possible to broaden the radius of the curb return slightly, or move the stop bar on the northbound ramp back from the intersection, to eliminate the need for this maneuver. These design refinements should be explored in subsequent design development.

Table 6
AutoTURN Analysis – NE 6th at I-405 Direct Access Ramps

Exhibit	Turning Movement	Assessment
EX06	Northbound to Westbound 	Left turn encroaches slightly on eastbound left-turn pocket BUS-45 would need both lanes on receiving leg of intersection
EX06	Southbound to Eastbound	Left turn encroaches slightly on westbound left-turn pocket BUS-45 would need both lanes on receiving leg of intersection
EX07	Eastbound to Northbound 	Left turn okay on receiving leg of intersection Concurrent left-turning BUS-45s conflict at front overhangs
EX07	Westbound to Southbound	Left turn okay on receiving leg of intersection Concurrent left-turning BUS-45s conflict at front overhangs
EX08	Eastbound to Southbound 	Right turn encroaches on curb return (turn from outside lane)
EX08	Southbound to Westbound 	Right turn encroaches on curb return (turn into outside lane)
EX08	Northbound to Eastbound	Right turn encroaches on curb return (turn from outside lane)
EX08	Westbound to Northbound	Right turn encroaches on curb return (turn from outside lane)
EX09A	Eastbound to Southbound 	Right turn clears curb return (BUS-45 turn from both lanes)
EX09B	Eastbound to Southbound 	Right turn clears curb return (Northbound stop bar moved back)
EX09C	Eastbound to Southbound 	Right turn encroaches on ramp shoulder (turn from curb lane)
EX10	Eastbound to Southbound 	Right turn clears curb return (A-BUS turn from outside lane)
EX09	Southbound to Westbound 	Right turn clears curb return (BUS-45 turn into both lanes)
EX10	Southbound to Westbound 	Right turn clears curb return (A-BUS turn into outside lane)

Notes:  indicates predominate movements for buses
Source: HNTB Corporation, 2012

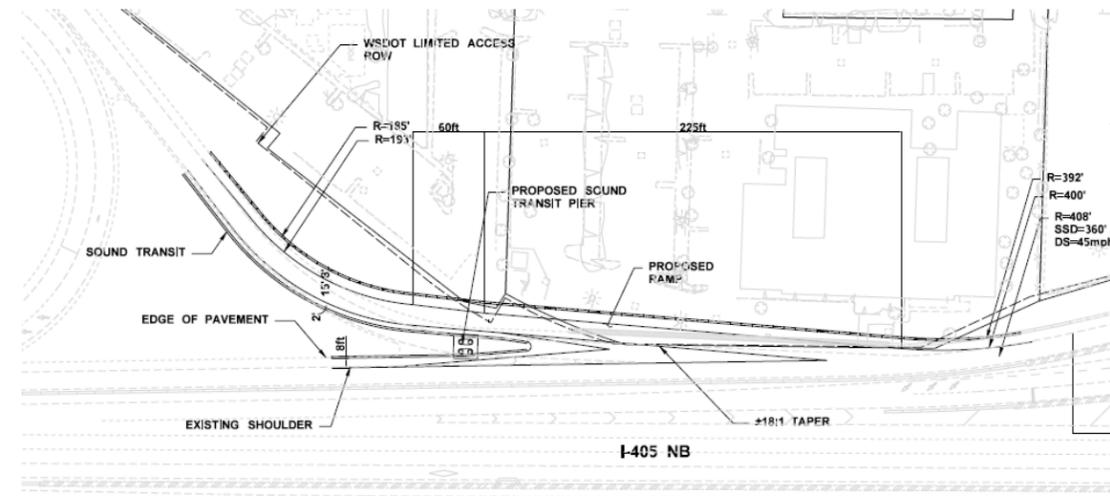
I-405 Northbound Collector Distributor Off-Ramp to NE 8th Street

To minimize the structure depth for the NE 6th Street Extension over the northbound I-405 mainline, the span length would desirably be reduced by utilizing an intermediate bent or pier. For similar reasons, the proposed Sound Transit East Link elevated guideway bridge structure adjacent to NE 6th Street will include an intermediate pier. This pier is proposed to be located in the gore area between the northbound I-405 collector-distributor roadway and the off-ramp to eastbound NE 8th Street. With the pier at this location, the existing off-ramp to eastbound NE 8th Street will be realigned (Figure 33 and Exhibit E11 in Appendix A).

The NE 6th Street Extension would place a second set of piers immediately south of the Sound Transit pier. An option utilizing a 20:1 off-ramp taper was developed (see Exhibit EX12 in

Appendix A). Based on initial feedback from WSDOT, two additional ramp realignment options were developed utilizing a 10:1 off-ramp taper rate, permissible under WSDOT's collector-distributor roadway design guidance (see Exhibits EX13 and EX14 in Appendix A). As shown in Figure 34, use of the sharper taper rate relative to the Sound Transit and initial NE 6th Street Extension designs allows the off-ramp departure point to be off of the upstream horizontal curve. This configuration would also maximize decision sight distance from the collector-distributor roadway as it passes under NE 4th Street.

Figure 33
Proposed Sound Transit East Link Pier Location and I-405 Ramp Configuration



Source: Sound Transit, 2011

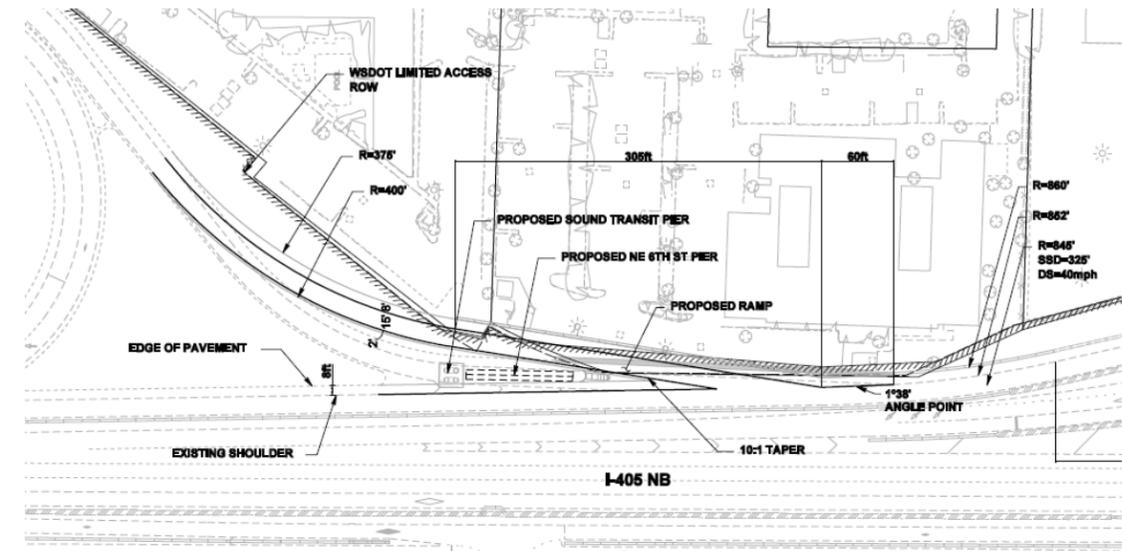
For all of the options considered, the re-aligned ramp would maintain the existing ramp shoulder and lane widths, with a 15-foot wide lane, a four-foot wide left shoulder, and an eight-foot wide right shoulder. Refinement of superelevation design will require additional survey to verify as-built conditions on the existing facilities, but at the current level of design development, it appears feasible to provide superelevation and transitions adequate for a 40 mph design speed.

It would be mutually beneficial for the City of Bellevue and Sound Transit to develop a northbound collector-distributor / off-ramp configuration that accommodates the future NE 6th Street Extension and East Link bridge piers, as shown on Figure 34. Such coordination would be beneficial because the following activities would be completed once rather than twice:

- Design development, review and approval
- Right-of-way acquisition
- Traffic control
- Storm drainage modifications
- Retaining wall construction
- Ramp reconfiguration

Both parties will benefit from each other's innovative ideas such as reducing right-of-way acquisition costs through design refinements like changing the ramp taper rate to 10:1 or using a fill wall on east edge of ramp. A cost sharing agreement between the City of Bellevue and Sound Transit could be agreed to once design is complete.

Figure 34
NE 6th Street Extension Pier Location and I-405 Ramp Configuration



Source: HNTB Corporation, 2011

119th Ave NE Intersection Options

NE 6th Street is envisioned to be a transit- and HOV-only facility west of 119th Avenue NE. East of 119th Avenue NE, single occupant vehicles (SOVs) would be allowed to provide access to adjacent properties, and to facilitate local circulation within the Wilburton Village area.

Pending final legislative approvals, WSDOT anticipates converting the I-405 HOV lanes north of NE 6th Street to express toll lanes. At that time, NE 6th Street and the existing direct access ramps at NE 6th Street would be open to all vehicles eligible for use of the express toll lanes, including single-occupant vehicles paying a toll.

Future design phases for the NE 6th Street Extension project will need to take into consideration signing and enforcement needs for this portion of the project. The specifics of these provisions will depend on the specifics of the use of the I-405 HOV or express toll / HOT lanes. Options for U-turn provisions on NE 6th Street in the vicinity of the 119th Avenue NE intersection are described below.

U-Turn Options

It is anticipated that HOV and/or express toll lane signing would be provided on both directions of 120th Avenue NE approaching NE 6th Street, to inform motorists of the restrictions on the use

of NE 6th Street west of 119th Avenue NE. Special consideration would need to be provided for signing on westbound NE 6th Street at 119th Avenue NE, to clearly delineate where the HOV restrictions take effect, and provisions (if provided) for U-turns. To reduce the potential for violations of the restrictions, and to facilitate circulation within the localized area, it may be desirable to incorporate U-turn provisions on NE 6th Street for motorists who are not eligible to utilize NE 6th Street between 112th Avenue NE and 119th Avenue NE.

The base alternative would provide a basic intersection at 119th Avenue NE, relying on use of private streets or parking lots for potential U-turn traffic. Four options have been developed that would provide for U-turns; these are depicted in Exhibits EX15-EX18 in Appendix A. All of these options would require additional right-of-way.

Option 1 (U-Turn With Bulb-Out)

A bulb-out would be provided on the southeast corner of the intersection to minimize cross-walk lengths. This would require shortening the westbound left-turn pocket. This configuration would accommodate a passenger car (“P”) design vehicle.

Option 2 (U-Turn Without Bulb-Out)

The southeast corner of the intersection would be widened by one lane width. The westbound left-turn pocket would be approximately one car length longer than Option 1. This configuration would accommodate a passenger car (“P”) design vehicle.

Option 3 (Jug Handle)

A jug handle turnaround on the south side of NE 6th Street west of 119th Avenue NE could accommodate larger vehicles, up to WB-50 trucks. Placing the turn-around facility downstream of the 119th intersection may be easier to sign than Options 1 or 2, but would introduce two additional cross-walks on the multi-use path.

This option would require more right-of-way than Options 1 and 2, or Option 4. Option 3 would represent the largest footprint and has been used for the purpose of establishing requirements for drainage.

Option 4 (Roundabout)

A single lane roundabout could accommodate traffic volumes at the intersection of 119th Avenue SE/NE 6th Street. This option was designed to provide five lanes east of 119th and two lanes west of 119th. With year 2030 PM peak hour traffic forecast volumes, the roundabout would operate at LOS B.

Predicted westbound traffic queues entering the roundabout would not be expected to extend to or block the upstream intersection at 120th Avenue NE. A potential area of concern would be the 240-foot storage length for eastbound traffic between 119th Avenue NE and 120th Avenue NE. Predicted 95th percentile queue lengths with year 2030 PM peak hour traffic volumes would be 250 feet, requiring the full storage length.

A second concern would be the operation of transit buses through the roundabout. A similar example exists in Snohomish County on Ash Way, adjacent to the Ash Way park-and-ride. Community Transit reports that this one-lane roundabout operates satisfactorily for their buses, including articulated and 40-foot coaches, with the truck apron provisions incorporated into the

roundabout. Observation of buses traversing the roundabout indicates that most operators are able to negotiate the roundabout without utilizing the apron. Other feedback from Community Transit noted the importance of adequate setbacks for signing and luminaire poles, and lighting and setback provisions for pedestrian crosswalks.

If a roundabout option were pursued further during subsequent phases of project development, the pedestrian and bicycle provisions shown in concept on Exhibit EX18 would need to be refined to reflect actual development patterns and associated non-motorized user circulation patterns through the intersection. This would include consideration of guidelines published in 2007 by the Public Rights-of-Way Access Advisory Committee (PROWAAC) of the United States Access Board that recommend that a traffic signal be provided for pedestrian crossings on two-lane approaches to roundabouts.

Traffic Signal Option

A traffic signal warrant analysis using the 2030 traffic volume forecast indicates that the 119th Avenue NE / NE 6th Street intersection would not require a traffic signal. A small increase in peak hour traffic volumes on 119th Avenue NE, which could occur with increased development in the Wilburton Village area, would however, increase peak hour traffic volumes to the point that a traffic signal may be warranted. A traffic signal may also be desirable to facilitate pedestrian and bicycle movements through the intersection, particularly for NE 6th Street options with four lanes west of 119th Avenue NE.

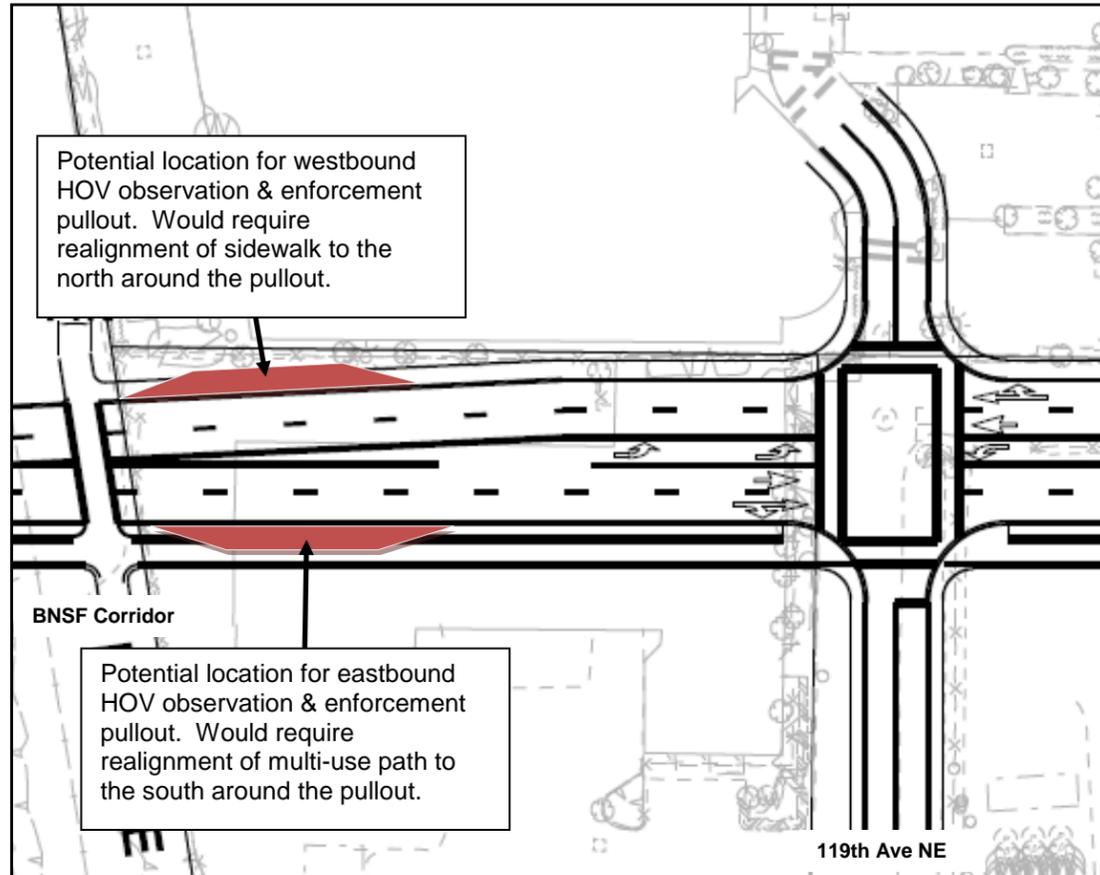
For the purpose of project estimates of probable construction cost, stop sign control has been assumed for the base alternatives. As the project progresses, the configuration and type of traffic control devices for the 119th Avenue NE intersection will need to reflect anticipated future developments on adjacent properties.

HOV/HOT Enforcement

The existing I-405 direct access ramps at NE 6th Street are restricted to high occupancy vehicle (HOV) users that include motorcycles, carpools, vanpools, and buses. At present, carpools are required to have two or more occupants. Trucks weighing more than 10,000 pounds are prohibited from using the ramps, regardless of the number of vehicle occupants. These restrictions are in place 24 hours per day, seven days per week. These restrictions on the ramps differ from the I-405 HOV lanes, which are currently restricted to eligible users only between the hours of 5 AM and 7 PM, seven days per week. Existing signing and pavement markings on the ramps and on NE 6th Street east of 112th Avenue NE indicates the HOV restrictions. Additional HOV signing is provided on NE 6th Street and 112th Avenue NE upstream of the intersection.

Enforcement of the HOV restrictions on the existing I-405 direct access ramps at NE 6th Street is conducted by the Washington State Patrol (WSP) and by City of Bellevue police. Law enforcement officers can park on the raised median area of NE 6th Street at the ramp terminal intersection and observe passing traffic to determine if HOV eligibility requirements are being met (Figure 35). The existing 6.5 foot wide shoulders of the direct access ramps are not wide enough to allow for enforcement activities on the ramps. An area wide enough (10 feet or more) to allow for enforcement activities is located at the bottom of the southbound on ramp on the left

Figure 37
Potential HOV Enforcement/Observations Provisions – East End of NE 6th Street Extension Between BNSF Corridor and 119th Avenue NE



Source: HNTB Corporation, 2012

OTHER DESIGN ELEMENTS

Geotechnical

Preliminary geotechnical recommendations have been prepared for the project, based on published geologic maps for the area and logs of previous borings conducted by WSDOT for nearby projects. Based on the available information, soils in the corridor are anticipated to consist of native glacial till overlain by variable thicknesses of fill. Previous borings indicate that groundwater has been encountered at shallow depths ranging from the surface to 15 feet.

Additional borings will be required for preliminary and final design, particularly east of I-405 where existing borings are limited. At a minimum, one boring will be required at each proposed bridge pier. Borings should include monitoring wells at several locations to measure and document groundwater conditions. Borings should also include environmental screening and testing to identify zones of possible contamination. The exploration program should be in accordance with the requirements of the WSDOT *Geotechnical Design Manual (GDM)*.

Seismic design criteria following recommendations in the AASHTO Guide Specifications for LRFD Seismic Bridge Design are contained in the *Preliminary Geotechnical Recommendations Technical Memorandum* (GeoEngineers, April 2011) prepared for this project.

Spread footings are the recommended foundation types for most bridge pier locations, except at the west abutment for the new bridge from I-405 to BNSF corridor, where micropiles placed in the existing retained fill are recommended, and at the pier immediately to the east of the I-405 northbound lanes, where drilled shafts are recommended due to site constraints. Retaining wall footings could also be spread footings. Excavations below ground water could be required in some locations, which would require dewatering activities.

Structures

Two new bridge structures and several retaining walls would be included in the NE 6th Street Extension project. In addition, the existing bridge structure carrying NE 6th Street over southbound I-405 and the structural earth (SE) retaining wall supporting the existing direct access ramp would be modified.

For more detailed information, see the structures technical memorandums listed under Other Project Documentation on page 52. The *Urban Design Master Plan* document includes a section on bridge architecture, including sketches of various pier concepts (see Appendix C, page 21).

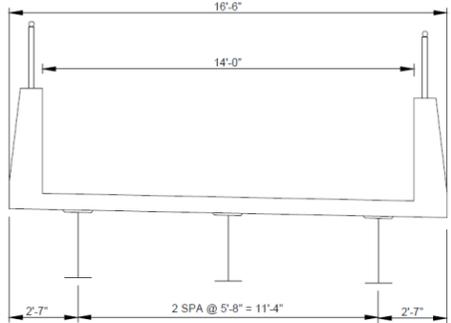
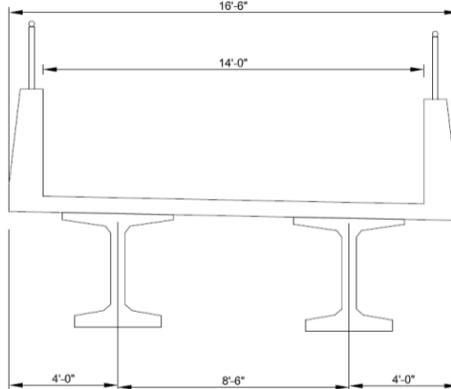
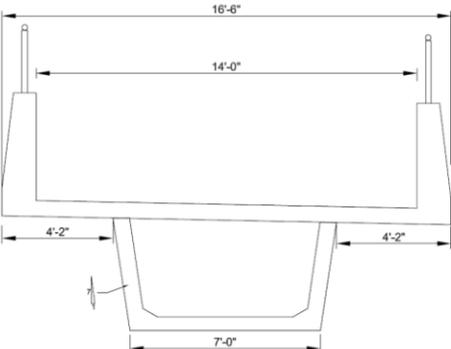
Multi-Use Path Connection, 112th Avenue NE to I-405 Ramps Intersection

A new bridge structure is proposed to carry the multi-use path between 112th Avenue NE and the I-405 direct-access ramps intersection. This structure would have two segments; the first between 112th Avenue NE and the I-405 right-of-way at 114th Avenue NE, and the second within the I-405 right-of-way over the southbound I-405 collector-distributor and mainline roadways.

112th Avenue NE to 114th Avenue NE/I-405

Between 112th Avenue NE and I-405, the new structure would be independent of the existing structure and could be one of three structure types. Typical sections for one steel girder and two concrete girder structure type options are shown in Table 7.

Table 7
Multi-Use Path Connection, 112th Avenue NE to I-405
Summary of Bridge Types Considered

Structure Type	Notes	Typical Section
Steel Girders	Higher cost (\$250/sf) relative to concrete but can be shallower depth to maintain required vertical clearances. Adaptable to curved alignments. Would match existing NE 6th structure over I-405.	
Precast Prestressed Concrete Girders (WF50G)	Least costly (\$160/sf) structure type considered. Would allow use of standard WSDOT girders. Could have longer spans, up to 120 feet. Not very adaptable to curved alignments. Would be a different structural style relative to proposed East Link overhead guideway structure, but would be similar to adjacent NE 4th Street structure.	
Precast Prestressed Concrete Tub Girders (U54G4 or U54G5)	Economical (\$175/sf) but higher cost than prestressed girders. Would allow use of standard WSDOT girders. Could have longer spans, up to 120 feet. Not very adaptable to curved alignments. Would more closely match architectural style of proposed East Link concrete box overhead guideway structure.	

Source: HNTB Corporation, 2012

The new structure would provide a 14-foot wide multi-use path and would have a total width of approximately 16.5 feet. Span lengths would vary by structure type but would likely range between 70 and 80 feet.

Construction of the portion of the structure between 112th Avenue NE and 114th Avenue NE would largely occur from the adjacent 114th Avenue NE right-of-way and the adjacent private parking area. If this adjacent property were not acquired for the project, a construction easement would be required.

Two design options were developed for the abutment that would be located at the southeast corner of the intersection of NE 6th Street and 112th Avenue NE (see page 25 of Appendix C). Both options would enlarge the existing plaza at this corner, with the enlarged plaza supported by a retaining wall. An existing path connector carrying the Lake Washington Loop bike route between 112th and 114th Avenues NE is adjacent to the retained earth structure supporting NE 6th Street. The two abutment options differ in how they would relate to the existing connector.

Option 1 would utilize a bridge structure to support the multi-use path connection from the enlarged plaza. Option 2 would utilize back-to-back retaining walls to support the first span of the multi-use path connection. With Option 2, the Lake Washington Loop bike route connection would then be in a trench for a portion of its length. Option 1 would be relatively more open. The cost of Option 2 would be approximately half of Option 1 (about \$1,400 per lineal foot of path on retained fill vs. about \$2,800 per lineal foot of path on bridge). Despite the higher relative construction cost, Option 1 is recommended for further project development because it would create a less closed-in environment for the Lake Washington Loop bike route connector. Option 1 would also have a better potential for use of the space under the multi-use path connector structure for parking.

Over Southbound I-405

For the section of the multi-use path connection over southbound I-405, two structure options are recommended for further consideration in the next phase of project development:

- Bridge Widening Option** – The widening option would use the same span lengths and steel girder types as the existing NE 6th Street bridge (Figure 38). This would be a conventional bridge deck widening but would have constrained work areas that would have higher than typical costs. One constraint associated only with this option would be the extension of existing Pier 3 to support the widened structure, which would require reconstruction of the retaining wall between the southbound collector-distributor roadway and the southbound off ramp to NE 4th Street. The extent of wall reconstruction is shown on Figure 39. This work could require closures of the southbound on ramps from NE 8th Street and/or the southbound off ramp to NE 4th Street.
- Separate Structure Option** – The separate structure option would place a new pier adjacent to existing Pier 2, located along 114th Avenue NE, but would not require a second intermediate pier at the location of existing Pier 3 (see Figure 38). This would result in a longer span than the existing NE 6th Street roadway structure. In order to span over the existing I-405 southbound lanes and ramps, a span length of 150 to 160 feet is proposed. Relative to the widening option, this option would have less impact on southbound I-405 traffic operations during construction.

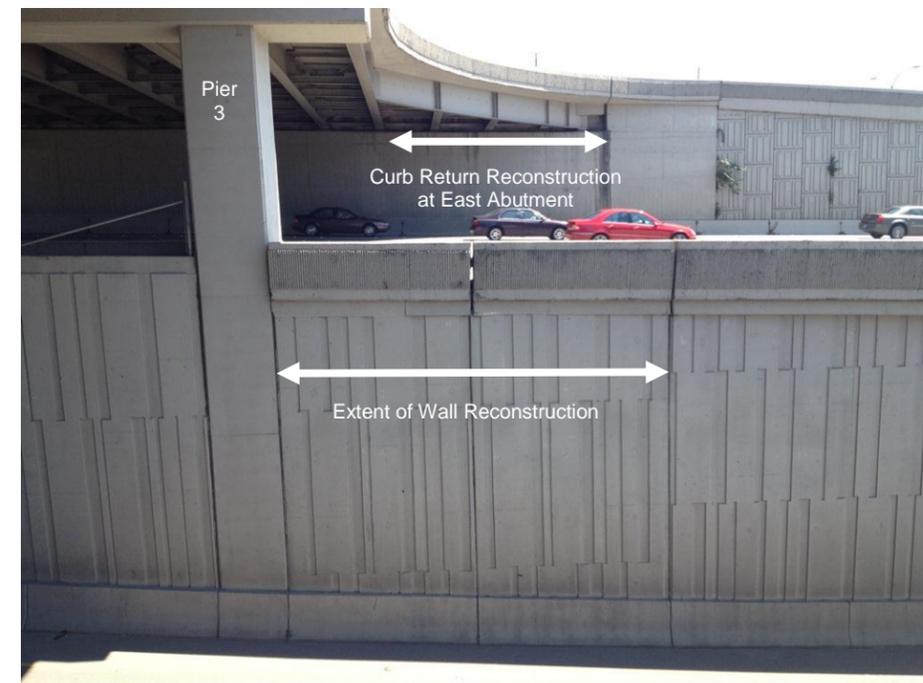
For either option, the east end of the new structure would be supported by the existing east abutment. This would require demolition and reconstruction of the steel girder structure supporting the southwest curb return at the direct access ramp intersection (Figure 39).

Figure 38
Existing NE 6th Street Bridge, over 114th Avenue & NE I-405 Southbound



Source: HNTB Corporation, 2010

Figure 39
Existing NE 6th Street Bridge over I-405 Southbound
Pier 3 to East Abutment



Source: HNTB Corporation, 2012

Reconstruction of the curb return could require a closure of the southbound transit/HOV direct access on-ramp to the I-405 HOV lanes. Alternatively, it might be possible to operate the transit/HOV direct access ramps to and from the south in a reversible time-of-day mode to minimize delay to transit and HOV operations. Under this staging concept, traffic in the peak direction would use the NE 6th Street ramp while traffic in the off-peak direction (southbound on in the morning, northbound off in the afternoon) would be detoured to the adjacent NE 4th Street interchange.

For either option, erection of the steel girders over the I-405 southbound mainline and adjacent southbound collector-distributor roadway would require closures of I-405, most likely during overnight hours. Mainline and/or ramp lane closures would be required to set form work for the deck and for painting and other ancillary activities.

Table 8 provides a comparison of two structural options for the multi-use path structure over southbound I-405. Both options are feasible and they each have advantages and disadvantages that make them both worth advancing to a higher level of design. Both the bridge widening and the separate pedestrian structure options should be carried forward to future project development.

The estimates of probable project cost included in this design report assume a precast, prestressed concrete tub girder structure for the western segment of the structure between 112th Avenue NE and 114th Avenue NE, and the separate structure option for a steel girder structure over southbound I-405.

Table 8
Comparison of Options for Multi-Use Path Structure Over Southbound I-405

Issue	Bridge Widening	Separate Structure
Structural Considerations	Matches existing NE 6th Street bridge pier locations and span lengths.	Longer spans would be more flexible and would likely require deeper girders or additional girders to meet AASHTO criteria for pedestrian bridge vibrations.
Operations	Would require relocation of Lake Washington Loop connection to 112th and possibly additional right of way acquisition. No longitudinal joint at direct access ramps intersection.	Lake Washington Loop connection to 112th could remain in existing location. Longitudinal joint at ramp intersection would have differential deflections under vehicle loads and could present difficulties for motorcycles or bicycles.
Constructability	Shoring and excavation required to widen foundation for Pier 3. Closures of up to 90 days could be required on southbound I-405 to NE 4th off ramp and/or NE 8th on ramps to southbound I-405.	Traffic impacts to southbound I-405 would be limited to the direct access ramp intersection and overnight closures of mainline and ramps to erect girders, form work, painting, etc.

Source: HNTB Corporation, 2012

NE 6th Street Extension, I-405 East to BNSF Corridor

East of the existing I-405 direct access ramps, NE 6th Street would be carried on a bridge structure over I-405 northbound and 116th Avenue NE to the BNSF corridor. The ten-span bridge structure would be approximately 1,110 feet in length.

The western section of the bridge would cross over the northbound I-405 mainline, collector-distributor, and NE 8th Street off-ramp with a two-span steel girder bridge similar to the existing bridge carrying NE 6th Street over southbound I-405. The section east of I-405 would be a concrete structure. Bridge type alternatives considered for this section include precast prestressed concrete girders, precast prestressed concrete tub girders, or a single cast-in-place concrete box (Table 9). Both sections of the bridge would have a concrete deck.

Other structure type alternatives for the proposed bridge were explored but dismissed during the early stages of the project. These other alternatives included signature bridge types. Representative of a signature bridge would be an arch structure for the span over 116th Avenue NE. This and other signature bridge types were dismissed by the Technical Review Team as prohibitively expensive, and they noted that future development would most likely obscure views of the structure. The team members expressed a preference for a simple and clean bridge type.

The typical sections east of I-405 shown in Table 9 depict the four-lane basic section alternative; the two-lane basic section alternatives would be similar but 24 feet narrower. The tapers required to transition from the maximum to minimum widths would be accomplished by varying the spacing of the girders and dropping girders at the piers. Coordination of roadway tapers and pier locations would be further refined in subsequent phases of the project's design.

Assumptions common to all the options include:

- The two spans over northbound I-405 would be steel girders.
- The eight spans east of northbound I-405 would be concrete.
- The structure depth would be limited to about 5 feet to provide a vertical clearance of at least 16.5 feet over I-405 and 116th Avenue NE.
- Pier placement and span lengths have been selected based in part on the pier locations for the proposed Sound Transit East Link structure.
- A structure type similar in architectural style to the proposed Sound Transit East Link elevated guideway structure would be preferable.
- A planter strip would be provided on the structure east of I-405. For the two concrete box alternatives, the tub girders or cast-in-place box could be internally reinforced for the additional load. For the girder alternative, it may be necessary to reduce the girder spacing to support the planter strip.

The intermediate pier between the steel spans would be placed to align with the proposed Sound Transit East Link light rail pier, between the northbound collector-distributor roadway and the off-ramp to eastbound NE 8th Street. This pier would likely be founded on drilled shafts due to the limited space in the gore area between the two roadways. Other piers east of this location would likely be spread footings as noted above under Geotechnical. Abutment concepts for the abutment at the I-405 direct access ramps are discussed below.

Table 9
NE 6th Street Elevated Structure, I-405 to BNSF Corridor
Summary of Bridge Types Considered

Structure / Type	Typical Section
Over NB I-405 Steel Girder	Two spans at 100-125 ft. each
East of I-405 Precast Prestressed Concrete Girders (WF50G) approx. cost = \$160/sf	Eight spans at 100-120 ft. each
Precast Prestressed Concrete Tub Girders (U54G4 or U54G5) approx. cost = \$175/sf	
Cast-in-Place Concrete Box approx. cost = \$230/sf	

Source: HNTB Corporation, 2011

The precast, prestressed tub girder alternative is the recommended bridge type due to its relative ease of construction, cost effectiveness, and appearance. It could be installed in considerably less time than the more costly cast-in-place concrete box alternative and with fewer impacts on traffic operations during construction. It would present a compatible appearance with the adjacent

Sound Transit East Link structure, and relative to the precast girder structure, a cleaner look when viewed from below.

In all cases, it would be preferable to construct a bridge that closely matches the existing grades on the HOV ramps and intersection, in order to minimize reconstruction of portions of the SE wall, moment slab barrier, and ramp roadways. As discussed earlier in this report, the conceptual profiles developed will need to be refined to reflect topographical survey of existing/as-built conditions on the ramp structures.

West Abutment Concepts for Bridge Over Northbound I-405

The proposed bridge over northbound I-405 will require an abutment along the east edge of the existing intersection of NE 6th Street and the HOV direct access ramps. The abutment would impact the existing SE wall and would require removal of a portion of the wall. The abutment cannot be built in front of the existing SE wall because future projects along northbound I-405 will require all of the pavement to the edge of the barrier at the bottom of the wall. Options considered for constructing the west abutment of the proposed bridge include founding the abutment on embankment soil improvements, micropiles, drilled shafts, or a full height cast-in-place concrete abutment. These concepts are discussed in more detail in the *I-405 Overcrossing Bridge Structure Type and Abutment Foundation Type Technical Memorandum* (HNTB Corporation, July 2012), found in Appendix D.

Two of the abutment options have significant flaws that would preclude their use. The other two options would be feasible, but one would pose fewer construction impacts.

Of the two undesirable options, Option 1 – Embankment Improvement, poses risks to the integrity of the existing SE wall and wall drainage systems, and raises difficulties obtaining verifiable uniformity in the capacity of the backfill. Option 3 – Drilled Shaft would have the potential to damage the wall and would also be more costly than other options. For these reasons, neither of these options are recommended for further consideration.

Of the two feasible options, Option 4 – Cast-In-Place Abutment would take a significantly longer time to construct and would cause greater disruption to the HOV direct Access interchange and northbound I-405. Disruptive construction activities would occur for over 3 months to excavate, shore, cast and cure the footing and abutment wall. This would make Option 4 less desirable than Option 2 – Micropiles.

Option 2 – Micropiles is recommended option due to its ease of construction and cost effectiveness relative to other options that were evaluated. It also could be installed in considerably less time than Option 4 and would have fewer impacts on traffic operations.

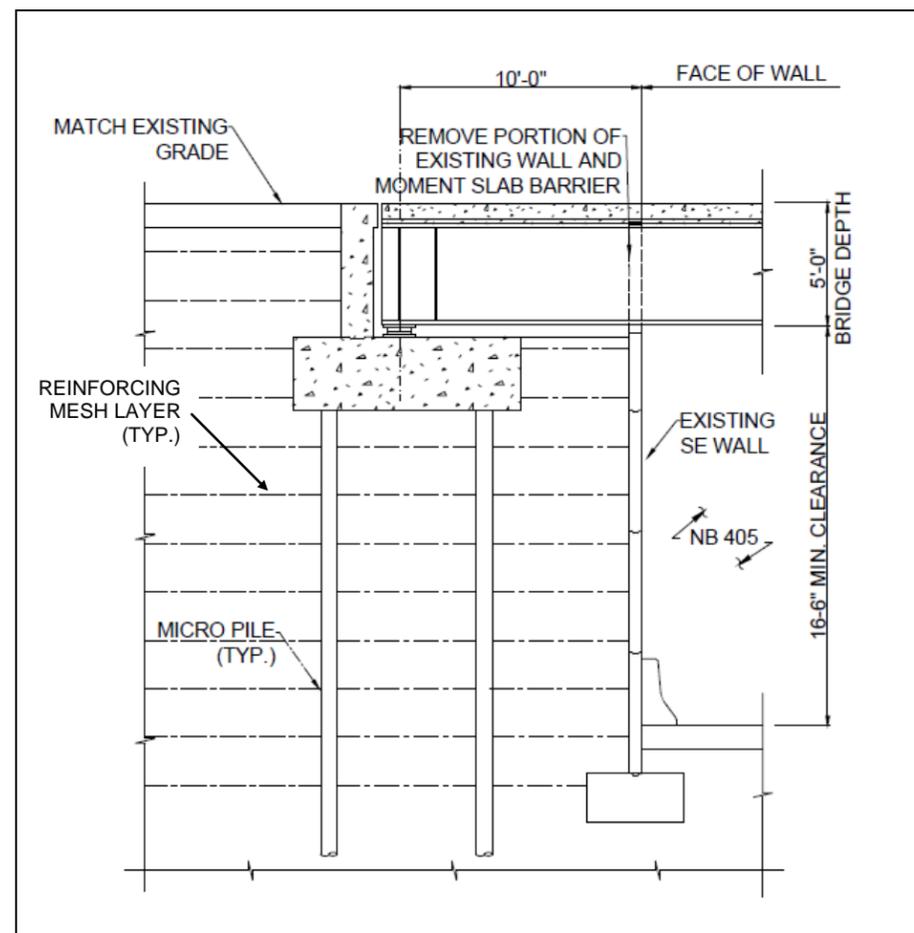
The recommended option would install six-inch diameter micropiles to support a shallow bridge abutment footing. The abutment would be on a shallow spread footing centered approximately 10 feet from the face of the existing SE wall. This would allow for a minimum of five feet from the edge of the abutment footing to the face of the wall (see Figure 40).

The abutment would be constructed by excavating approximately 10 feet of the existing fill for the HOV direct access intersection. A portion of the existing SE wall and soil reinforcing mesh would be removed, as would a portion of the existing moment slab barrier. Removal of a portion

of the wall is performed in reverse of the original wall construction. The micro-piles would be installed after excavation is completed.

The micro-piles would be installed between the rows of wire reinforcing mesh in the existing SE wall. The as-built plans show a gap of 20 inches clear space between the adjacent wire reinforcing mesh. The spacing of the mesh is regular and aligns with the five foot horizontal spacing of the SE wall panels. Driving the micropiles through the reinforcing mesh zone may not be desirable because the friction on the piles may affect the stresses in the mesh. Drilling and installing the piles would be the preferred method of installation. Further evaluation of the pile installation methods to reduce the risk of overloading or damaging the reinforcing mesh would be desirable in the design phase of the work.

Figure 40
West Abutment Option 2 – Micro Piles



Source: HNTB Corporation, 2011

The soil conditions from previous borings indicate that the soils consist of fill overlying very dense silty sand with gravel from 10 to 23 feet overlying very dense clean sand to 40 feet

overlying interbedded hard silt and very dense sand to 50 feet (bottom of borings). Micro piles installed into these soils should be capable of developing design-allowable capacities on the order of 150 to 250 kips each. Based on conversations with local foundation contractors, allowable bond capacities on the order of 4-6 kips/foot would be reasonable for these soils, so the micro pile bond length (excluding the zone above the bottom of the wall) would be on the order of 30 to 45 feet.

Retaining Walls

Retaining Wall 1 – Southwest Quadrant of 112th Avenue NE & NE 6th Street

A retaining wall will support the expanded pedestrian/bicycle plaza at the southwest corner of the intersection of 112th Avenue NE and NE 6th Street (see Wall 1 Plan & Elevation, sheet WL01 in Appendix B). Either Structural Earth (SE) or cast-in-place walls could be used at this location. A structural earth (SE) wall has been assumed for the purpose of estimating project costs. Because this wall is curved, the SE wall fascia panels would be chorded around the curve.

Retaining Wall 2 – East of I-405 Off-Ramp

A retaining wall will be required along the east side of the relocated northbound I-405 off-ramp to eastbound NE 8th Street. This retaining wall would be approximately 570 feet long and five feet high (see Wall 2 Plan & Elevation, sheet WL02 in Appendix B). A structural earth (SE) wall is recommended for this location based on its relatively low cost and the continuity with other nearby walls in the I-405 corridor. Precast concrete fascia panels with a random board pattern finish are proposed for the wall face in order to match other walls in this portion of the I-405 corridor.

Retaining Walls 3 & 4 – Bridge Approach at BNSF Corridor

Retaining walls will be required on either side of the approach embankment at the east end of the NE 6th Street Bridge near the BNSF Rail Corridor (see Wall 3 & 4 Plan & Elevation, sheets WL03 and WL 04 in Appendix B). Two alternative wall types have been evaluated for this location; a WSDOT Standard Plan reinforced concrete retaining wall, or structural earth walls with precast fascia panels.

General parameters that are common to both wall type options include:

- The proposed retaining walls would be approximately 140 feet in length.
- The proposed retaining walls would have a maximum height of approximately 20 feet.
- It will be necessary to span over or otherwise protect the existing 72-inch sanitary sewer gravity line owned by King County.
- The proposed finish for these walls would be a random board pattern.

Structural earth (SE) walls with precast fascia panels would be preferred over WSDOT Standard Plan reinforced concrete retaining walls based on the relatively lower construction cost for SE walls. Protection for the existing 72-inch sanitary sewer line will require special design considerations. These include provisions to limit settlement and to monitor before and after construction conditions of the line.

Construction Staging

An initial assessment of significant construction staging issues for the NE 6th Street Extension was developed. This assessment focused on three primary elements of work, all associated with the structural elements of the project:

- reconstruction of the existing SE wall supporting the NE 6th Street transit/HOV direct access ramps to provide the west abutment of the new bridge structure over I-405;
- construction of the new bridge structure over northbound I-405; and
- reconstruction of the southwest curb return at the NE 6th Street / direct access ramps intersection to provide the east abutment for the new multi-use path bridge structure providing a connection to 112th Avenue NE.

Descriptions of potential construction staging, sequencing and durations, and traffic control / maintenance of traffic strategies follow.

Stage 1 – Realign the I-405 Northbound C-D to Eastbound NE 8th Off-Ramp

The first step in constructing the new bridge over northbound I-405 would be to realign the existing off-ramp to eastbound NE 8th Street to provide a working area for construction of the intermediate pier or bent that would be located in the gore area between the ramp and the northbound collector-distributor roadway.

Construction Sequence

- Shift the I-405 northbound collector-distributor west to build new ramp wall on east side.
- Build the new ramp retaining wall and pavement.
- Spread the I-405 northbound collector-distributor and NE 8th Street off-ramps to open up a work area in the gore for the new pier(s).
- Shift the NE 8th Street off-ramp to new pavement.
- Build new pier in gore area work zone.
- Restore traffic to the finished configuration.

The work to realign the I-405 Northbound C-D to Eastbound NE 8th Street off-ramp to accommodate piers or bents supporting the NE 6th Street Extension would desirably be combined with Sound Transit's East Link project, which proposes a bridge pier in the gore area of the existing off-ramp. This would minimize or eliminate "throw-away" or re-work that could occur if this work was not coordinated between the two projects.

Stage 2 – Piers for New Span(s) to East

The second stage of construction would run concurrently with the first and third stages. It would construct the foundations and piers for the portion of the NE 6th Street Extension immediately east of I-405 so as to minimize the amount of time that that traffic on the NE 6th Street direct access ramps would be affected by construction of the extension. This would allow girders to be set and the deck and barriers poured immediately following completion of the west abutment.

Construction Sequence

- Excavate and pour spread footings for pier(s) east of I-405

- Build piers and pier cap(s)
- Prepare for erection of girders

Stage 3 – West Abutment of NE 6th Street Bridge over Northbound I-405

The start of the third stage of construction could overlap with Stage 2 such that both were completed at the same time. The third stage would have the greatest impact on NE 6th Street direct access ramp operations. Because of this, the construction contract would desirably include both incentives for early completion and penalties for late completion. This is also be an area where innovation in construction means and methods would be desirable. The description below represents a starting point for future detailed analysis and evaluations of construction staging and maintenance of traffic.

Construction Sequence

- Shift I-405 northbound mainline to the outside (east) to create a median work area adjacent to the existing SE wall. This median work area would provide contractor access to the wall for demolition and reconstruction activities.
- Relocate the existing ramp intersection traffic signal to temporary location (or remove and implement stop control for the construction period).
- Excavate from the SE wall west to approximately centerline of ramps. Laying back the excavation slope would be preferred over sheet piles due to likely interference of sheet piles with existing SE wall reinforcing straps or grids (mesh).
- Install micropiles from above. If micropiles can be installed prior to the excavation of the SE wall, the intersection may remain open to traffic during the day while construction occurs at night. This would require coring through the PCC ramp pavement and moment slab. A conceptual design of the piles indicates that 6-inch diameter piles could be used, which would require 8- to 10-inch diameter core holes.
- Form and pour the new abutment. It may be possible to do the abutment work over a shorter period of time by allowing a total closure of the ramps, preferably during summer months when weather conditions are favorable and traffic volumes are lower. Pre-cast pile cap and/or abutment elements could be considered to shorten the closure duration.
- Restore ramp roadway pavement from ramp centerline to back wall of abutment.

Construction Duration

Two scenarios were developed to determine the approximate duration of a total closure. As outlined below in Table 10, one would utilize traditional cast-in-place construction methods while the other would utilize pre-cast elements to reduce construction time. Based on this first-cut analysis, reconstruction of the abutment would require ramp closures of approximately three to six weeks, depending on how many shifts per day were worked and whether cast-in-place or pre-cast methods were used.

Traffic Control

Two options for traffic control are described below – a total ramp closure option, and a limited closure option. The total closure option would likely have a shorter duration, while the limited closure option would maintain peak-direction access to the NE 6th Street direct access ramps.

**Table 10
Construction Duration for Abutment Options**

Cast-in-Place Abutment		Pre-Cast Abutment Pile Caps	
Excavation	1 week	Excavation	1 week
Micropiles	1 week	Micropiles	1 week
FRP (form–rebar–pour) abutment pile cap	2 weeks	Pre-cast abutment pile cap	1 week
Cure/FRP abutment back wall	1 week	FRP abutment back wall	1 week
Cure/Backfill/barrier/pave	1 week	Cure/Backfill/barrier/pave	1 week
Total at 8 hours/day	6 weeks	Total at 8 hours/day	5 weeks
Total at 24 hours/day	3 weeks	Total at 24 hours/day	2.5 weeks

Source: HNTB Corporation, 2011

Total Closure of NE 6th Street Direct Access Ramps During Abutment Construction

This option would close the NE 6th Street direct access ramps and divert traffic from these ramps to the adjacent NE 8th and NE 4th Street interchanges. The NE 4th Street interchange has HOV lane and ramp-meter bypass provisions and would be the likely detour route for transit buses traveling between the Bellevue Transit Center and I-405.

Advantages of using a total closure of the NE 6th Street ramps:

- NE 6th Street from 112th Avenue NE to I-405, and the direct access I-405 ramps, would be available for contractor staging and access to the work zone.
- Traffic control would be simpler for the contractor.
- Access would be easier to perform other work in the vicinity of NE 6th Street during the total closure.

Disadvantages of using a total closure of the NE 6th Street ramps:

- HOV/HOT access to Bellevue would need to be re-directed to NE 8th or NE 4th Streets
- Bus schedules may need to be adjusted based on longer travel times

Partial Closure of NE 6th Street Direct Access Ramps During Abutment Construction

This option would close one ramp lane in each direction to create the abutment work zone. Use of a reversible ramp operation could be considered – northbound and southbound off in the morning peak period, and northbound and southbound on in the afternoon peak period. This would require off-peak direction users of the NE 6th Street direct access ramps to utilize the adjacent NE 4th Street or NE 8th Street ramps.

Advantages of using a partial closure option:

- Maintains access for peak-direction direct access ramp provisions for transit, HOV, and I-405 express toll lane users.

Disadvantages of using a partial closure option:

- Limits the amount of access available for construction, therefore the duration and possibly cost of construction would be expected to be longer. Off-peak and night closures of the ramps may be required to provide adequate contractor access to the work area.

- Traffic control would be more complicated and temporary signals and illumination would likely be needed.
- With reversible operation, traffic control would need to be designed and implemented to minimize the potential for wrong-way entry onto I-405 through the intersection.

Other Options Considered

Overnight ramp or interchange closures could be utilized but would still likely require partial closures because once the area is excavated in preparation for installing the abutment pile cap, traffic could not be restored to the excavated area until the abutment work is completed.

Stage 4 – New Span(s) to East

The fourth stage of construction would immediately follow Stages 2 and 3. It would include setting girders across I-405 northbound and forming and pouring the bridge deck and railings.

Construction Sequence

- Set steel girders over northbound I-405 – this would require total closures of I-405, most likely during overnight hours.
- Place forms and pour concrete deck – false work and/or form placement could occur during overnight lane closures. Stay-in-place forms could be considered to reduce total closure times.
- Form and pour bridge rail/barriers.
- Adjust the existing profile of NE 6th Street at the direct access ramps to reduce the vertical inflection point on the east edge of traveled way.
- Restore traffic to the direct access ramps, and restore shifted mainline traffic lanes to their permanent configuration.

Stage 5 – Southwest Curb Return / Pedestrian Connection to 112th Ave NE

Reconstruction of the southwest curb return could require restrictions on the southbound direct access on-ramp. To minimize these disruptions, this stage could be part of a total closure option for Stage 3 east abutment work.

Construction Sequence

- Shift southbound mainline traffic lanes to the west to create a median work area for the contractor. Shift traffic lanes to the east on the ramps to/from the south to create a work area in the southwest quadrant of the direct access ramp intersection. Close the eastbound to southbound lane (curb lane) on the NE 6th Street approach to the ramp intersection.
- Demolish the existing southwest curb return, likely utilizing overnight closures of one or more mainline lanes on southbound I-405.
- Modify the abutment as required to accommodate the new steel girder configuration.
- If required, erect false work in the median work area to provide temporary supports during steel girder erection at the curb return.
- Erect the multi-use pathway girders across southbound I-405, utilizing overnight total closures of the mainline and collector-distributor roadways.

- Place forms and pour concrete deck – false work and/or form placement could occur during overnight lane closures. Stay-in-place forms could be considered to reduce total closure times.
- Form and pour bridge rail/barriers.
- Restore traffic to the direct access ramps, and restore shifted mainline traffic lanes to their permanent configuration.

The construction sequence described above applies to the separate structure option for the bridge over southbound I-405. A similar sequence would occur with the widening option, which would also potentially require closures of the NE 8th Street on ramps to southbound I-405, and/or the southbound off-ramp to NE 4th Street. For the widening option, the work at Pier 3 that would affect these ramps would occur prior to the work at the curb return. The Pier 3 work could occur concurrently with Stages 1 and 2 described above.

Stormwater

Existing Conditions & Assumptions

The project is located within the Sturtevant Creek basin. Sturtevant Creek passes through the project corridor in a culvert near the NE 8th Street off-ramp. Four threshold discharge areas (TDAs) were identified for the project corridor (Figure 41). All four areas are either directly or hydraulically connected to Sturtevant Creek. Existing land uses in the TDAs total 230,227 square feet (5.29 acres) with 87% of this area considered impervious. Based on conversations with City staff, there are no known capacity problems with the existing stormwater systems in the project corridor, or with Sturtevant Creek downstream of the project.

**Figure 41
Threshold Discharge Areas (TDAs) for Stormwater Analysis & Design**



Source: Parametrix, Inc., 2011.

The four lane basic section alternative with the Jug Handle U-turn option at 119th Avenue NE, which would have the largest footprint, was assumed as a “worst case” for the purpose of determining stormwater runoff treatment facility requirements. The modifications to the

northbound I-405 collector-distributor roadway and off-ramp to NE 8th Street were also included in the analysis. If an alternative or options with smaller footprints were selected for implementation, stormwater facilities could be reduced in size relative to those identified for the conceptual design.

Design Criteria & Requirements

Portions of the project are located within WSDOT right-of-way and the remainder, primarily east of I-405, would be within City of Bellevue right-of-way. Stormwater runoff within WSDOT right-of-way (TDA S1) is assumed to be managed per WSDOT practices in accordance with their *Highway Runoff Manual*. Stormwater runoff on the portions of the project within City right-of-way (TDA W1, W2), or discharging to City stormwater systems (TDA S2), would be managed in accordance with the 2010 *City of Bellevue Stormwater Manual*. Core Requirements identified in these manuals, and the project’s proposed approach for compliance, are summarized in Table 11.

**Table 11
Compliance with Stormwater Core Requirements**

Bellevue City Manual (TDAs W1 and W2)	WSDOT Highway Runoff Manual (TDAs S1 and S2)	Project Compliance
1. Preparation of Stormwater Site Plans	1. Stormwater Planning	Stormwater site plans will be prepared for this project.
2. Construction Stormwater Pollution Prevention	2. Construction Stormwater Pollution Prevention	A Construction Stormwater Pollution Prevention Plan (CSWPPP) will be prepared for this project.
3. Source Control of Pollution	3. Source Control of Pollutants	Source control BMPs are not applicable to this project during operational phases. Source control of pollutants during construction will be covered by the CSWPPP.
4. Preservation of Natural Drainage Systems and Outfalls	4. Maintaining the Natural Drainage	The project is located in a highly urbanized watershed with limited natural drainage systems. Runoff from the proposed project will discharge into the same drainage system as existing conditions to the maximum extent possible.
5. On-site Stormwater Management		On-site management of runoff is not applicable to the elevated portion of the roadway west of the BNSF railway corridor. On-site management of runoff is applicable to the areas east of the BNSF railway corridor. See narrative below.
6. Runoff Treatment	5. Runoff Treatment	Runoff treatment will be provided as discussed below.
7. Flow Control	6. Flow Control	Flow control will be provided as discussed below.
8. Wetlands Protection	7. Wetlands Protection	Stormwater runoff from TDAs W1 and W2 will be subject to this additional analysis.
	8. Watershed/Basin Planning	There are no basin plans that identify more stringent standards for treatment or detention applicable to the project site.
9. Operation and Maintenance	9. Operation and Maintenance	Existing WSDOT and City of Bellevue operations and maintenance manuals for stormwater facilities will be used.

Source: Parametrix, Inc. 2011

On-Site Stormwater Management

Best Management Practices (BMPs) that either infiltrate or disperse stormwater on-site is required on all projects. The feasibility of using on-site stormwater management BMPs has been evaluated for the entire project corridor.

The City has established two tiers of compliance with this Core Requirement. Tier 1 requires a project to minimize runoff; Tier 2 requires the project to retain runoff on-site. Each project is expected to meet the Tier 1 and Tier 2 requirements to the extent feasible. Because of the elevated roadway structure and highly urbanized nature of the surrounding land uses, the ability for the project to meet Tier 1 and Tier 2 requirements is limited.

Tier 1 (Minimize Runoff) can only be accomplished by limiting the overhead footprint of the roadway. The roadway has been configured to provide the narrowest footprint possible while providing capacity and safety for vehicles and pedestrians.

Tier 2 (Retain Runoff On-site) will be accomplished to the maximum extent possible in TDA W2, east of the BNSF railway corridor. This is the only portion of the proposed project corridor that will be located at grade. Because of the highly urbanized existing development and till soils within the subgrade, dispersion and infiltration of stormwater are not feasible. Bioretention for water quality treatment is presented as one of the options to be provided throughout the length of the roadway at grade with conveyance provided via downspouts.

Runoff Treatment

Runoff treatment is required for stormwater runoff from projects that create more than 5,000 square feet of new pollution-generating impervious surface (PGIS) in any TDA (WSDOT 2010; City of Bellevue 2010). The proposed project would create more than 5,000 square feet of new PGIS in all of the TDAs except S1; therefore, runoff treatment would be required for TDAs S2, W1, and W2.

The project corridor drains to Sturtevant Creek, which is a tributary of a fish-bearing stream that is not identified as a Major Receiving Water. Therefore, in accordance with the 2005 Ecology Manual, enhanced treatment is required. Although Bellevue and WSDOT have modified this requirement based on project type, both manuals require enhanced treatment for roads with greater than 7,500 vehicles per day (vpd) annual average daily traffic (AADT). Because the project has an anticipated AADT of 11,750 vpd west of 119th Avenue NE and 13,050 vpd east of 119th Avenue NE, enhanced runoff treatment would also be required by both the WSDOT and City Manuals.

Flow Control

Flow control is required for stormwater runoff from projects that create more than 5,000 square feet of new and replaced impervious areas in any TDA (WSDOT 2010; City of Bellevue 2010). The proposed project would create more than 5,000 square feet of new impervious surfaces in all of the TDAs; therefore, flow control would be required in all of the TDAs for this project.

Ecology has established a modified flow control standard that is applicable to specific highly urbanized watersheds in Western Washington, including the Sturtevant Creek watershed (Ecology 2005b; City of Bellevue 2011). This modified flow control standard is known as the 40/20 rule and was developed using several studies performed on Puget Sound streams. The

40/20 rule states that alternative flow control standards are ecologically sufficient in watersheds that had more than 40 percent impervious surface cover prior to 1986.

At a project level, the modified flow control standard requires only that discharges from the project site match existing land use conditions. Therefore, the project is not required to assume forest as a pre-developed land use condition.

In addition to the 40/20 rule, a TDA is exempt from flow control requirements if the change in the 100-year peak flow rate is equal to or less than 0.1 cubic feet per second (cfs) from existing to developed conditions. The hydrologic model, WWHM4, was used to perform this flow control analysis. All four TDAs would meet the exemption.

Stormwater Management BMPs

Enhanced water quality treatment facilities would be required for TDAs S2, W1, and W2. Water quality treatment would not be required in TDA S1 because it would not be pollution generating. In addition, the project would be exempt from detention facilities. An alternatives analysis was performed for approved enhanced treatment Best Management Practices (BMPs); based on the results of this analysis, two BMPs were carried forward to conceptual design. Bioretention facilities and Filterra® BMPs would be most suitable for the project corridor. Table 12 summarizes additional general information about bioretention facilities and Filterra® to further distinguish between these BMPs. Total facility areas for conceptual stormwater treatment BMPs are summarized in Table 13.

**Table 12
Recommended Enhanced Stormwater Treatment BMPs**

Method	Installation Cost	Maintenance Costs	Footprint	Proprietary System	Visual Aesthetics
Bioretention	Medium	Medium	Medium	No	Yes
Filterra®	Medium	Low	Small	Yes	Yes

Source: Parametrix, Inc. 2011

**Table 13
Stormwater BMP Sizing**

TDA	Bioretention Total Facility Area (square feet)	Filterra® Total Facility Area (square feet)
S1	treatment not required	treatment not required
S2	1,900	324
W1	900	120
W2	1,700	228

Source: Parametrix, Inc. 2011

The bioretention facilities would require 18 inches of amended soils to ensure that an infiltration rate of 2.5 inches per hour would be met. These facilities could be constructed in a typical rain garden configuration located at-grade, or in concrete boxes located above grade. The bioretention

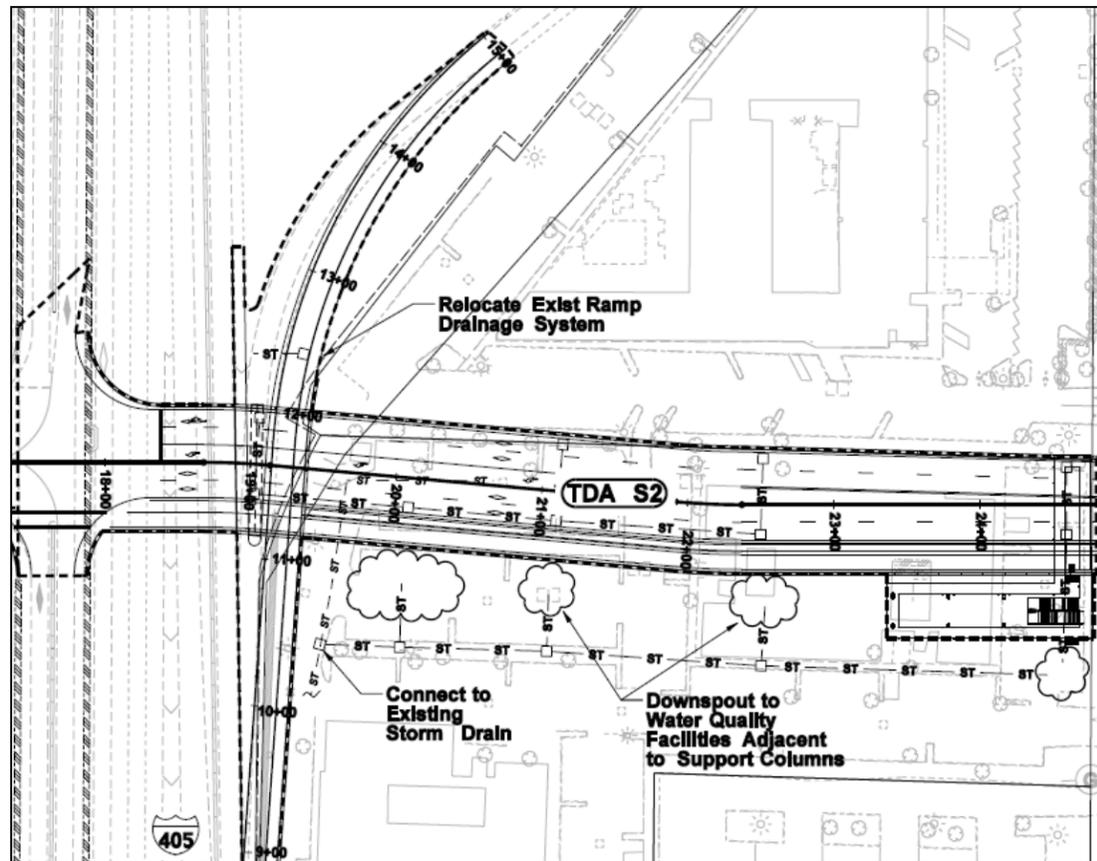
facilities would have underdrains to collect all stormwater after filtering, conveying it to the storm drain system.

The Filterra® bioretention systems were sized as sand filters and utilizing standard Filterra® vault sizes, in this case ranging from 6 feet by 6 feet to 6 feet by 10 feet (length times width). As with the generic bioretention facilities, the Filterra® vaults would utilize an underdrain system connected to the storm drain system.

Conceptual Drainage Design

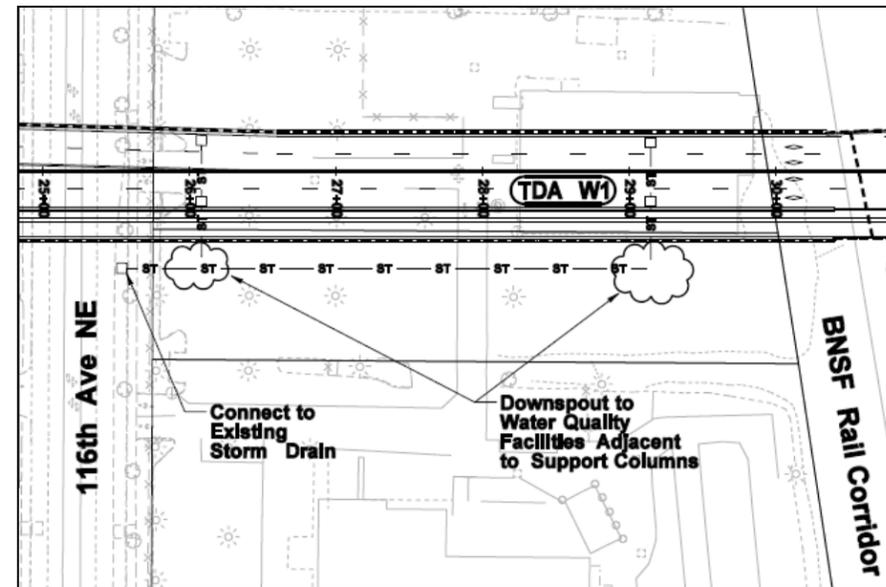
For TDAs S2 and W1, stormwater runoff would be collected in inlets on the bridge deck and piped to downspouts located on the structural columns or piers. For the bioretention option, the downspout flow would be discharged through a level spreader into the rain gardens located at-grade. These facilities would be located on the south side of the bridge structure to ensure that they would receive the proper amount of light for vegetative growth (see Figure 42 and Figure 43). Filterra® units would be located in similar locations, although there would be more flexibility to place these units under the elevated structure in shaded areas.

**Figure 42
Conceptual Drainage Design – TDA S2**



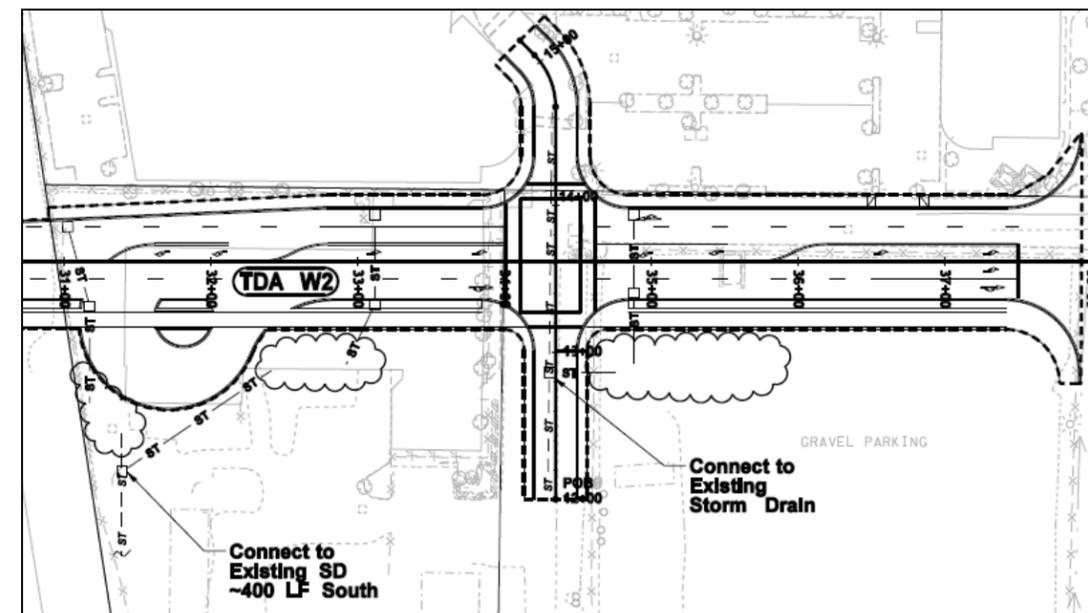
Source: Parametrix, Inc. 2011

**Figure 43
Conceptual Drainage Design – TDA W1**



Source: Parametrix, Inc. 2011

**Figure 44
Conceptual Drainage Design – TDA W2**



Source: Parametrix, Inc. 2011

In TDA W2 (see Figure 44), stormwater treatment facilities would be located at-grade. Stormwater would be collected in catch basins along the curb line of NE 6th Street and conveyed to the bioretention facilities. The conceptual design assumes that these facilities would be on the south side of NE 6th Street to minimize impacts on the developed properties to the north. They could be placed in one location, say adjacent to the BNSF Corridor, if that were advantageous from the perspective of focusing property impacts in one location.

For more information on the drainage design see *Stormwater Management Technical Memorandum* (Parametrix, May 2011) found in Appendix D.

Utilities

An existing King County 72-inch diameter gravity sanitary sewer line runs north and south within the BNSF corridor. This sanitary sewer line is located on the west side of the BNSF corridor, approximately 34 to 35 feet from the centerline of the corridor. King County has indicated that their primary concern for this line would be related to potential settlement resulting from construction over or adjacent to the sanitary sewer line. They will require analysis and monitoring during construction to ensure that any potential settlement issues are addressed. The conceptual design for the elevated structure carrying NE 6th Street between I-405 and the BNSF Corridor located the proposed abutment approximately 50-60 feet west of the sanitary sewer line to minimize the potential for settlement (see sheet ST02 in Appendix B). Other provisions may also be needed to protect the line, such as relocating the sanitary sewer similar to the design shown for the City of Bellevue's NE 4th Street project.

Puget Sound Energy has natural gas and power facilities in the vicinity of the project. The current effort was limited to review of Puget Sound Energy's utility maps of the project vicinity. Utility locates are required to determine the exact facilities impacted by the project. Existing power lines are underground along 112th Avenue NE and 120th Avenue NE, and above-ground along 116th Avenue NE. It is likely that overhead power lines along 116th Avenue NE would need to be relocated or raised to provide sufficient vertical clearance to the elevated structure carrying NE 6th Street over 116th Avenue NE. This relocation will also likely be required for Sound Transit's East Link project and would desirably accommodate both projects.

In Bel-Red program utility coordination meetings conducted by the City in 2011, utility companies have indicated a need to consider both existing and future development patterns as utility provisions are identified for the City's street projects. For the NE 6th Street extension, this would primarily apply to the portions of the corridor east of I-405.

The existing NE 6th Street bridge connecting 112th Avenue NE to the direct access interchange in the median of I-405 does not include provisions for public utilities. Retrofit of utility provisions could provide problematic, particularly at the SE fill supporting the direct access ramps. For these reasons, it is unlikely that public utilities would be accommodated on the new bridge structure east of I-405 to the BNSF corridor. Provisions would need to be made, however, for WSDOT/City systems including power for illumination, signal, and ITS; and communications provisions for tolling systems and ITS.

BNSF Corridor

In the vicinity of the NE 6th Street Extension project, there are four primary parties that have a stake in the BNSF corridor. The Port of Seattle purchased the corridor from BNSF Railway and they are actively negotiating with various agencies and utilities to sell portions of the corridor for transportation and utility uses. The provisions of the Port's purchase under federal rail-banking statutes could allow freight rail service to be restored on the corridor at a future date. Sound Transit has purchased a portion of the corridor immediately north of NE 6th Street for use by the East Link light rail line, and easements for potential future high capacity transit in other portions of the corridor. King County Parks has a trail easement through the entire corridor for use by a future regional non-motorized trail. The City of Bellevue is interested in the corridor because it crosses existing and future City of Bellevue streets that would interchange with future dual-use of the corridor for a regional trail and high-capacity transit. During this project's charrette/stakeholder meetings each of the interested parties expressed their viewpoints and desires for the corridor.

As a part of this project, the interaction of the City's NE 4th, 6th, and 8th Streets with future regional trail and high-capacity or freight rail in the BNSF corridor has been evaluated. Three options for horizontal and vertical alignments for future regional trail and railroad or rail transit facilities were developed:

- Over NE 6th Street
- At-grade at NE 6th Street
- Under NE 6th Street

For the purpose of the evaluations, the alignments extend from the Wilburton Trestle north to just north of NE 8th Street, encompassing Sound Transit's East Link Hospital Station.

The primary criteria for evaluation of rail and trail alignments are those related to profile grades. In recognition that under rail banking provisions freight rail service could be restored in the corridor, the maximum gradient for rail facilities was limited to 2%. This maximum rail gradient would also accommodate commuter rail service. The maximum regional trail grade was set at 5%, the maximum grade without landings allowed per ADA criteria.

Based on these profile grade criteria, geometrically possible alignments were identified. Combinations of feasible options were discussed with project stakeholders. Based on the evaluation and stakeholder input, the City determined that the following configurations would be the most desirable for future rail and trail facilities in the BNSF corridor:

- Future Freight or Commuter Rail – at-grade crossings of NE 4th, 6th, and 8th Streets
- Future Regional Trail – either:
 - over NE 4th, at-grade at NE 6th, and over NE 8th
 - over NE 4th, NE 6th, and NE 8th

An at-grade crossing would be preferable to facilitate non-motorized connections between the NE 6th Street Extension and a future regional trail in the BNSF corridor. This configuration would also minimize the footprint of the regional trail by eliminating a need for separate ramps between the NE 6th Street Extension and an elevated regional trail. It would also be more compatible with

King County’s vision for a linear park along the regional trail corridor. The at-grade crossing, depicted in Figure 28 on page 20, is assumed in estimates of probable construction cost. The cost of the regional trail in the BNSF corridor is not included.

Sound Transit is planning to build the East Link Hospital Station north of NE 8th Street. This elevated station and the planned elevated trail crossing over NE 8th Street will require further coordination during final design. A preliminary analysis determined that the primary issues associated with an elevated trail crossing that will need to be addressed in subsequent design phases include:

- The vertical clearance between the trail and the underside of the LRT elevated guideway structure on the south side of NE 8th Street is not adequate as shown in the preliminary engineering plans.
- A trail on the west side of the station would be mutually exclusive with any future freight commuter rail service in the BNSF Corridor.

Two feasible trail alignment options for a trail on the east side of the proposed East Link Hospital Station were developed. A third option was developed by Sound Transit for the west side of the East Link Hospital Station. In both cases, these alignments would meet vertical clearance requirements for the trail, streets, and rail facilities. The BNSF Corridor Regional Trail Technical Memorandum provides additional information (see Appendix D).

Driveways

Driveways or other connections to adjacent properties are only anticipated to be allowed within the Wilburton Village Zone, between the BNSF corridor and 120th Avenue NE. Local access connections are proposed at 119th Avenue NE, and at one existing intermediate driveway connection on the north side of NE 6th Street. Plans and profiles for these proposed connections are depicted on plan sheets DW01-DW02 and profile sheets DWP01-DWP02 in Appendix B. Revisions to the intermediate driveway that are planned to occur with the 120th Avenue NE Stage 1 project were not reflected in the conceptual design of this project. Future design refinement for this project will include coordination with adjacent property owners to refine driveway configurations.

C-curb is recommended between 119th Avenue NE and 120th Avenue NE to prohibit left turns in/out of the existing driveway. Any driveways would desirably be right-in, right-out. Left turns out of the adjacent properties would occur at the proposed intersection of NE 6th Street with 119th Avenue NE. As described earlier in this design report, this intersection would be either stop-sign or traffic signal controlled.

If driveway connections were desired off of the elevated structure between I-405 and the BNSF Corridor, these should only on the north side to avoid crossing the multi-use path. If left turns were allowed, it would be desirable to provide a turn lane or turn pocket at the driveway location. This may not be feasible between I-405 and 116th Avenue NE, as the westbound left turn pocket for the ramp terminal intersection requires nearly the full distance between I-405 and 116th Avenue NE. Special consideration would need to be made to accommodate structural flexing on the elevated structure at any driveway connections.

Illumination

Applicable street lighting design criteria are summarized in Table 12. These are a combination of WSDOT and City of Bellevue criteria. During 30% design of the project, a uniform set of design criteria would desirably be established for the roadway and multi-use path elements of the project. Criteria for light levels underneath the elevated portions of the NE 6th Street extension between I-405 and the BNSF corridor will depend on the anticipated use of the areas under the bridge structure. At 116th Avenue NE, the City’s major arterial criteria would apply.

Table 14
Street Lighting Design Criteria

Project Segment/Element	Criteria/Classification	Light Level (note 1)	Maximum Uniformity Ratio (note 2)	Maximum Veiling Luminance Ratio (note 3)
NE 6th Street, 112th Ave NE to east side of I-405	WSDOT/ Urban Minor Arterial (M-5)	1.2 foot-candles	4:1	0.3:1
Multi-Use Path	WSDOT/ Walkways & Bicycle Trails	0.8 foot-candles	3:1	0.3:1
NE 6th Street, east side of I-405 to 120th Ave NE	City of Bellevue/ Major Arterial	9 LUX (PCC) 13 LUX (HMA)	3:1	not specified
Intersection BNSF corridor trail	City of Bellevue/ Major – Ped Crossing	26 LUX (HMA)	not specified	not specified
Intersection 119th Ave NE	City of Bellevue/ Major – Tertiary	18 LUX (HMA)	3:1	not specified
Intersection 120th Ave NE	City of Bellevue/ Major – Major	26 LUX (HMA)	3:1	not specified

Notes:

- 1) Light Level = minimum average maintained horizontal light level
- 2) Maximum Uniformity Ratio = minimum average maintained light level / minimum light level
- 3) Maximum Veiling Luminance Ratio = maximum veiling luminance / average luminance
- 4) PCC = Portland Cement Concrete Pavement – bridges and NE 6th Street between 112th Ave NE and I-405
- 5) HMA = Hot Mix Asphalt Pavement – at-grade pavement, BNSF corridor to 120th

Sources:

City of Bellevue *Street Lighting Design Guide*, Revised May 2011
WSDOT *Design Manual* Chapter 1040, Revised June 2009

Pedestrian scale lighting typically consists of luminaires mounted 12 to 15 feet above the pedestrian or bicycle facility, often utilizing decorative fixtures. Pedestrian scale lighting is desirable for several reasons. It typically provides improved light uniformity and thereby enhances a user’s comfort, sense of security, and safety. While not noted in the design criteria summarized in Table 14, vertical illuminance criteria, such as those included in Illuminating Engineering Society of North America (IESNA) G-1 standards for security lighting, can be more readily incorporated as supplemental design criteria for facilities with pedestrian scale lighting, improving a user’s ability to discern obstacles and other people on the facility. Pedestrian scale lighting can also be a complement to other urban design elements such as railings, and can

provide thematic continuity and act as a way finding tool for a corridor connecting activity centers, such as the proposed NE 6th Street extension.

The existing roadway lighting on NE 6th Street between 112th Avenue NE and I-405 is consistent with WSDOT's standard practices at the time of construction, i.e. it utilizes 40 to 50 foot high metal poles with cobra head luminaires. The luminaires are mounted on the concrete wall/bridge rails and are installed in a staggered pattern along NE 6th Street (Figure 45).

Figure 45
Existing Roadway Lighting, 112th Avenue NE to I-405



Source: HNTB Corporation, 2010

The I-405 program provides two existing examples of roadway lighting configurations on City streets crossing over I-405 (Figure 46). These two projects used different lighting configurations, but both are generally consistent with the I-405 Context Sensitive Solutions (CSS) guidelines:

- NE 10th Street – Utilizes two different styles of 14-foot high poles with I-405 CSS luminaires at the back of sidewalks; spaced 50 feet on-center on both sides of the street.
- NE 12th Street – Utilizes 25-foot high poles with I-405 CSS luminaires at the back of sidewalk/multi-use path; spaced 100 feet on-center on both sides of the street.

The I-405 CSS guidelines also include roadway luminaires of the shoebox style, mounted on 40-50 foot high poles. These fixtures are similar to the City's Sterner shoebox luminaires.

Street lighting configuration options for the NE 6th Street Extension have been identified and were discussed City staff on the project's Technical Review Team. The four options were various combinations of roadway and pedestrian luminaires. Luminaire pole location options included mounting poles on bridge rails and within the proposed landscape strip separating the multi-use path from the traffic lanes. These options are depicted on page 22 of the Urban Design

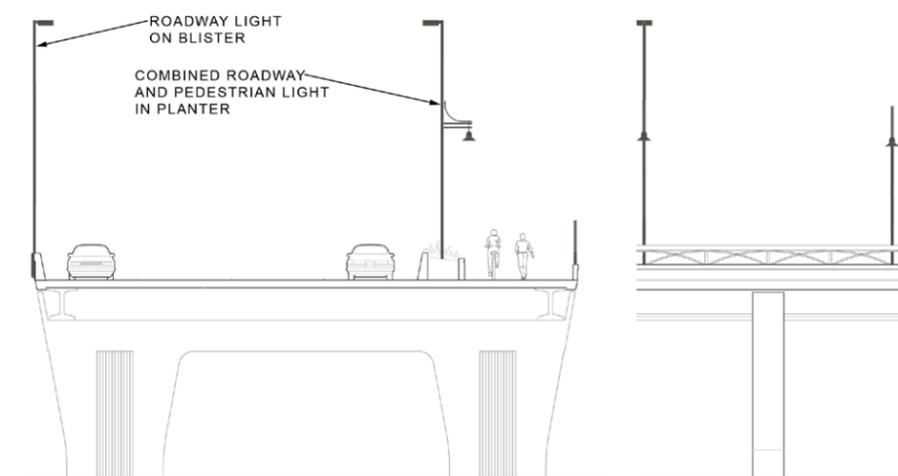
Master Plan (see Appendix C). As a result of this discussion, a recommended lighting configuration was developed as shown in Figure 47.

Figure 46
I-405 CSS Lighting Examples, NE 10th & 12th Streets over I-405



Source: HNTB Corporation, 2012

Figure 47
Recommended Lighting Configuration, I-405 to 120th Avenue NE



Source: HNTB Corporation, 2011

The proposed lighting configuration would combine shoebox luminaires on metal poles in a staggered configuration with pedestrian luminaires mounted in the planter strips. On the elevated structure, the planter would be between the roadway and the multi-use path. Street trees identified for the elevated structure would consist of species with a mature height of approximately 15 feet. East of the BNSF corridor to 120th Avenue NE, the planter beds would be on both sides of NE 6th Street between the sidewalk (north side) and multi-use path (south side). The City's design guide states that "...no street trees are placed within 25 feet of a new street light." Spacing of pedestrian luminaires and street trees will need to be coordinated during subsequent design activities.

Figure 47 depicts the Four Lane Base Alignment alternative. If a narrower roadway cross-section were implemented, such as one of the two lane alignment alternatives, or a hybrid three lane alternative, the roadway illumination could probably be located exclusively on the north bridge rail, with only pedestrian scale illumination in the landscaped area or on the south bridge rail. This would be similar to the configurations shown on Options 1, 2, and 4 in the Urban Design Master Plan (Appendix C).

Existing roadway lighting on NE 6th Street between 112th Avenue NE and the I-405 ramps intersection would not be directly impacted and as such, would not require replacement. The existing ramps intersection would be reconstructed and traffic signal equipment replaced, so an evaluation of whether or not to replace the existing lighting systems with I-405 CSS style poles and luminaires would be appropriate during subsequent project design activities. Part of this evaluation could consider the availability and life-cycle costs of lower energy consumption luminaires such as those utilizing LED technology. Selected luminaires would reflect City and/or WSDOT design standards in effect at the time of final design, including energy efficiency requirements.

Urban Design

The conceptual design for the project has integrated urban design elements intended to enhance the basic mobility functions of the project – these are focused on the user experience for both motorized and non-motorized modes of travel, and reflecting existing and potential future development adjacent to the NE 6th Street Extension. An urban design master plan has been developed for the project and is summarized in the *Urban Design Master Plan for NE 6th Street Extension, I-405 to 120th Avenue NE* (HNTB Corporation, July 2012). The complete master plan is contained in Appendix C of this design report.

The master plan provides summaries of the charrette and technical review team meetings, including design options presented and feedback received; a site analysis and stakeholder survey identifying key issues in the corridor; design themes including architectural elements for bridge structures; options for pedestrian connections to 116th Avenue NE; roadway lighting configuration options; multi-use path enhancements including railing styles, pavement scoring, and refuge areas; way finding/gateway elements; and site furnishings and details.

ENVIRONMENTAL DOCUMENTATION & PERMITS

Environmental Documentation

Environmental baseline conditions have been documented in technical memorandums prepared for the following elements of the environment:

- Transportation;
- Built Environment;
- Cultural Resources;
- Visual Quality;
- Air Quality;
- Noise;
- Natural Resources;
- Stormwater Drainage;
- Geology and Soils; and
- Hazardous Materials.

These memorandums are listed under the “Other Project Documentation” section of this report. Copies of the technical memorandums are included in Appendix D or Appendix E.

Environmental Activities through Completion

Federal law requires Federal Highway Administration (FHWA) approval of all revisions to the Interstate system, including changes to limited access (WSDOT 2009). The NE 6th Street Extension project would modify the access at the intersection of NE 6th Street and I-405 for HOV and transit. The requirement to comply with NEPA would likely be triggered by FHWA approval of the Interchange Justification Report and may be triggered by future federal funding.

The level of documentation needed for this project would likely be a NEPA Environmental Assessment (EA). This approach could include a Notice of Intent (NOI), scoping, the EA, and a Finding of No Significant Impacts (FONSI). SEPA rules allow an agency to adopt an environmental analysis, prepared under NEPA, to satisfy SEPA requirements (Washington Administrative Code [WAC] 197-11-610).

Another potential approach is completing a NEPA Documented Categorical Exclusion (DCE) and SEPA Checklist. These approaches are described in the “Environmental Documentation Moving Forward” section of the Environmental Report.

Environmental Assessment (EA)

The EA would provide an analysis for determining if the project would cause any significant environmental impacts. Analysis of the existing conditions, construction effects, permanent effects, mitigation measures, and cumulative and indirect effects would be supported by discipline reports, technical memoranda, or other design reports as appropriate. The environmental disciplines discussed in WSDOT’s *Environmental Procedures Manual* (WSDOT 2011) are grouped below to indicate those that are likely to need a discipline report or technical

memorandum, or are not applicable for this project. Elements of the environment where a discipline report and additional analysis would likely be needed are as follows:

- Land Use and Relocations — An analysis would be required to identify properties for partial or full acquisition between I-405 and 120th Avenue NE.
- Social and Economic — Because properties would be acquired, analysis and coordination with the businesses and employees would be needed to determine economic effects, including any potential effects on environmental justice populations.
- Visual Impacts — Because the NE 6th Street Extension would be elevated over 116th Avenue NE, an analysis would be needed to determine any potential effects on the environment or if any mitigation measures are required. In addition, Sound Transit is expected to build the East Link light rail project and the City of Bellevue is also undertaking several other projects in the vicinity that may include elevated structures. The cumulative effects on visual resources in the project area would need to be analyzed.
- Noise — The Coast Bellevue Hotel is a noise sensitive receiver and would need to be analyzed for noise impacts. Additional locations may also need to be evaluated.
- Stormwater — Analysis of construction BMPs and requirements (such as scheduling work during the dry season, water quality treatment, and flow control) would be required prior to relocating the Sturtevant Creek pipe.
- Hazardous Materials — An analysis of acquired properties would be needed to identify any sites of concern and potential mitigation measures required if contaminated soils or other hazardous materials were encountered.
- Historic, Cultural, and Archaeological Resources — The Area of Potential Effects would need to be defined and approved by the appropriate parties. A professional archaeologist would review the proposed project to determine if additional research or fieldwork is needed. Resources in the project area would be documented through the National Historic Preservation Act Section 106 process. Section 106 resources of concern are not likely to be identified for this project.

In addition to these discipline reports, a Drainage Report would be prepared to address surface water. During the next phase of design, a geology and soils (earth) analysis would be conducted as the engineering plans are developed. Informal ESA consultation would be documented to meet the NEPA and SEPA requirements applicable to this project for the fish, wildlife, and vegetation assessments.

Elements of the environment where a technical memorandum and supporting information would likely be needed are as follows:

- Transportation — Traffic operations would need to be analyzed to provide information for the new corridor between I-405 and 120th Avenue NE for transit, HOV, and non-motorized users. Depending on the timing of implementation, which affects forecast and analysis horizon years, the information contained in the Traffic Operations Analysis Report may be sufficient.
- Public Services and Utilities — A field assessment would need to be conducted to determine the exact utility locations and facilities affected by the project. Potential

construction effects would need to be evaluated to determine if any mitigation measures are needed for emergency services in the vicinity.

- Air — The level of service at the NE 6th Street and 112th Avenue NE intersection would need to be analyzed for air quality impacts. Additional intersections may also need to be evaluated.
- Energy — Energy usage and greenhouse gas (GHG) emissions would need to be evaluated for compliance with Washington State's latest guidance (Revised Code of Washington [RCW] 70.235.020) and GHG reduction goals. Energy needed to construct and operate the project, as well as GHG emissions, would be a very small percentage of the overall energy consumed by the region.

Disciplines for which documentation is not anticipated include:

- Department of Transportation Act, Section 4(f) Evaluation
- Land and Water Conservation Fund Act, Section 6(f) Evaluation
- Wetlands
- Floodplains
- Resource Lands
- Groundwater

A notice of availability for the EA is required and would need to be published in the local newspaper. The public review and comment period for an EA is typically 30 days. The EA would be sent to the Washington State Department of Ecology SEPA Unit. The City of Bellevue and WSDOT should also distribute the EA to interested federal, state, tribal, and local government agencies, including those agencies involved with permit issuance and approval.

A FONSI would be prepared after the EA is completed and a determination of no significant impacts has been made. The EA and FONSI must be available to the public (23 Code of Federal Regulations [CFR] 771.119(d)) after FHWA issues the FONSI. A final mitigation plan and all required permits would then need to be completed before construction of the project could begin.

Documented Categorical Exclusion (DCE) and Checklist

Another potential approach is completing a NEPA DCE and SEPA Checklist. A DCE can be completed for a project that includes actions with a potential for impacts, but those impacts would be mitigated and the project would not have a significant effect on the environment. A WSDOT Environmental Classification Summary (ECS) would need to be completed to document the categorical exclusion. Supporting documentation, such as a wetlands or cultural resources report, must be submitted to FHWA with the ECS form. The project would also complete an Environmental Checklist to meet SEPA regulations (WSDOT 2011). All of the discipline reports, technical memorandums, and supporting information listed for the NEPA EA would also apply to this approach. Once the DCE and SEPA Checklist are completed, a final mitigation plan would be developed and permits would need to be approved before construction of the project could begin.

There are no public involvement requirements for DCEs or SEPA Checklists, but open houses, newsletters, and other public outreach may be done. Public notice for the SEPA Determination of

Non-Significance or Mitigated Determination of Non-Significance would be provided, consistent with the requirements of WAC 197-11-510.

Endangered Species Act

The U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NOAA Fisheries) are the agencies responsible for administering the ESA. These agencies would need to be contacted early in the environmental review process. The project could potentially qualify for a "no effects" determination because no federally listed endangered species are known to occur within the project vicinity. However, the project may need to conduct Section 7 consultation on behalf of FHWA (50 CFR 402.07) because federally listed salmonid species occur downstream of the project. If consultation is required, it is anticipated that an assessment would conclude that the NE 6th Street Extension project "may affect, but is not likely to adversely affect" ESA-listed species.

Permit Coordination

Assumptions

The following assumptions were made in assembling this list of likely permits and approvals for project construction:

1. The City of Bellevue will continue to be the project proponent through the environmental process, in cooperation with WSDOT, who will likely lead the final design/construction phases of the project.
2. No changes are required to the City's Comprehensive Plan.
3. No change will be made to Sturtevant Creek. It will remain a closed stream segment as defined by BCC 20.50.
4. Electrical, mechanical, and sewer permits/approvals will be determined or confirmed by the contractor.
5. Night-time construction work (including haul to and from the site) is required.
6. A federal nexus is triggered by Federal Highway Administration (FHWA) approval of the Interchange Justification Report and may be triggered by future federal funding.
7. The City of Bellevue may be required to participate in an agreement with WSDOT, FHWA, Federal Transit Administration (FTA) and possibly others on the use of the NE 6th Street Direct Access Ramp completed as the Sound Transit Bellevue HOV Access project in 2004.

Permits and Approvals Required for Construction

The following permits and approvals are anticipated to be required for the project:

Federal and State

1. National Environmental Policy Act – FHWA
2. Endangered Species Act, No Effects Letter or Informal Consultation – FHWA, USFWS, NOAA Fisheries
3. National Historic Preservation Act Section 106 – Washington Department of Archaeology and Historic Preservation

4. Interchange Justification Report approval – FHWA/WSDOT
5. Air Space Lease Agreement – FHWA/WSDOT
6. Final Channelization Plan Approval – FHWA/WSDOT
7. General Construction Permit – WSDOT
8. Hydraulic Project Approval (HPA) — Washington State Department of Fish and Wildlife (to relocate the Sturtevant Creek pipe)
9. National Pollutant Discharge Elimination System (NPDES) Construction Stormwater General Permit coverage—Washington State Department of Ecology

City of Bellevue

1. State Environmental Policy Act
2. Clearing and Grading Permit
3. Noise Variance
4. Critical Areas Ordinance

If there is consideration of daylighting Sturtevant Creek in the future, the project would potentially need to comply with the U.S. Army Corps of Engineers Section 404 permit and follow ESA regulations. The current regulations and permits would need to be confirmed at the time the project resumes.

RIGHT OF WAY

Right of way acquisition and temporary construction easements would be required to implement the NE 6th Street Extension project. The impact on public and private land parcels in the corridor would vary between alignment alternatives, as shown on Figure 48, Figure 49, and Figure 50. The differences between alternatives would be in the degree of impact, i.e. the areas of impact, not in the number of individual parcels that would be affected. The largest area of potential acquisitions would occur with the 4-Lane Base Alignment Alternative, and the smallest with the 2-Lane Refined Alignment Alternative.

Table 15 provides a summary of potential right of way acquisition areas by affected parcel. These areas are based on the footprint of the three alignment alternatives. Also identified are areas associated with the optional pedestrian connection to 116th Avenue NE, with stormwater treatment facilities, and for construction easements. The stormwater treatment facility areas represent conceptual designs sized to accommodate the largest footprint for the project, as described earlier in this report (see Conceptual Drainage Design on page 38). Not shown are potential additional right of way areas that could be required for U-turn options at 119th Avenue NE.

Potential uneconomic remainders or remnants have been shown in Table 15 and on Figure 48, Figure 49, and Figure 50. These areas represent parcels with existing uses that might be compromised by the project to the point where WSDOT and/or the City would offer to acquire the entire parcel. These property areas would not be required for operation of the project, and if acquired, would potentially be considered “surplus” and disposed of by the acquiring agency. It is possible, however, that one or more of these areas could be used during construction for contractor staging and/or lay down areas. The four properties that would potentially be in this category are:

- Legacy Bellevue 530 LLC – Location of a restaurant (out of business and for lease as of August 2012); direct impacts on parking areas could potentially affect the viability of the business.
- Fazenda LLC / Toyota of Lake City – Currently occupied by adjacent auto dealerships, the project would bisect these adjoining properties under the same ownership and would require removal of an existing auto dealer/service building on the southern parcel.
- Mutual Material Co. – The new street would run through the northern portion of the existing office/warehouse building on the site, requiring its removal.
- Bellevue School District 405 – The school district performs light maintenance and parks school buses on this site; the project would eliminate some parking spaces and would require reconfiguration of the parking and circulation aisles. The reduction in parking area may result in a need for the school district to find an alternative location with sufficient parking for their needs.

For the purpose of estimating potential right-of-way costs, the “Total Permanent Acquisition” areas shown on Table 15 have been used, with a cost of \$100 per square foot assumed.

Subsequent phases of design development will need to determine what, if any, modifications to the existing WSDOT / I-405 limited access limits would be required. The proposed multi-use path facilities, including the proposed at-grade intersection at the direct access ramp terminal intersection, would appear to be compliant with the guidance for limited access facilities in WSDOT’s *Design Manual* Chapter 530.03.

Table 15
Summary of Potential Right of Way Acquisitions

#	Affected Parcel Owner	Tax Parcel Number	Total Parcel Area (square feet)	Approximate Acquisition Area (square feet)			
				4 Lane Base Alignment	2 Lane Base Alignment	2 Lane Refined Alignment	
1	Legacy Bellevue 530 LLC	3225059201	37,993	7,351	7,351	7,351	
	uneconomic remainder			30,642	30,642	30,642	
2	JG 520 Building LLC	3225059171	66,510	1,129	1,129	1,129	
3	Goldtrust Hotel LLC	3225059002	158,875	4,179	3,293	8,049	
4	City of Bellevue	3225059005	184,500	45,368	40,483	32,505	
	Stormwater Treatment Facilities			3,996	3,996	3,996	
	116th Ave NE Pedestrian Connection			6,313	6,313	6,313	
	Potential Uneconomic Remainder			-	2,434	-	
5	Fazenda LLC	3325059124	64,662	29,356	22,741	22,568	
	Potential Uneconomic Remainder			35,306	41,921	42,094	
6	Fazenda LLC	3325059038	38,412	3,598	-	-	
	Stormwater Treatment Facilities			2,345	2,345	2,345	
7	Port of Seattle	3325059029	570,008	8,161	5,993	6,203	
8	City of Bellevue ROW	N/A	11,400	11,400	11,400	11,400	
9	Mutual Material Co.	3325059134	89,747	30,007	24,828	25,621	
	Stormwater Treatment Facilities			2,916	2,916	2,916	
	Potential Uneconomic Remainder			56,824	62,003	61,210	
10	TRF Capital	3325059120	253,174	4,392	4,392	4,392	
	Temporary Construction Easement			4,870	4,870	4,870	
11	Bellevue School Dist 405	3325059121	201,310	30,308	30,308	30,308	
	Stormwater Treatment Facilities			1,424	1,424	1,424	
	Temporary Construction Easement			5,408	5,408	5,408	
	Potential Uneconomic Remainder			164,170	164,170	164,170	
Total Potential Acquisitions				1,676,591	489,463	480,360	474,914
Subtotal, Street Right-of-Way				175,249	151,918	149,526	
Subtotal, 116th Ave NE Ped Connection				6,313	6,313	6,313	
Subtotal, Stormwater Treatment Facilities				10,681	10,681	10,681	
Total Permanent Acquisitions				192,243	168,912	166,520	
Subtotal, Temporary Construction Easements				10,278	10,278	10,278	
Subtotal, Potential Uneconomic Remainders				286,942	301,170	298,116	
Total Potential Temporary Acquisitions				297,220	311,448	308,394	

Source: HNTB Corporation, 2011

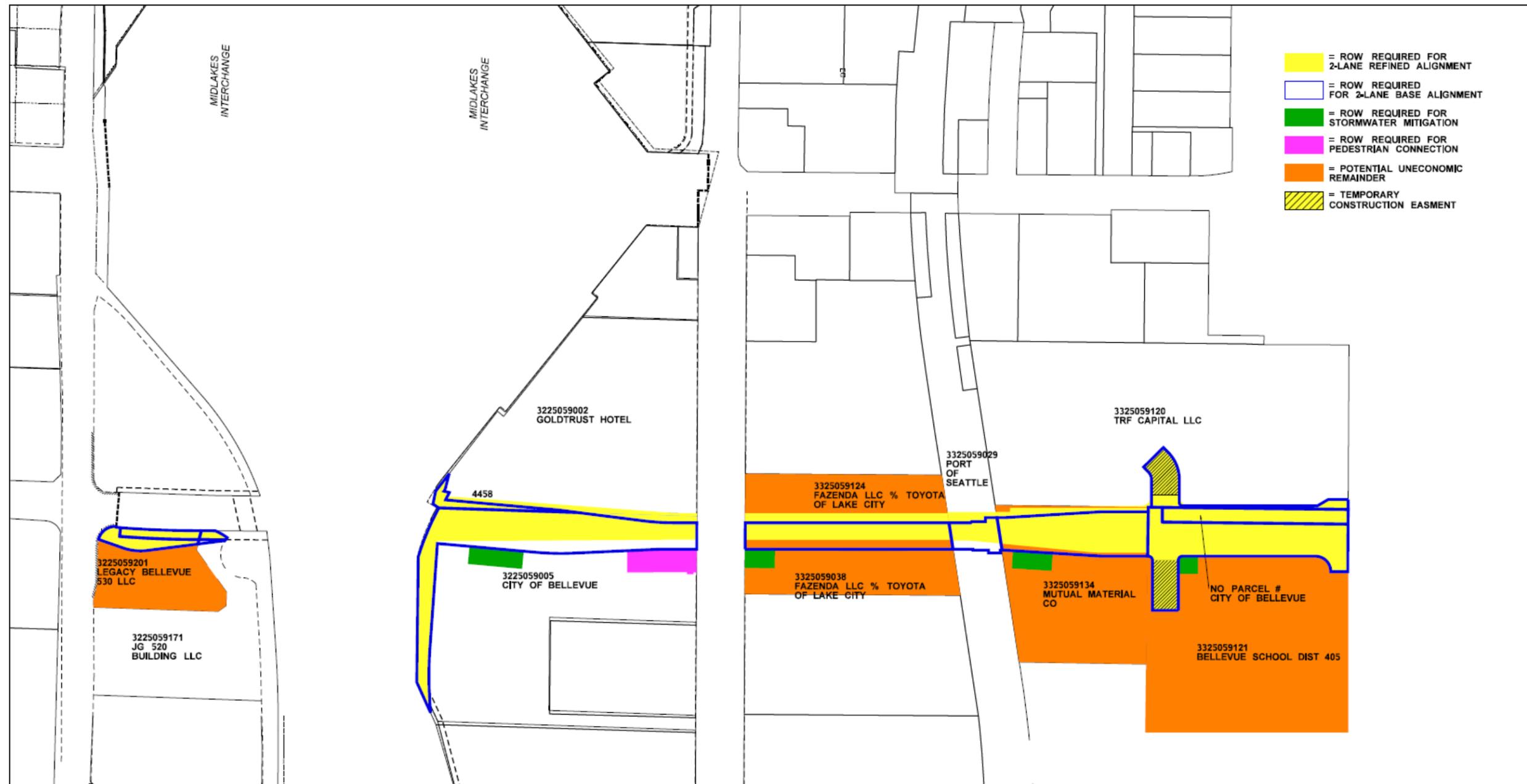
Figure 48
Potential Right of Way Acquisitions
Comparison of 2-Lane Base vs. 4-Lane Base Alignments



Figure 49
Potential Right of Way Acquisitions
Comparison of 2-Lane Refined vs. 4-Lane Base Alignments



Figure 50
Potential Right of Way Acquisitions
Comparison of 2-Lane Base vs. 2-Lane Refined Alignments



ESTIMATES OF PROBABLE PROJECT COST

The project is currently in the planning level of design development, as defined in WSDOT’s *Cost Estimating Guidance for WSDOT Projects* (M 3034.02, July 2009). The design described in this report is at approximately a 5% level of design completion. Miscellaneous items and planning design level allowances represent 46% of the estimated construction cost, not including mobilization, survey, and potholing, have been applied to the estimates. This total allowance is at the high end of the 30% to 50% range recommended by WSDOT for the planning phase of a project. The specific assumptions for miscellaneous allowances applied to construction items are itemized below. These allowances represent project elements for which preliminary design has not been developed during the current phase of the project.

Construction Items— percentage of construction items estimated

- Traffic Control 7%
- Roadside Cleanup 1%
- Temporary Erosion & Stormwater Control (TESC) 2%
- Property Restoration 5%
- Permanent Signing 1%
- Miscellaneous Items Not Yet Estimated 10%
- Allowance for Planning Level Design Accuracy 20%
- Mobilization, Survey, Potholing 12%

Existing utilities crossing the NE 6th Street Extension corridor include Puget Sound Energy power and gas lines and various communications utilities located in or along 116th Avenue NE (see summary in Utilities on page 39). It is possible that some of these will need to be relocated to accommodate the NE 6th Street Extension and the parallel Sound Transit East Link project. No specific costs for these potential relocations have been estimated at the current level of project development. In addition, a 72-inch sanitary sewer line owned by King County also crosses the corridor. The current assumption is that the project will protect the sewer line in its existing location. Sales tax is assumed to be applied only to utility work by others per APWA Standard Specifications. For all other work sales tax is included in unit prices.

Utilities & Agreements

- State Sales Tax (only applies to utility work by others) 8.9%
- Construction Work by Others at Owner’s Expense none identified
- Agreements (utilities, etc.) none identified

Allowances for construction and design engineering and administration are summarized below.

Construction Administration – percentage of construction,

- Construction Engineering 10%
- Construction Contingency 10%

Design Engineering & Administration

- Design Engineering 20%
includes preliminary design/environmental documentation, final design, and PS&E
- Agency Administration 10%
- Alignment Survey 1%

A summary of estimated project costs by roadway alternative is shown in Table 16. Also shown are estimated costs for optional project elements that could be added to the roadway alternatives. These include provisions for a 16-foot wide multi-use path, for a pedestrian connection from the elevated NE 6th Street Extension to 116th Avenue NE, and four options for U-turn provisions at or near the intersection of NE 6th Street with 119th Avenue NE. Right of way costs include permanent acquisitions but do not include construction easements or potential uneconomic remnants or remainders.

**Table 16
Summary of Estimates of Probable Project Cost**

Alternative/Option	Construction, Design & Administration	Right of Way	Total Project Cost
Roadway Alternatives			
4-Lane Base Alignment	\$66.7	\$18.6	\$85.3
2-Lane Base Alignment	\$59.2	\$16.3	\$75.5
2-Lane Refined Alignment	\$57.2	\$16.0	\$73.2
Optional Project Elements			
16-foot wide Multi-Use Path	\$1.9	---	\$1.9
116th Pedestrian Connection	\$3.7	\$0.6	\$4.3
119th Intersection Options			
Option 1 – U-turn with bulb-out	\$0.1	\$0.4	\$0.5
Option 2 – U-turn without bulb-out	\$0.1	\$0.5	\$0.6
Option 3 – Jug Handle	\$0.3	\$0.9	\$1.2
Option 4 - Roundabout	\$0.3	\$1.1	\$1.4

Notes:

- 1) All costs are in millions, year 2011 dollars.
- 2) The costs shown above represent estimates of probable construction and project costs prepared in good faith and with reasonable care. HNTB has no control over the costs of construction labor, materials, or equipment, nor over competitive bidding or negotiating methods and does not make any commitment or assume any duty to assure that bids or negotiated prices will not vary from the attached estimates.

Source: HNTB Corporation, 2011

The potential range of cost for the project would be approximately \$73 million to \$93 million. The low end of the range represents the Two-Lane Basic Section Refined Alignment alternative without any optional project elements identified in Table 16. The high end of the range represents the Four-Lane Basic Section Base Alignment alternative with the 16-foot wide multi-use path, 116th Avenue NE pedestrian connection, and Jug Handle U-turn provision at 119th Avenue NE.

The cost differences between roadway alternatives are primarily related to the number of lanes and associated structure width east of the I-405 right of way limits to 116th Avenue NE. It is in this area that the roadway channelization of the alternatives would differ, generally as follows:

- 4-Lane Basic Section, Base Alignment – A 5-lane section at the I-405 direct access ramps intersection tapers down to a 4-lane section at 116th Avenue NE.

- 2-Lane Basic Section, Base Alignment – A 5-lane section at the I-405 direct access ramps intersection tapers down to a 2-lane section at 116th Avenue NE.
- 2-Lane Basic Section, Refined Alignment – A 4-lane section at the I-405 direct access ramps intersection tapers down to a 2-lane section at 116th Avenue NE. The project cost savings associated with the reduced section width on the refined alignment would be approximately \$12.1 million.

A breakout of estimated project costs by corridor segment is contained in Table 17. The costs shown do not include the optional project elements noted identified in Table 16. The primary project construction cost elements associated with each segment are described below:

- 112th Ave NE to I-405 – A multi-use path connection between 112th Avenue NE and the I-405 direct access ramps intersections, and channelization modifications on the existing portions of NE 6th Street.
- I-405 to BNSF Corridor – All work associated with the extension of NE 6th Street from the I-405 direct access ramps intersection to the BNSF Corridor, including a multi-use path on the south side of NE 6th Street. This segment would be almost entirely elevated on bridge and retaining wall structures.
- BNSF Corridor to 120th Avenue NE – Widening of the existing portion of NE 6th Street west of 120th Avenue NE and an extension of NE 6th Street west to the western edge of the BNSF Corridor. This segment includes provisions for an at-grade connection to a future regional trail facility in the BNSF Corridor.

Stormwater treatment and drainage facility costs were estimated based on the “worst case” for net new impervious area, i.e. the 4-Lane Basic Section on the Base Alignment alternative. These costs were distributed between the corridor segments based on the conceptual designs depicted on page 38.

Table 17
Estimated Construction Costs by Corridor Segment

Roadway Alternative	112th Ave NE to I-405	I-405 to BNSF Corridor	BNSF Corridor to 120th Ave NE	Total Construction
4-Lane Base Alignment	\$5.8	\$44.3	\$3.4	\$53.5
2-Lane Base Alignment	\$5.8	\$38.3	\$3.2	\$47.3
2-Lane Refined Alignment	\$5.8	\$36.8	\$3.3	\$45.9

Notes:

- 1) All costs are in millions, year 2011 dollars.
- 2) Costs are construction only and do not include Design Engineering and City/WSDOT Administrative costs.
- 3) The costs shown above represent estimates of probable construction and project costs prepared in good faith and with reasonable care. HNTB has no control over the costs of construction labor, materials, or equipment, nor over competitive bidding or negotiating methods and does not make any commitment or assume any duty to assure that bids or negotiated prices will not vary from the attached estimates.

Source: HNTB Corporation, 2011

OTHER PROJECT DOCUMENTATION

Preliminary Engineering Design Documentation

Preliminary design activities for the project are described in more detail in the documents listed below, found in Appendix C (Urban Design Master Plan) and Appendix D (all others).

- *Preliminary Geotechnical Recommendations, Proposed NE 6th Street Extension Memorandum*, GeoEngineers, Inc., April 13, 2011
- *Median Abutment Foundation Options Memorandum*, GeoEngineers, Inc., April 14, 2011
- *Stormwater Management Technical Memorandum*, Parametrix, June 15, 2012
- *Traffic Operations Analysis Report (TOAR)*, HNTB Corporation, August 15, 2011
- *NE 6th Street / 119th Avenue NE Roundabout Analysis Technical Memorandum*, Parametrix, June 3, 2011.
- *Urban Design Master Plan for NE 6th Street Extension, I-405 to 120th Avenue NE*, HNTB Corporation, July 2012
- *BNSF Corridor Alignment Study Technical Memorandum*, HNTB Corporation, August 3, 2012
- *Alignment Options with East Link Hospital Station Technical Memorandum*, HNTB Corporation, October 13, 2011
- *I-405 Overcrossing Bridge Structure Type and Abutment Foundation Type Technical Memorandum*, HNTB Corporation, July 10, 2012.
- *Structure Types, I-405 East to BNSF Corridor Technical Memorandum*, HNTB Corporation, July 9, 2012.
- *Structure Types for Multi-Use Path Connection, 112th Avenue NE over Southbound I-405 Technical Memorandum*, HNTB Corporation, July 9, 2012.

Environmental Documentation

The environmental report prepared for the project and the supporting technical memorandums listed below are found in Appendix E.

- *NE 6th Street Extension, I-405 to 120th Avenue NE Environmental Report*, Parametrix, June 2012
- Transportation Baseline (see the *Traffic Operations Analysis Report*)
- *Baseline Information on the Affected Built Environment Technical Memorandum*, Parametrix, June 15, 2012
- *Preliminary Cultural Resources Review of the NE 6th Street Extension, I-405 to 120th Avenue NE Technical Memorandum*, Paragon Research Associates, November 30, 2010
- *Visual Quality Baseline Technical Memorandum*, HNTB Corporation, July 2012
- *Baseline Information on Air Quality Technical Memorandum*, Parametrix, June 15, 2012
- *Baseline Information on Noise Technical Memorandum*, Parametrix, June 15, 2012
- *Baseline Information on Natural Resources Technical Memorandum*, Parametrix, June 15, 2012
- Baseline Information on Stormwater/Drainage Conditions (see the *Stormwater Management Technical Memorandum*)
- *Geology and Soils Discipline Report*, GeoEngineers, Inc., April 6, 2011
- *Hazardous Materials Discipline Report*, GeoEngineers, Inc., April 6, 2011
- *Permit Coordination Technical Memorandum*, HNTB Corporation with Parametrix, July 2012

APPENDIX A – EXHIBITS

APPENDIX B – CONCEPTUAL PLANS

APPENDIX C – URBAN DESIGN MASTER PLAN

APPENDIX D – PRELIMINARY ENGINEERING DESIGN TECHNICAL MEMORANDUMS

Geotechnical

- *Preliminary Geotechnical Recommendations, Proposed NE 6th Street Extension Memorandum*, GeoEngineers, Inc., April 13, 2011
- *Median Abutment Foundation Options Memorandum*, GeoEngineers, Inc., April 14, 2011

Structures

- *Structure Types for Multi-Use Path Connection, 112th Avenue NE over Southbound I-405 Technical Memorandum*, HNTB Corporation, July 9, 2012.
- *I-405 Overcrossing Bridge Structure Type and Abutment Foundation Type Technical Memorandum*, HNTB Corporation, July 10, 2012.
- *Structure Types, I-405 East to BNSF Corridor Technical Memorandum*, HNTB Corporation, July 9, 2012.

Stormwater

- *Stormwater Management Technical Memorandum*, Parametrix, June 15, 2012

Traffic

- *Traffic Operations Analysis Report (TOAR)*, HNTB Corporation, August 15, 2011
- *NE 6th Street / 119th Avenue NE Roundabout Analysis Technical Memorandum*, Parametrix, June 3, 2011.

BNSF Corridor

- *BNSF Corridor Alignment Study Technical Memorandum*, HNTB Corporation, August 3, 2012
- *Alignment Options with East Link Hospital Station Technical Memorandum*, HNTB Corporation, October 13, 2011

APPENDIX E – ENVIRONMENTAL DOCUMENTATION TECHNICAL MEMORANDUMS

- *NE 6th Street Extension, I-405 to 120th Avenue NE Environmental Report*, Parametrix, June 2012
- *Permit Coordination Technical Memorandum*, HNTB Corporation with Parametrix, July 2012
- *Baseline Information on the Affected Built Environment Technical Memorandum*, Parametrix, June 15, 2012
- *Preliminary Cultural Resources Review of the NE 6th Street Extension, I-405 to 120th Avenue NE Technical Memorandum*, Paragon Research Associates, November 30, 2010
- *Visual Quality Baseline Technical Memorandum*, HNTB Corporation, July 2012
- *Baseline Information on Air Quality Technical Memorandum*, Parametrix, June 15, 2012
- *Baseline Information on Noise Technical Memorandum*, Parametrix, June 15, 2012
- *Baseline Information on Natural Resources Technical Memorandum*, Parametrix, June 15, 2012
- *Geology and Soils Discipline Report*, GeoEngineers, Inc., April 6, 2011
- *Hazardous Materials Discipline Report*, GeoEngineers, Inc., April 6, 2011