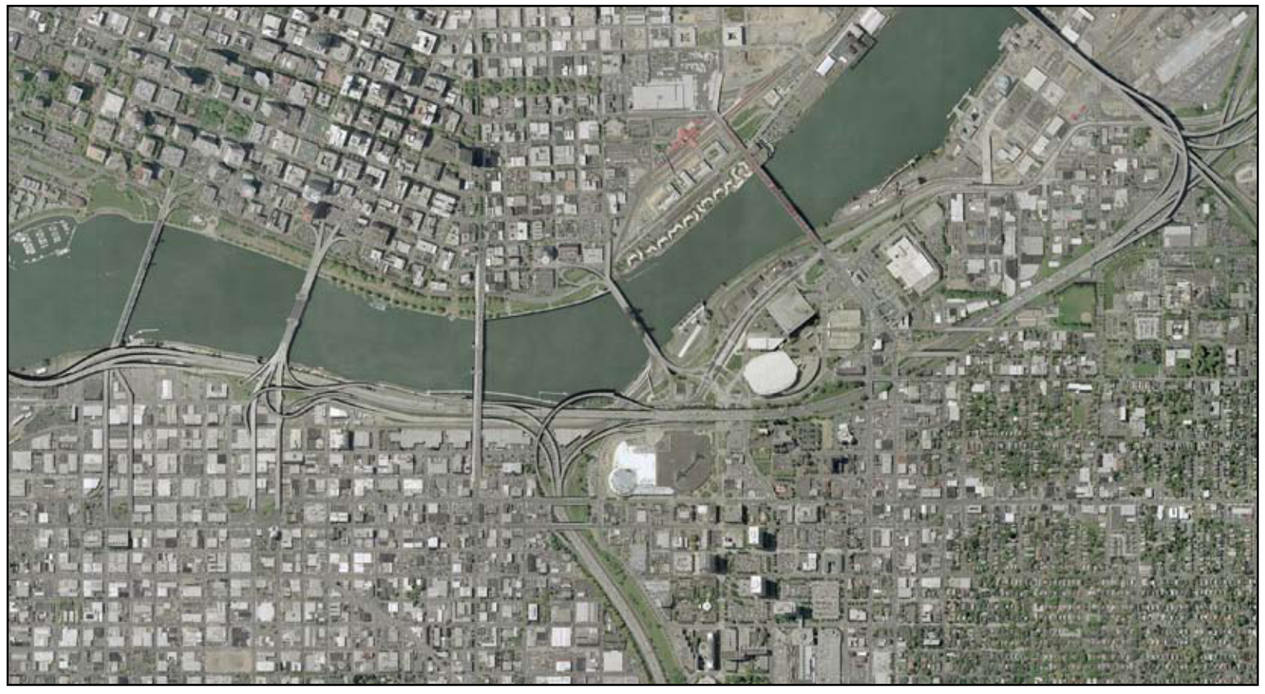
I-5: I-84 to I-405
Design Workshop Concept Report

NOVEMBER 2007



PREPARED FOR

OREGON DEPARTMENT OF TRANSPORTATION

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CITY OF PORTLAND OFFICE OF TRANSPORTATION

Preface – November 2010

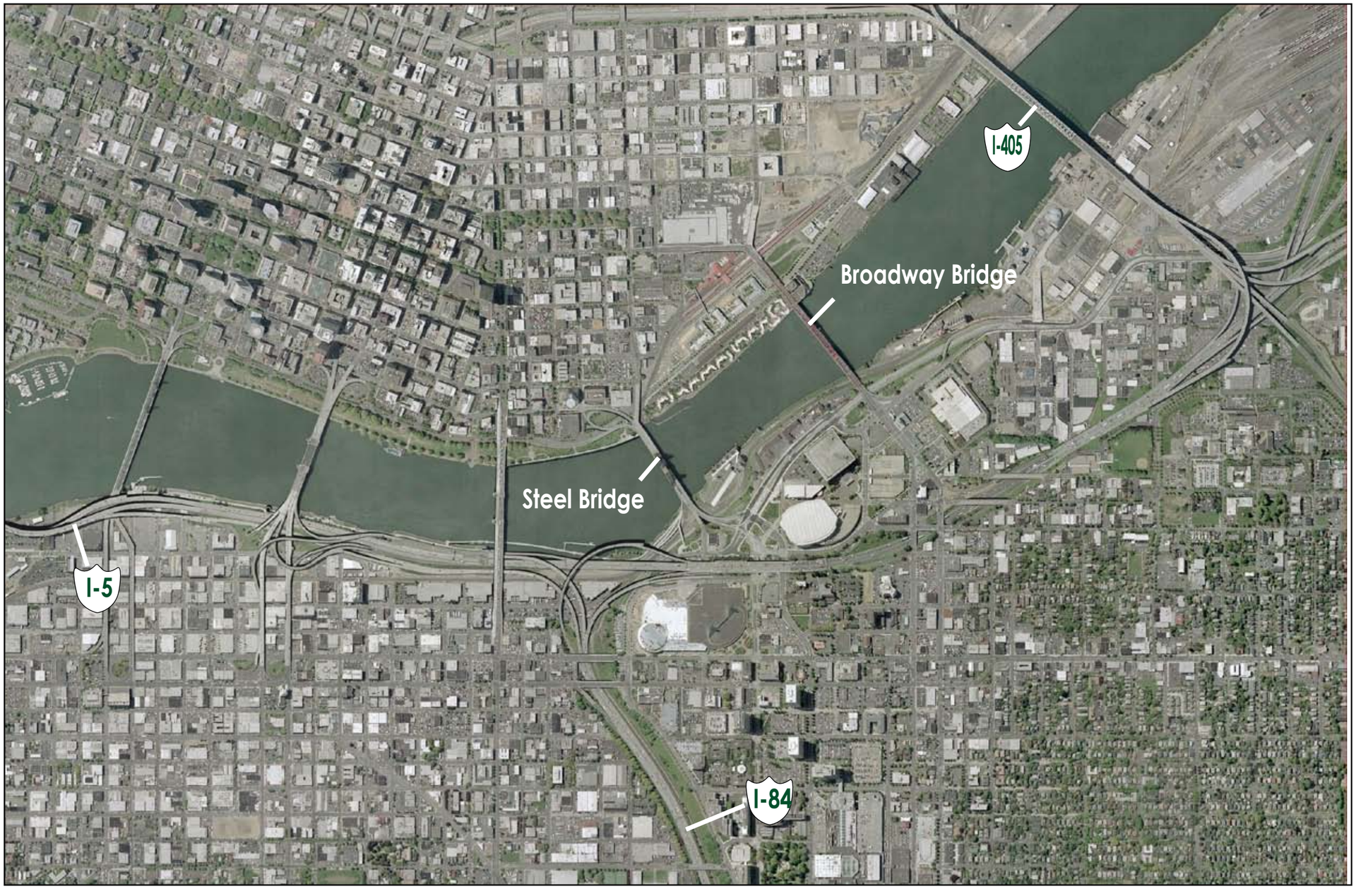
I-5: I-84 to I-405 Design Workshop Concept Report

In 2007, ODOT and the City of Portland met to follow-up on the Freeway Loop Study recommendation to address the bottleneck at the I-5/I-84 Freeway Interchange. The consulting firm CH2MHill was selected to facilitate an informal workshop to assess whether there were any feasible conceptual ideas for “modest” improvements to I-5 operations and safety. Key results from this process included recognizing the operational and safety issues and that flexible design approaches were needed to address the needs and constraints of I-5 at the Broadway/Weidler interchange. Concepts resulting from the workshop were to illustrate the range of concepts and challenges. No decisions were made, and there was agreement that a collaborative partnership between ODOT and City of Portland would be needed for a public process to address this issue.

Now, a joint ODOT-City process has started for the N/NE Quadrant and I-5 Broadway/Weidler Plans. It is a full planning process with the public, stakeholders, and other regional agencies at the table. As a result, the following concepts are starting points – not an end. ODOT and the City expect additional concepts to emerge and all concepts will be evaluated for positive benefits and negative impacts. From there, the most viable concepts will be refined. At the end of this current process, the Stakeholder Advisory Group may recommend no action or that the best options may move forward for further refinement and development.

Project Area Background

Exhibit 1: Vicinity photo



History

The section of I-5 from the I-84 Interchange to the I-405 Interchange has historically suffered congestion and high crash rates. Much of this is due to the fact that the Broadway/Weidler service interchange is located between two closely spaced system interchanges.

Several previous studies: the Greeley Ramp-North Banfield Section Study (1987), the Blazer Arena Study (1991) and the Freeway Loop Study (2005), have addressed the operational issues of this section. This current effort was a fresh look at feasible solutions that could be implemented in the relative short term.

Freeways

The project area is at the crossroads of the Portland freeway system, as shown in Exhibit 1. I-5 is the north-south freeway facility and extends through the metropolitan area; in fact, it runs the full length of the U.S. west coast, from Canada to Mexico. Within the project area, I-84 intersects I-5 and extends east across the U.S. A mile and a quarter north of I-84, I-405 connects to I-5 at the Fremont Interchange. This interchange is the northerly connection of the I-405 loop around the west side of downtown Portland, with the southerly connection at the west end of the Marquam Bridge. Within the overlap section, I-5 serves through traffic as well as connecting traffic between I-84 and I-405. This section, used by all three freeways, has only two lanes in each direction—the least capacity in the freeway system—and the resulting weaving movements make it the most significant bottleneck on the Portland freeway system.

The "area of influence" for this study extends from the Marquam Bridge to just north of the I-405 interchange along I-5, and east along I-84 from I-5 to the 39th Avenue Interchange. A smaller "improvement area" was identified from the Morrison Bridge Interchange through the I-405 interchange along I-5 and along I-84 to near the 12th Avenue undercrossing. It was assumed for this study that the physical improvements would be located within this smaller area.

Project charge from agency

To date, agreement has not been reached between public agency stakeholders with regard to an acceptable outcome for issues within this portion of the I-5 corridor. This effort should assist the City of Portland and ODOT in determining a mutually beneficial project direction based on informed consent, thus allowing the project to move into conceptual development. This effort has been characterized as "homework" to determine if there are one or more feasible and acceptable alternatives. This effort is not intended to determine a preferred alternative. If it appears that there are feasible alternatives, the agencies will then determine the next steps. Those steps could include refinement planning or formal project development that would include public involvement.

Project Area Background

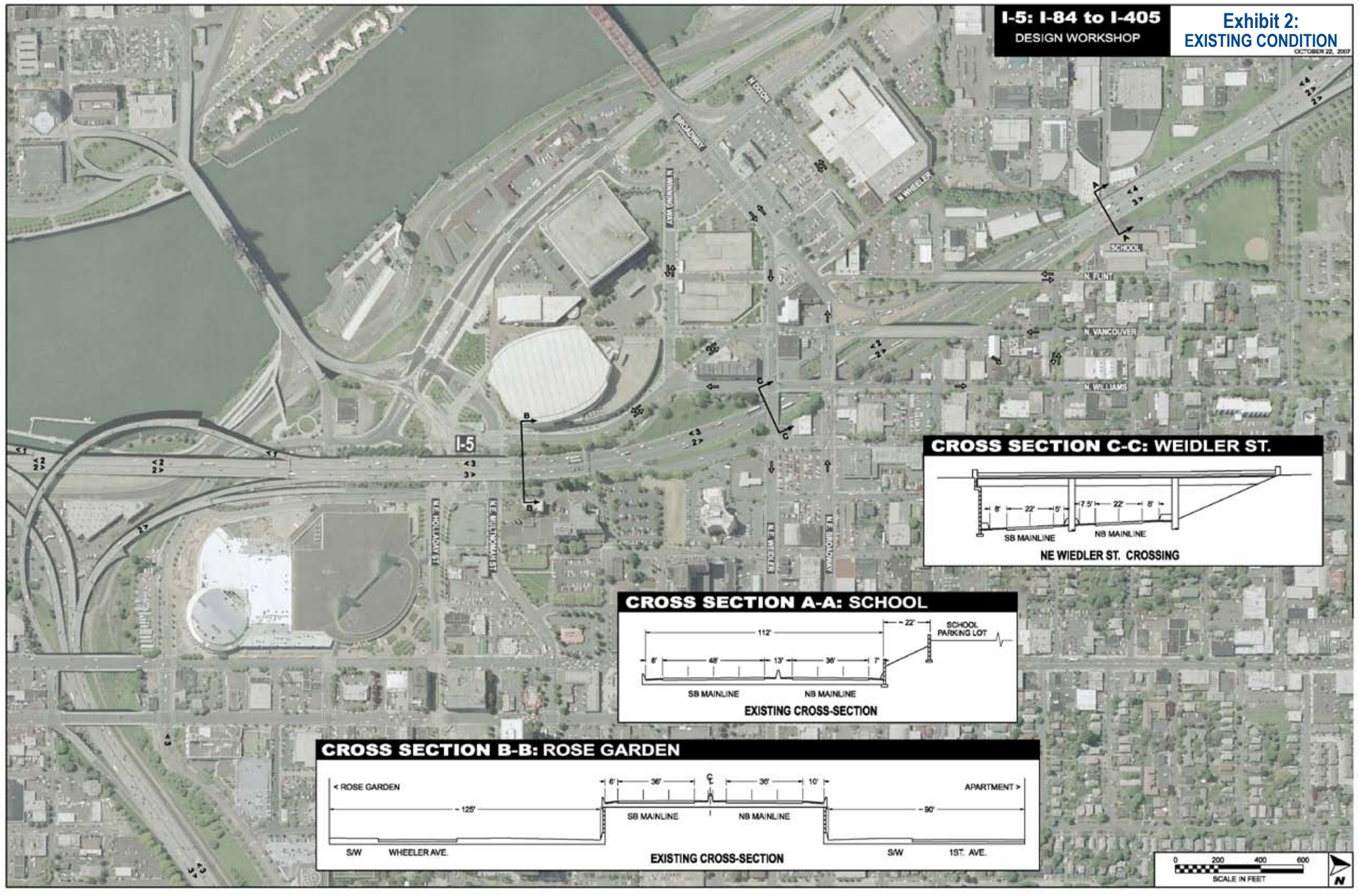
At three locations, existing limitations will be especially important in the development of concepts.

Section A-A on Exhibit 2 represents the area north of the Broadway/Weidler interchange area where there is only about 140 feet between an industrial building on the west side of I-5 and a school parking lot/access road on the east side. I-5 is on a viaduct in this area.

Section B-B represents the area adjacent to the Rose Quarter and is of concern because of the need to avoid direct impacts to this building. It is approximately 320 feet between the Rose Garden and the apartment building located on NE 1st Avenue. This is a significant width, but it is close to the I-84 interchange and may limit revisions that can be accomplished.

The structures carrying Weidler, Broadway and Williams surface streets over I-5 create operational constraints today for I-5 (Section C-C). The horizontal clearance between shoulder barrier and median barrier is approximately 37 feet in the northbound direction and 35 feet in the southbound direction. ODOT has investigated the possibility of providing a third lane in both directions through this area, but that would require eliminating shoulders on the outside of the roadways as well as the median. That situation has not been considered acceptable in the past evaluations.

The vertical clearances of these three structures also place limitations on the movement of over-height freight shipments. In the northbound direction, loads are limited to 15' 8" in the right lane and 16' 3" in the left lane. The actual vertical clearances are 4" more than these restrictions (16' 0" and 16' 7"). Similarly, in the southbound direction, the load limitations are 16' 5" in the right lane and 16' 3" in the left lane (actual clearances of 16' 9" and 16' 7"). All of these locations fall short of the vertical clearance standard for Interstate Highways of 17' 6".


I-5: I-84 to I-405
DESIGN WORKSHOP
Exhibit 2:
EXISTING CONDITION
OCTOBER 22, 2007
I-5
BROADWAY
N. DIXON
N. WHEELER
N. MANNING WAY
SCHOOL
N. FLINT
N. VANCOUVER
N. WILLIAMS
N.E. HOLLADAY ST.
N.E. MULTNOMAH ST.
N.E. WEIDLER
N.E. BROADWAY
CROSS SECTION C-C: WEIDLER ST.
8'
22'
5'
7.5'
22'
8'
SB MAINLINE
NB MAINLINE
NE WIEDLER ST. CROSSING
CROSS SECTION A-A: SCHOOL
112'
22'
SCHOOL PARKING LOT
8'
48'
13'
36'
7'
SB MAINLINE
NB MAINLINE
EXISTING CROSS-SECTION
CROSS SECTION B-B: ROSE GARDEN
< ROSE GARDEN
~ 125'
6'
36'
36'
10'
APARTMENT >
~ 90'
SB MAINLINE
NB MAINLINE
S/W
WHEELER AVE.
EXISTING CROSS-SECTION
S/W
1ST. AVE.
0
200
400
600
SCALE IN FEET
N

Surface streets

Several important surface streets cross the project area.

Martin Luther King Blvd. (MLK) and Grand Avenue comprise the main north-south couplet in the vicinity. MLK is the southbound street of this pair. This couplet is located about four blocks east of I-5. This couplet is terminated two blocks north of Broadway and MLK continues as a two-way street all the way to an I-5 connection just south of the Columbia River crossing. The MLK/Grand extends approximately two miles south of Broadway where the one-way couplet is terminated and the route becomes the two-way McLoughlin Blvd.

The secondary north-south couplet is Williams and Vancouver Avenues. Williams is the northbound leg of this couplet. This couplet extends south from Killingworth Street in North Portland and terminates on the south end in the Rose Quarter area in the project study area. At its south end, Vancouver becomes Wheeler Avenue and is a direct connection to the southbound I-5 on-ramp at the Broadway/Weidler Interchange.

The primary east-west couplet is Broadway and Weidler Street. The Broadway Bridge over the Willamette River carries four lanes of two-way traffic. Just west of the interchange with I-5, Broadway splits into the Broadway/Weidler couplet. Weidler is the eastbound street. The couplet extends easterly all the way through the Lloyd District to 24th Avenue where eastbound traffic is routed back to Broadway. Broadway then extends east as a two-way arterial to Sandy Blvd.

The Broadway/Weidler Interchange is a service interchange located between the relatively closely spaced systems interchanges with I-84 and I-405. This interchange is a split diamond. The northbound off-ramp intersects Weidler opposite Victoria Avenue. The northbound on-ramp peels off of Williams Avenue just north of Broadway. The southbound off-ramp intersects Broadway at the Vancouver Avenue intersection. This intersection is complicated by two separate southbound movements entering the intersection on separate signal phases. As explained above, the southbound on-ramp is actually an extension of Vancouver and Wheeler Avenues. The six intersections on Broadway and Weidler with Victoria, Williams, and Vancouver create what has been coined as the “box” of the Broadway/Weidler Interchange.

A “ring road” concept was developed by the City of Portland several years ago. Within the study area, elements of this ring road are Lloyd Blvd. and Interstate Avenue. Lloyd Blvd. extends more or less east-west just north of I-84 from 16th Avenue to the MLK/Grand couplet and then west and north around the Oregon Convention Center facility. It crosses under I-5 and becomes Interstate Avenue at the Multnomah Blvd. intersection just south of the Rose Garden. Lloyd is two-way for all of this length. Interstate Avenue extends north from this intersection, passing under Broadway, but connected to Broadway via a signalized intersection with Larrabee Avenue. Interstate Avenue extends all the way through North Portland, connecting to I-5 just south of the Columbia River crossing. Interstate Avenue is also two-way for this entire length.

The last of these important surface streets is Multnomah Blvd. On the west end, Multnomah connects to the Steel Bridge. Proceeding eastward, it passes by the Rose Garden and under I-5. It extends on to the east past the MLK/Grand couplet to 16th Avenue and beyond. On this route it passes directly through the center of the Lloyd District. This entire route is two-way.

East of I-5, the adjacent area is served by a very regular grid pattern of local access streets.

Land use

The study area is comprised of the Lloyd District, Eliot Neighborhood, and the Central Eastside.

The Lloyd District includes the Lloyd Center, Rose Quarter, Oregon Convention Center, and a commerce area containing several hotels and high rise office buildings.

The Lloyd Center shopping mall occupies the land between Multnomah and Halsey from 9th to 16th.

The Rose Quarter is located just west of I-5 and south of the Broadway/Weidler Interchange. It includes the Rose Garden, home to the Portland Trailblazers, the Memorial Coliseum, several parking structures, and several other businesses that support the sports/ entertainment function of this property. The Rose Quarter generates very high event traffic volumes. The locaation of the Rose Garden immediately adjacent to I-5 created one of the design constraints for this effort.

The Convention Center is located in the NE quadrant of the I-5/I-84 interchange and along MLK.

The Eliot Neighborhood is a mature residential neighborhood north of Broadway. This neighborhood will not change significantly, but impacts to this neighborhood were considered as revisions to the local street system were evaluated.

The Central Eastside area has historically been an industrial sanctuary. More recently, that focus has begun to change to more intense land use. An early example of that change is the Burnside Bridgehead project. This is an area planned for redevelopment north of the east end of the Burnside Bridge. The construction of the streetcar through this area will support the new character of this area. In conjunction with this new focus on the Central Eastside, some people would like to reclaim the riverfront that is now occupied by I-5 between the Marquam Bridge and the I-84 Interchange. In this study effort, concepts were evaluated against the criteria of not precluding long range revisions to I-5 in this area.

Local access

At seven locations within the study area, local access is provided from or to the freeway system.

Six of these locations are on I-84:

- Eastbound on-ramp from Grand
- Eastbound on-ramp from 16th
- Partial interchanges at 33rd
- Partial interchanges at Sandy Blvd./39th
- Westbound off-ramps at Lloyd Blvd.
- Within the I-5 Interchange connecting to Holladay

The Grand and 16th on-ramps cause traffic queuing on I-84 in the PM peak hour and need to be addressed. The 33rd and Sandy/39th Interchanges did not receive recommendations for revisions in this study. The Lloyd off-ramp performs satisfactorily and there are no recommendations for revisions. The ramp to Holladay that is located within the I-5 Interchange does not meet geometric standards. This ramp carries a very low volume of traffic except for during events at the Convention Center or Rose Quarter.

There are undercrossing structures where I-84 passes under MLK, Grand Avenue, 12th, 21st and 28th; however, these were not addressed by the findings of this study. Previous studies have looked at freeway overcrossing structures at 7th on I-84 and at Clackamas on I-5.

There is only one location on I-5 where local access is provided: the Broadway/Weidler Interchange. This is a full movement split diamond interchange with on-ramps and off-ramps in both directions. All of these ramps cause serious weaving problems on the I-5 mainline at the I-84 and I-405 Interchanges. The crash rate in this section is about 50% higher than average for this type of facility. These weaving issues are one of the main drivers for this study.

Transit

The study area is well served by transit, including bus, light rail, and vintage trolley. Additionally, an extension of the Portland Streetcar is planned for this area.

Numerous TriMet bus lines run on surface streets in the study area (Exhibit 3):

- Vancouver/Williams, #4 and #44
- Broadway/Weidler, #9
- Multnomah, #8, #10, #70, #74 and #7
- MLK/Grand, #6
- Interstate Avenue, #33, #35 and #72

All of these lines service the Rose Quarter Transit Center except #6 and #9. This transit center is located just west of I-5 at the east end of the Steel Bridge just south of the Rose Garden. This transit center also connects these bus lines to three of the light rail lines.

From the transit center, bus lines #4, #8, #10, #33, #35, #44, and #77 all cross the Steel Bridge to downtown Portland.

Line #9 provides a connection to downtown over the Broadway Bridge.

In addition to these local buses, C-TRAN express buses to Vancouver pass through this area on I-5 and into the Rose Quarter Transit Center.

As mentioned, three light rail lines pass through this area. The Blue MAX Line to Gresham and the Red MAX Line to the Airport pass over the Steel Bridge, through the Rose Quarter Transit Center and continue east along Holladay Street. The Yellow MAX Line to the Expo Center connects to the other two light rail lines and the bus lines here and extends north along Interstate Avenue. The stops for the Blue and Red Lines are located under I-5, and the stop for the Yellow Line is located on Interstate Avenue just north of Multnomah.

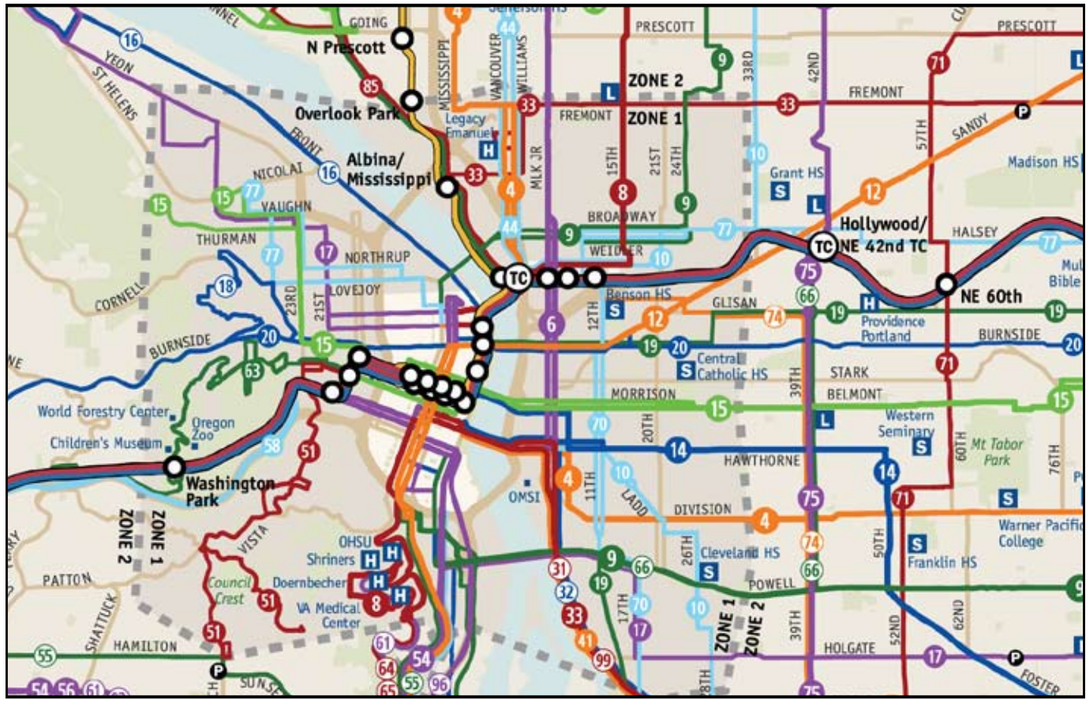
An extension of the Portland Streetcar system is planned for the study area. It is planned to come across the Willamette River on the Broadway Bridge and extend eastward on Broadway and Weidler to Grand and 7th. The southbound leg will return to MLK on Oregon Street and the two legs will extend southerly through the study area on MLK and Grand.

Willamette River

The section of I-5 from the Marquam Bridge to the I-84 Interchange is along the east bank of the Willamette River. The southbound drivers get their first views of the river and downtown Portland where the southbound exit ramp to I-84 leaves the mainline. That view continues across the Marquam Bridge. Views of the river from the transportation system and views of the I-5 freeway from the river were considered as conceptual options were evaluated.

The southbound ramp from I-5 to I-84 has several piers in the water of the Willamette River. Revising these piers or adding additional ones would have significant environmental issues.

Exhibit 3: Trimet bus route map



The Eastbank Esplanade extends along the east bank of the Willamette from the Steel Bridge on the north to south of the Marquam Bridge at Caruthers Street. Most of this length is on the shore, although there is a short segment near the north end that floats on the river surface. This facility is open to pedestrians and bicycles. A walkway has been added to the lower deck of the Steel Bridge and this connects the Esplanade to McCall Waterfront Park on the west side of the river. In addition to the Steel Bridge crossing, the Esplanade also has connections to the Morrison and Hawthorne Bridges.

Railroad

The Union Pacific Railroad mainline runs north-south from the Marquam Bridge to five blocks south of the Burnside Bridge between Water and 2nd Avenues. From that point, the railroad is adjacent to the east side of I-5 into the I-84 Interchange. In the middle of the interchange, this line curves to the west and proceeds across the lower deck of the Steel Bridge to Union Station. This line passes under the I-5 mainline and the southbound ramp from I-5 to I-84.

At the point where the railroad mainline curves to the west, another line branches off to the east and proceeds easterly along the north side of I-84. This line passes under the I-84 undercrossing structures that were mentioned above.

This line to the east connects only to the segment of the mainline that goes across the Steel Bridge. There has been discussion that the railroad would like to connect it to the line that goes south along I-5. That would require another leg to the "Y" that is integrated under the I-5/I-84 Interchange.

Another existing line goes north from the Steel Bridge between Interstate Avenue and east bank of the river, but that line had no bearing on this study.

Regional context

As previously mentioned, the study area has regional importance.

Starting with the road system, the study area includes three Interstate routes. I-405 is an important regional facility that functions as a loop around downtown Portland and connects US 30 and US 26 to I-5 and I-84. I-5 and I-84 are obviously regional and national in importance as they connect the outer areas of the region to the central city as well as connecting this region to the rest of the country.

Off the Interstate System, Broadway and the Broadway Bridge are one of the major routes connecting the eastside of Portland to downtown and the westside. MLK/Grand is one of the major north-south arteries connecting all of the areas between Vancouver on the north and Oregon City on the south.

As outlined above, this area is an important transit connection point for buses and light rail serving the whole region.

Age of infrastructure

I-5 was constructed during the first half of the 1960s. This includes the roadway and the structures, so these elements are now more than forty years old. There has not been major reconstruction of any of these elements.

The Fremont Bridge and the I-405 (Fremont) Interchange were constructed about ten years later in the first half of the 1970s.

I-84 was constructed several years before I-5 in the late 1950s. The MLK and Grand structures over I-84 significantly pre-date I-84 having been built in 1908. Their original function was to carry these streets over Sullivan's Gulch (what is now I-84 and UPRR).

I-84 was reconstructed in the first half of the 1980s decade as part of the Blue Line MAX light rail construction.

None of the bridges in this study area have received significant seismic retrofitting.

Study area land uses

Many of the land uses in the study area serve more than the regional population, including the Willamette Valley, State of Oregon and in some cases, the Pacific Northwest. These examples are:

- Oregon Convention Center
- Rose Quarter
- Lloyd Center
- Doubletree, Red Lion, Marriott, other hotels
- State of Oregon office building
- Bonneville Power Administration headquarters
- Lloyd Tower, 700 Multnomah Building, 500 Multnomah Building, Liberty Mutual building

Significant investment in maintenance or reconstruction will be needed just to maintain the existing section during the next 20 years.

Related Previous Studies

The Greeley Ramp-North Banfield Section Study (1987) provided the "full design" version of eliminating the weaves between I-84 and the Broadway/Weidler Interchange. While this might have been a good design for traffic operation, it did not garner support from the City of Portland. The construction of the Rose Garden has made much of the original southbound design infeasible now. The project team used the reasons why this design was unacceptable in guiding this latest design effort. Beyond that, this report was not used.

Elements of southbound and northbound braiding found in the Blazer Arena Study (1991) were used in some concepts developed by this study. The 1991 study had assumed the Interstate light rail line would been placed between the Rose Garden and I-5, which is not the case. Today, we know the line has been built on Interstate Avenue.

One finding of the Freeway Loop Study (2005) played a significant part in this study. Among other things, the Loop Study includes the possibility of significantly revising I-5 between the Marquam Bridge and the I-84 Interchange. For these reasons and others that will be explained later, this study concentrated on the Broadway/Weidler Interchange for improving the most significant issues in this segment. Using this approach maximizes the chance that anything recommended by this study will not preclude major revisions in the long term.

This entire study effort was completed in approximately two months. Again, the purpose was to determine if there might be one or more concepts to address the recognized transportation problems in the study area that could be feasible and acceptable by the agencies involved. Selecting a preferred alternative was not part of the project purpose.

The effort began with a series of agency stakeholder interviews. The purpose of those interviews was to gain general guidance about expected outcomes and to understand all elements of the current problem and limitations on solutions. Interviews were held with representatives of ODOT, PDOT, Portland Planning Bureau, Portland Development Commission, and Port of Portland. At ODOT, PDOT, and Portland Planning Bureau, these interviews included management and technical staff.

The project team felt that the design session would be most valuable if a planning document was prepared that laid out all of the parameters needed to guide conceptual planning. The Planning Framework was developed in a day-long session on June 5, 2007.

The Problem Definition Summary was developed during the Planning Framework session. The Framework Elements and the Evaluation Elements were also developed in that session.

On the first morning of the design session, the entire design team and several agency staff toured the project area to gain knowledge of the transportation system and the best possible feel for the surrounding area before starting work on design brainstorming.

Problem Definition Summary

ODOT, Portland Department of Transportation (PDOT), Portland Bureau of Planning, FHWA, and the consultant team attended a planning workshop June 5, 2007, prior to the design element of this project.

In addition to developing a Planning Framework to guide concept development, this workshop also produced a Problem Definition Summary. The elements of that Summary include the following:

- There is not sufficient mainline capacity to meet travel demand. Hours of delay are increasing and impinging on the non-peak hours that serve freight needs. The drop from three to two lanes in the southbound direction adds to the problem. The design is substandard to handle existing and projected volumes.
- The proximity of on and off movements creates too-short weaving distances.
- The number of rear-end crashes are high in both northbound and southbound directions.
- Eastbound I-84 traffic backs up onto I-5.
- Land use changes are increasing the demand for access to the area. The area is developing as an entertainment/ convention hub. The Central Eastside area is converting from industrial to mixed use. Streetcar may be introduced to the area. The River Renaissance initiative is increasing demand for river access.
- Ramps off of I-5 lead to narrow cross streets with little excess capacity.
- There is a speed differential with higher speeds on the mainline as compared to the ramps, and speed differentials among lanes on the mainline in some locations.
- The freight community has publicly stated that the congestion in this section is one of their highest priorities for improvement. Through the Columbia River Crossing project, the project team knows the freight community does not want separate facilities, but rather desires highways with sufficient capacity, good reliability (low frequency of incidents), and good geometrics for turning, stopping, and other movements.

Activities Preceding Design Session

Framework Elements

The group agreed on the following guidance for the design effort:

- Study area termini:
  - North: north of I-405 interchange
  - South: northbound exit from I-5 to I-84 at east end of Marquam Bridge
  - East: 33rd Avenue (first interchange on I-84 with multiple ramps)
  - West: riverbank
- Focus for improvements: Morrison Bridge to Greeley Ramps
- Use 2030 traffic model developed for Columbia River Crossing Project
- Maintain existing I-5 capacity
- Willing to accept two hours of Level F congestion
- Willing to consider time-of-day use of full width shoulders for traffic
- Minimum mainline design speed: 60 MPH
- Minimum system interchange ramp design speed: 40 MPH
- Minimum lane widths: 11 feet with 2-foot shy distance
- Minimum shoulder widths of 2 feet acceptable for short distances (provide incident management pull-outs to compensate)
- High priority sites to minimize impacts
  - Rose Garden
  - Convention Center
  - Historic District along Russell
  - Harriet Tubman School and adjacent park
  - East Bank Esplanade
  - New convention center headquarters hotel site across MKL Blvd from convention center
  - Burnside bridge head development area
  - "Big Pipe" access points
- Sites to avoid if possible
  - Old Ramada Inn near Rose Garden (potential redevelopment site)
  - Kalberer site at Steel Bridge head (potential redevelopment site)
  - Parcel across Holladay from the Convention Center, bordered by Multnomah Blvd. on the north, light rail line on the south, MLK on the east, and 2nd Avenue on the west (redevelopment site)
  - Parcel across Holladay from the Convention Center, bordered by Multnomah Blvd. on the north, light rail line on the south, 2nd Avenue on the east and 1st Avenue on the west (redevelopment site)
  - City of Portland road maintenance shops under the East Fremont Interchange
- Maintain bike/pedestrian access in east-west direction across the Broadway and Weidler structures
- Provide bike/pedestrian access to the Steel Bridge
- Consider moving light rail stations and lines
- Coordinate mainline and ramp revisions with the existing UPRR mainline as well as a possible direct railroad connection from the mainline northbound to the Sullivan's Gulch eastbound line

Evaluation Elements

The group agreed on the elements to be evaluated by this study. The project team will provide qualitative evaluations on these elements for each of the scenarios:

- Improve safety
  - Improve conditions at high crash locations
  - Eliminate weaving sections
  - Eliminate a significant number of weaving vehicles
  - Eliminate lane drops
  - Provide a consistent six-lane section
  - Eliminate substandard conditions
- Reduce system delay
  - All traffic
  - Freight traffic
  - Commuter traffic
- Enable long term interchange and freeway solutions (potential for implementation of Loop Study findings and possibility for lower profile)
- Retain parcels for future development (maximize opportunities)
- Contain capital cost
- Minimize project development time (consider timeline for NEPA process)
- Maintain mobility during construction
- Provide access
  - Freight movements
  - Special events
  - To central city
  - Within the "box" (Broadway/Weidler)
- Enhance aesthetics and livability
  - Footprint of freeway
  - Barrier effect ("box" to I-84, access, visual)
- Ensure "permitability"
- Provide opportunities for stormwater retention

Scenario Approach

The Planning Framework workshop attendees also agreed that the project team should develop two general scenarios that would address the identified problems and would be intended to serve a 20-year life. Sub-options are to be developed for each scenario as described below. Each scenario and sub-option will be evaluated qualitatively against the criteria listed above.

Scenarios to be developed:

- Maximize throughput, maintain function hierarchy and limit access with no increase in number of lanes on I-5
- Increase I-5 capacity and maintain local access (three lanes each direction on I-5)

For both scenarios, consider sub-options:

- Freight mobility enhancement
- Transportation System Management/Operations (TSMO) enhancement
- Community enhancement/aesthetic enhancement

As indicated above, the project team will consider these scenarios in relation to the feasibility of a lower profile solution for a longer term revision to I-5.

The planning framework meeting and technical background on the project provided the project team with focus areas and the nature of solutions most likely to be deemed acceptable to all stakeholders. The following considerations were the focus of the study team:

- Previous studies (loop study) have identified the potential for relocation of I-5 (horizontally, vertically or both), with particular interest in that portion of I-5 from I-84 south through the Morrison Bridge. Proposals for such relocation are understood by all to be very expensive with no identified funding sources, have long project delivery times, are complex in terms of environmental and public processes, and hence by their nature, are uncertain in terms of their feasibility. However, as they remain real options for the long-term future of I-5, there is recognized risk in looking at reconstruction or reconfiguration of I-5 in its current location. This risk is primarily associated with any significant infrastructure investment that would be incompatible with relocation of I-5 (that is, may be viewed as a 'throw-away').

- The portion of I-5 from I-84 through I-405 is recognized as a major bottleneck and a source of recurring congestion that is growing over time. Moreover, as improvements to I-5 proceed north of this area, it is understood that I-5 between the two system interchanges represents the next potential major system constraint.

- Roadway and bridge infrastructure at the I-405 and I-84 interchanges and in the section between I-84 and Morrison Bridge present significant physical constraints to additional capacity.

- Direct service interchange access to the Convention Center and Rose Quarter area off I-5 is considered essential given the nature of the land uses.

- Development of land adjacent to the Convention Center and Rose Quarter has been stymied by uncertainty. There are some planned developments or developable property near the freeway, but the lack of certainty regarding a path forward inhibits decisions and investments.

- There is strong interest by both ODOT and the City of Portland to address existing congestion and safety problems along I-5, in the context of an affordable plan that recognizes the uncertainty of the future of I-5.

For the above reasons, the study team focused its attention on I-5 between I-84 and I-405. While mindful of many operational problems along I-5 south of I-84, it was decided to defer consideration of additional improvements there, given the complexity and cost of any meaningful projects.

System Considerations Driving Design Solutions

The 1.2 mile segment of I-5 between I-84 and I-405 is similar to other system bottlenecks in U.S. cities. Multiple freeway system movements overlap, resulting in significant weaving and lane changing. Superimposed in this segment is a major service interchange, referred to as the Broadway/Weidler "box" Interchange.

The combination of service interchanging and system interchanging activities within a confined, 1.2-mile segment produces much of the traffic operational, congestion, and safety problems observed here. Weaving traffic movements (that is, the crossing of conflicting entering and exiting movements along a freeway sharing the same section) are well recognized by transportation professionals as the greatest hindrance to achieving optimal flow under high volume conditions. Solutions to weaving generally involve either elimination of the conflicting movements or spreading these movements over either longer or wider freeway segments.

Hierarchy of Solutions

Exhibit 4: Operational Concept Closely Spaced Interchanges

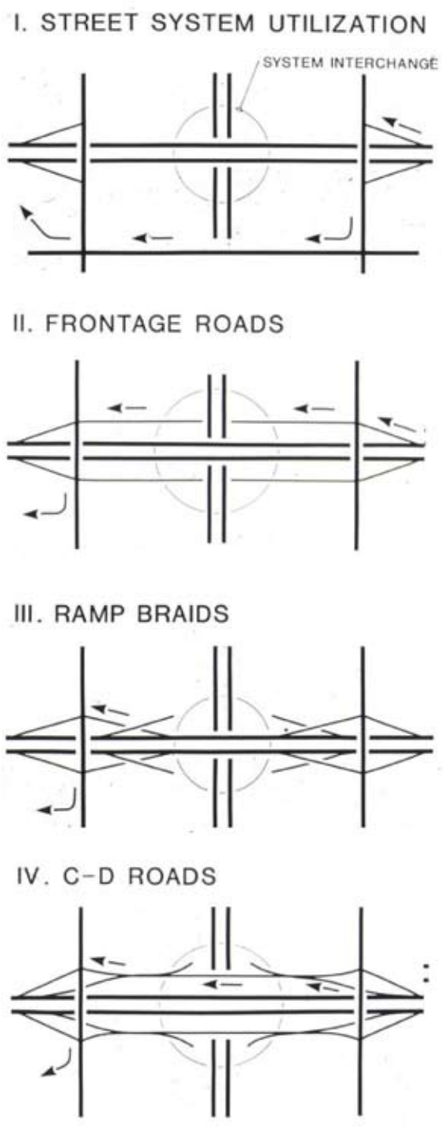
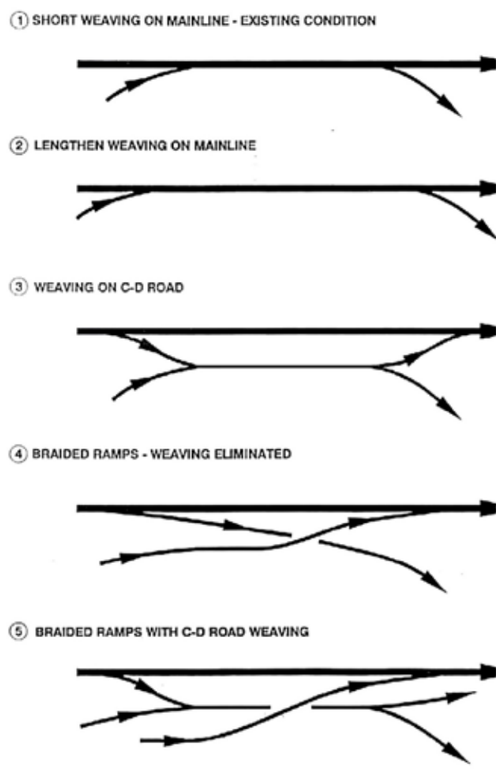


Exhibit 5: Freeway Weaving Improvement



Classic Solutions

Classic solutions to the problem are diagrammed in Exhibit 4. Ideally, where closely spaced system interchanges create weaving movements, no service interchanging would be provided. Rather, service interchanging would be placed on external approaches to the overlap section, with reliance on the street system to access land uses within the area of the overlap section. This solution eliminates the weaving.

This classic approach is not applicable along I-5 given that service interchanging already exists, and the area adjacent to the overlap section contains high visibility and traffic generating land uses (Convention Center, Rose Quarter, etc.) that rely on that access.

Solutions to freeway weaving problems that are practically feasible in this context are illustrated in Exhibit 5. The solutions in Exhibit 5 are arrayed generally by their operational effectiveness and difficulty or cost to implement. One can lengthen the weaving section (providing greater distance and time for drivers to execute the weave), widen the weaving section by adding one or more lanes (spreading out traffic more and creating gaps for weaving maneuvers), or a combination of both. Collector-distributor roads are used to separate weaving traffic from non-weaving higher speed traffic. Finally, ramp braids physically separate weaving maneuvers, with one roadway placed over the other. This latter solution is the most operationally effective approach, as it completely eliminates weaving movements.

Application of Concepts to I-5

Previous efforts (Greeley Ramp-North Banfield Section Study, 1987) to address the traffic operational problems relied significantly on the use of ramp braids, as shown on Exhibit 6. While the traffic benefits of these solutions were clearly demonstrated, concerns over their cost, footprint, and visual impacts prevented their implementation.

For this effort, the study team was mindful of the history of I-5 studies. While the project team did not reject the use of ramp braids, solutions incorporating the full range of strategies outlined above were examined.

The focus of the study team therefore turned to design concepts for improving the freeway and reconfiguring the Broadway/Weidler "box" to positively address weaving traffic.

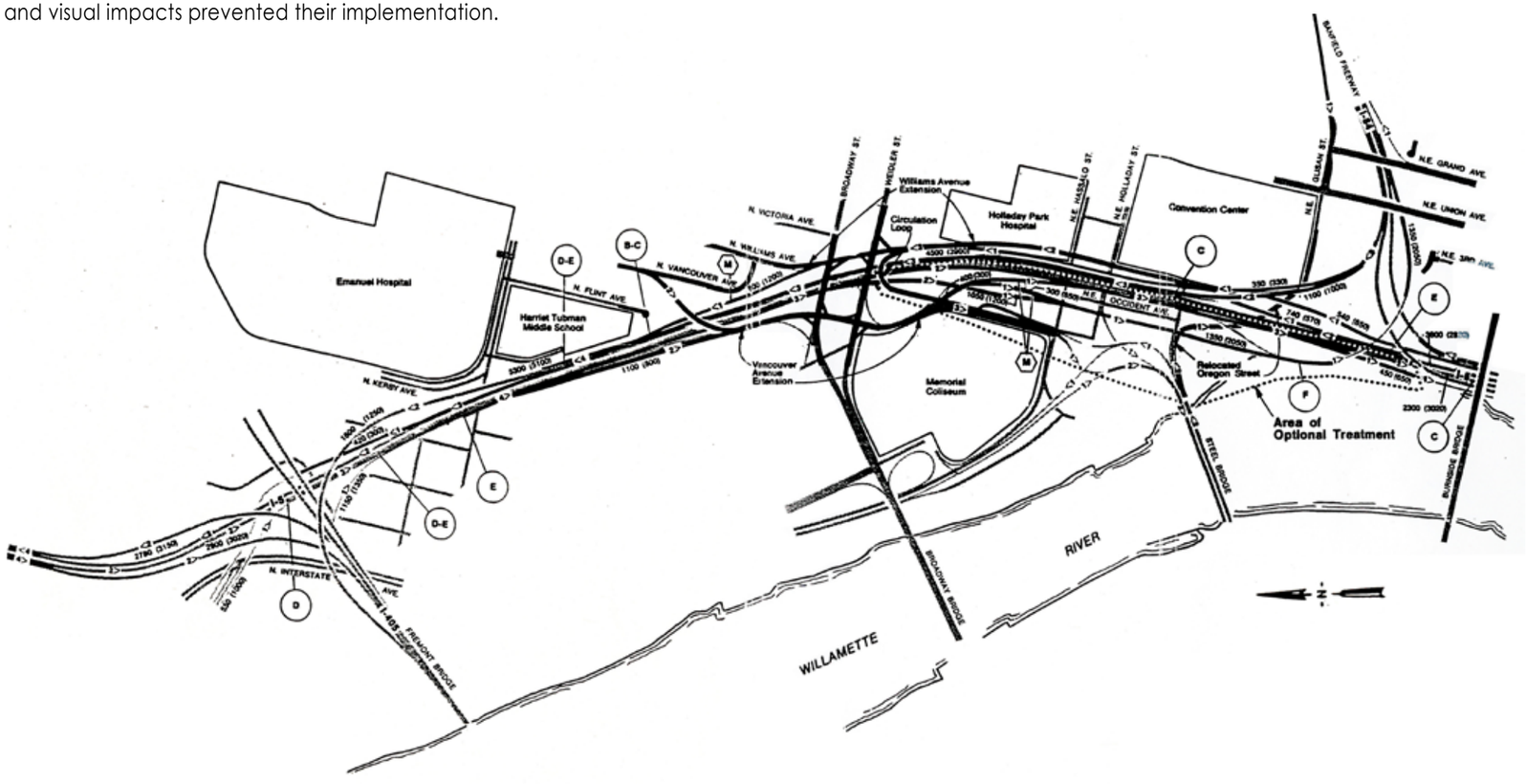
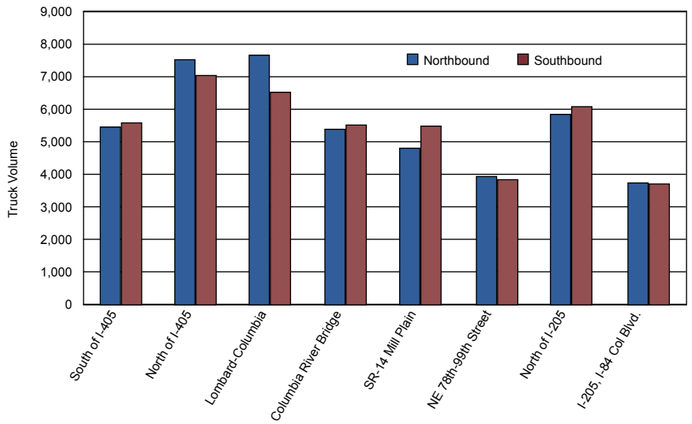


Exhibit 6: Build Alternative Option 2

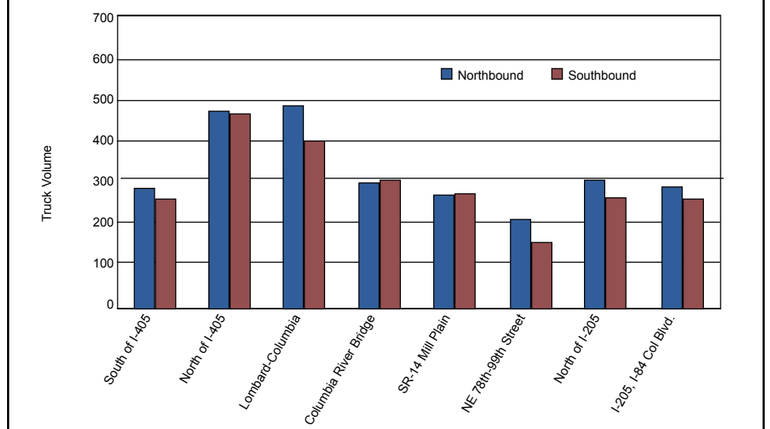
Greeley Ramp - North Banfield Section
Pacific Highway (1-5), November 1987

Exhibit 7: Medium and heavy truck volume by location, daily trips



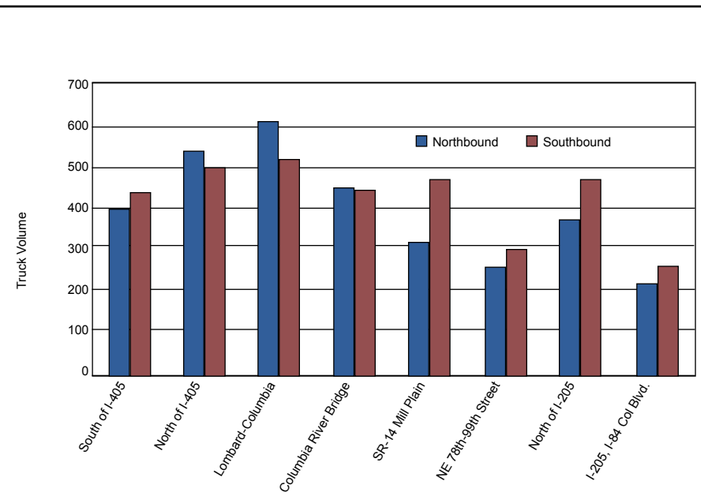
Source: Columbia River Crossing Project, October 2005 Traffic Data, October 2004 on I-205

Exhibit 8: Medium and heavy truck volume by location, 8:00 to 9:00 a.m.



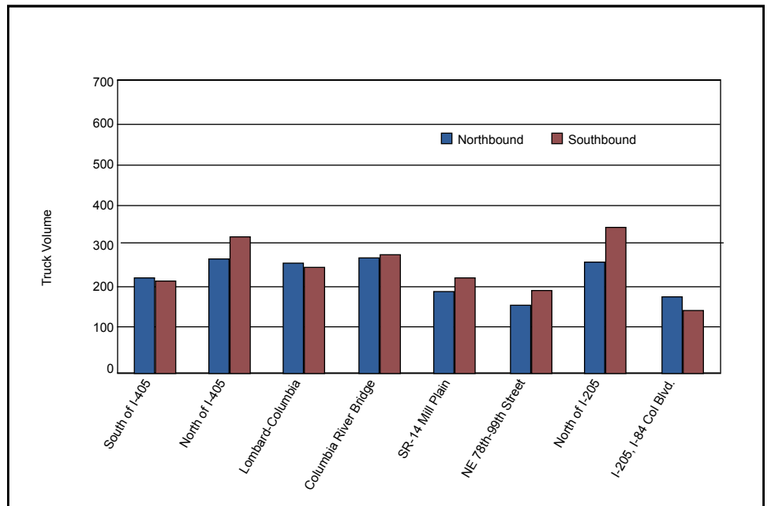
Source: Columbia River Crossing Project, October 2005 Traffic Data, October 2004 on I-205

Exhibit 9: Medium and heavy truck volume by location, 12:00 to 1:00 p.m.



Source: Columbia River Crossing Project, October 2005 Traffic Data, October 2004 on I-205

Exhibit 10: Medium and heavy truck volume by location, 4:00 to 5:00 p.m.



Source: Columbia River Crossing Project, October 2005 Traffic Data, October 2004 on I-205

Freight movement though this corridor has been raised as a major concern. Exhibits 7 to 10 illustrate the truck volumes on this segment and much of the overall I-5 Portland corridor. The heaviest truck movements are between 12:00 and 1:00 pm. The freight community has made it clear that the best solution for freight movement is an overall efficient and reliable roadway network, so what works well for cars also works well for freight.

Traffic Operations Analysis – Weaving Sections

There are four weaving sections, two northbound and two southbound, along I-5 between the I-84 Interchange and the Broadway/Weidler Interchange and between Broadway/Weidler and the I-405 Interchange. The operational analysis focused on determining the "capacity" of each of the existing four weaving sections and then comparing those to the capacities for the concept designs during the workshop.

Recent traffic counts and the calibrated Columbia River Crossing VISSIM model for I-5 were used in determining the existing weaving section capacities. It was concluded that capacity for the weaving sections was reached when operating speeds were in the 35 to 45 MPH range and operating densities were approximately 45 vehicles per mile per lane. The volume in the four existing weaving sections of three lanes each was 5,200 to 5,300 vehicles per hour.

Information from interviews with key stakeholders and input from the planning framework meeting provided input to the project team (Exhibits 11 to 13) on attributes of a successful solution as viewed by the full range of stakeholders. Any investment in the I-5 corridor should:

- Result in measurable, significant improvement in traffic operations along I-5 (reduced delay, increased average speed, improved level of service) over a reasonable time period (ten years or more)
- Improve the reliability of traffic flow
- Reduce crashes
- Be affordable, including the ability to construct usable portions over multiple phases
- Not preclude advancement of long term visions for I-5 that may result in its re-alignment or relocation
- Create and/or support opportunities for desired land development adjacent to the corridor
- Enhance and facilitate pedestrian and bicycle networks and movements
- Accommodate or enhance transit movements
- Respect existing land uses (minimize new right-of-way required for interchange or highway improvements)
- Respect key cultural and historic sites near the corridor
- Be constructable, enabling reasonable maintenance of traffic flow and access during reconstruction

Exhibit 13: Team Session

Exhibit 11: Team Session

Exhibit 12: Planning Board

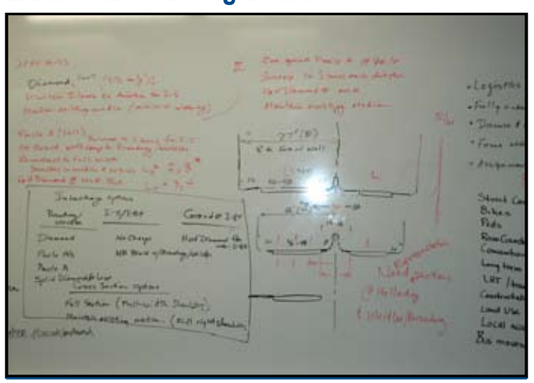


Exhibit 14: Existing and Scenario 1 Configuration

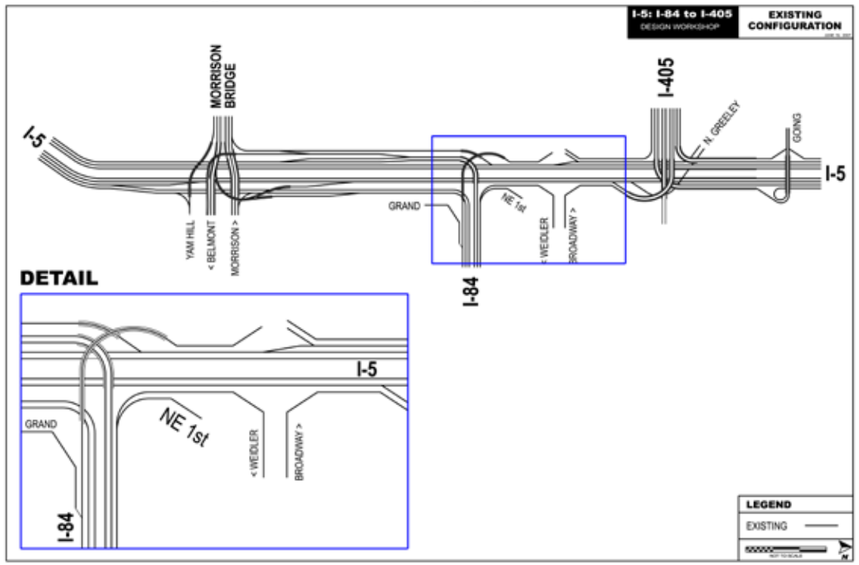
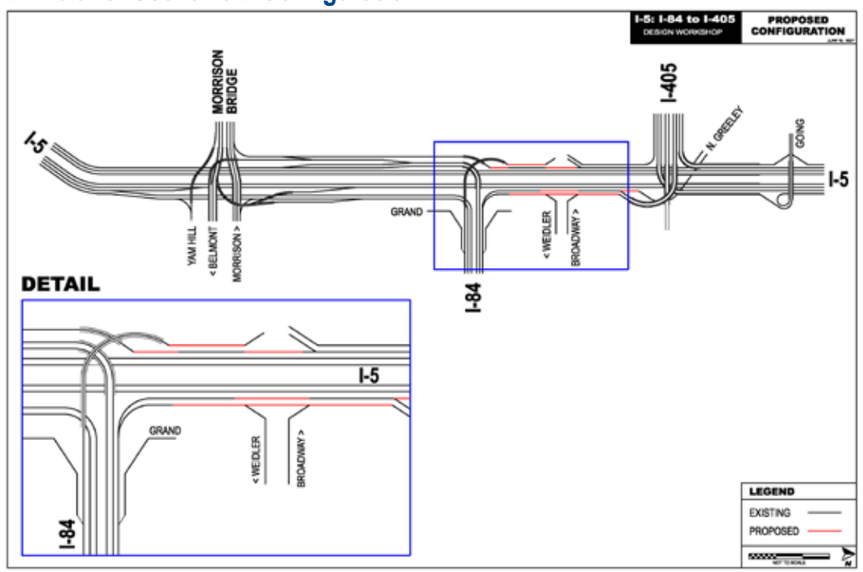


Exhibit 15: Scenario 2 Configuration



Lane Arrangements

The difference between the two design scenarios is in the provision for and arrangement of auxiliary lanes along I-5 between I-84 and I-405. In both scenarios, the existing four basic lane capacity (two each direction of travel) is maintained. Neither scenario involves expansion to six basic lanes, primarily because of the significant expense in doing so, since it would be associated with reconstruction of system interchange geometry both north and south of the area of study, and lack of certainty regarding the long range future of I-5.

The engineering drawings that follow this discussion were developed with Scenario 2 (three through lanes on I-5); however, they are also compatible with Scenario 1 (two through lanes on I-5). Traffic operational analysis was performed to understand how these concepts would perform with Scenario 1.

Auxiliary lanes are typically used to facilitate entering, exiting, and weaving traffic and to minimize unnecessary lane changes over shorter lengths of a freeway. Auxiliary lanes are particularly effective where entering and exiting volumes are high and where operation at or near capacity is expected. In Scenario 2, interchange reconfiguration would be accompanied by the addition of an auxiliary lane between I-405 and I-84. Existing (and Scenario 1) and Scenario 2 mainline lane arrangements are illustrated in Exhibits 14 and 15.

The study was structured to demonstrate the full range of impacts and implications of various courses of action. Different basic design scenarios were discussed and presented to illustrate the range of potential solutions addressing the problems and constraints noted above. The design scenarios coming from the planning workshop reflect different approaches to freeway capacity and access:

Scenario 1 – Improve Traffic Operations without increasing freeway lanes

Scenario 2 – Improve Traffic Operations incorporating auxiliary lanes between interchanges

Given the above considerations, both scenarios focused on reconfiguration of the Broadway/Weidler "box" Interchange to improve traffic flow along I-5.

In developing each scenario, the same basic design philosophy and approach was used. Every effort was made to minimize the horizontal and cross sectional footprint of freeway and interchange plans. Retaining walls are assumed in all cases to avoid a right-of-way taking (recognizing that in project development further studies would be undertaken before committing to walls versus right-of-way acquisition). Grade separated ramp braids were only employed where they could be executed in two levels or where they could take advantage of existing ramp profiles and thus not result in construction of higher roadways.

The development of each scenario recognizes that even under optimal conditions some time period of congestion (demand exceeding capacity) will occur along I-5.

Four interchange concepts were developed for the Broadway/Weidler Interchange in coordination with various ramp to ramp weaving solutions between the Broadway/Weidler Interchange and the adjacent system interchanges of I-5 with I-84 and I-405. Each interchange concept addressed the weaving solution in three basic ways: (1) lengthen the weaving sections, primarily for Broadway/Weidler to I-84) (2) eliminate the weaving with ramp braids; or (3) minimize the weaving with collector-distributor (C-D) roads. Every concept focused on the interchange on the Broadway/Weidler one-way couplet and separated the remaining street system (Flint, Vancouver, and Williams) from the interchanging ramps. This was to improve operations of the interchange ramp interface with the street system and improve street system operations. The Holladay Street exit ramp from the I-84 westbound to I-5 northbound ramp was eliminated in all concepts and replaced with a ramp exiting from westbound I-84 to Lloyd Blvd. to complement the existing eastbound entrance ramp from the MLK/Grand one way couplet.

The discussion and description of concepts will focus on interchange form, the street system, transit, pedestrians, bicycles, and right-of-way impacts.

Consistent with concerns over operational integrity for Interstate Highways, the design of new interchange entrance ramps accommodates the potential for ramp metering. This primarily involves development of longer ramp lengths to enable storing of vehicles at the meter.

Finally, budget limitations preclude the full development and discussion of all possibilities involving interchanging, street system improvements, and alternative transportation modal impacts. The portrayal of a street system concept with an interchange configuration does not imply that this is the only possible solution. Readers of this report can note where "mixing and matching" of a street system feature from one concept plan may be applicable to another plan.

CONCEPT 1 – Diamond Interchange (Exhibits 16 and 17)

Concept 1 is a diamond interchange similar in configuration to the existing interchange. To increase both northbound and southbound weaving length between Broadway/Weidler and the I-84 Interchange, Broadway is continued east and split into the one-way couplet of Broadway and Weidler east of the interchange. This increases the length of weaving in the northbound direction between I-84 and the Broadway off-ramp by approximately 300 feet. In the southbound direction between Broadway and I-84, the weaving length is increased by approximately 300 feet as well.

This concept also eliminates five-legged intersections involving ramp terminals. Ramp terminal turning lane capacity would be increased. These measures would allow the ramp intersections with Broadway to operate with a more efficient three-phase signal control, thereby limiting cycle length and reducing exit ramp queuing back onto the freeway.

The interchange itself would take little additional right-of-way, and would require removal of two buildings between existing Broadway and Weidler, one east of I-5 and the other west of I-5. The new Vancouver/Williams crossing of I-5 would also take one building.

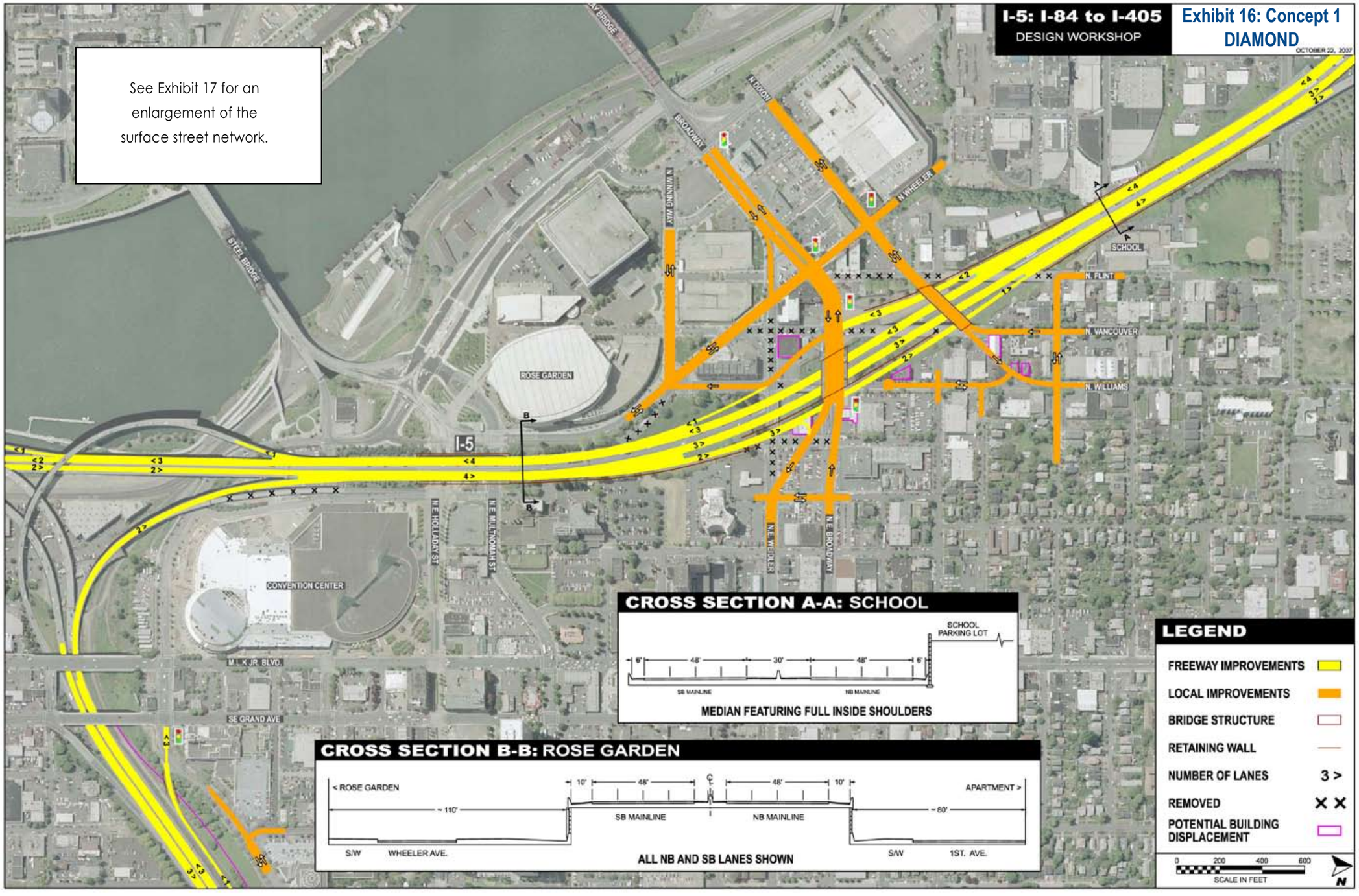
Street System Operations

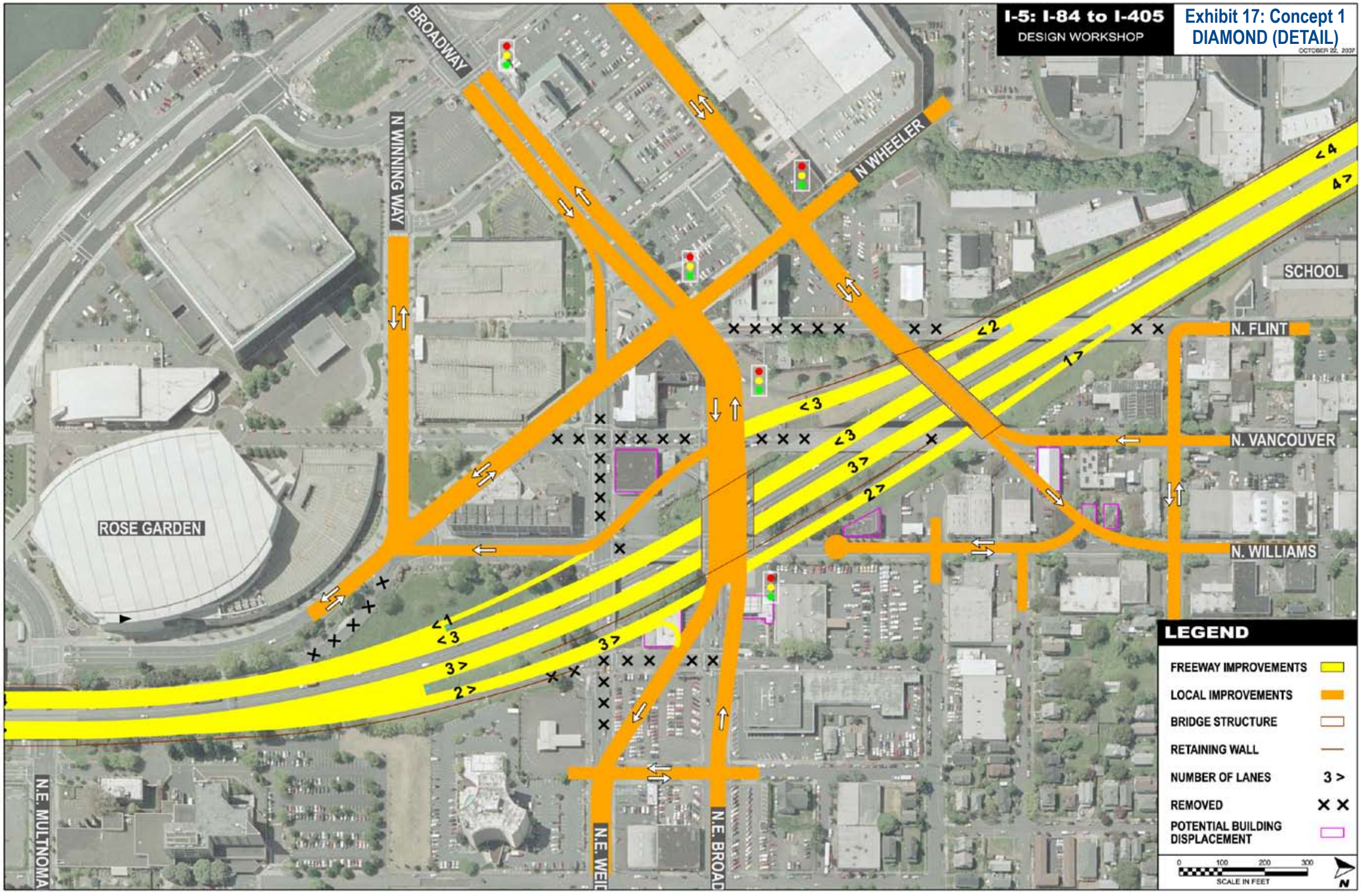
The existing Williams, Vancouver, and Flint overcrossings of I-5 would be eliminated. Replacing these is a single crossing of I-5 North of Broadway combining the one-way couplet of Vancouver and Williams separate from the interchange. This new arterial would intersect with N. Wheeler and N. Dixon. The arterial would continue to and cross Broadway into the Rose Quarter and to Lloyd Blvd. and the LRT station. This new crossing of I-5 provides both East-West as well as North-South access across the Interstate.

Transit/Pedestrians/Bicycle Transportation

The bus routes along Williams and Vancouver accessing the Rose Quarter Transit Center would be routed over I-5 on the new overcrossing that combines the Williams/Vancouver one-way couplet. Bicycles and pedestrians could also utilize this new crossing without crossing the interchange ramps at Broadway. It would also be possible to construct a new pedestrian crossing of I-5 one block south of Broadway into the Rose Quarter.

See Exhibit 17 for an enlargement of the surface street network.




I-5: I-84 to I-405
DESIGN WORKSHOP
Exhibit 17: Concept 1
DIAMOND (DETAIL)
OCTOBER 22, 2007
BROADWAY
N WINNING WAY
N WHEELER
SCHOOL
N. FLINT
N. VANCOUVER
N. WILLIAMS
ROSE GARDEN
N.E. MULTNOMA
N.E. WEI
N.E. BROAD
LEGEND
FREEWAY IMPROVEMENTS
LOCAL IMPROVEMENTS
BRIDGE STRUCTURE
RETAINING WALL
NUMBER OF LANES
REMOVED
POTENTIAL BUILDING DISPLACEMENT
0 100 200 300
SCALE IN FEET
N

CONCEPT 2 – Partial Cloverleaf (Parclo-AB) (Exhibits 18 and 19)

Interchange Concept 2 is a partial cloverleaf (Parclo – AB) with loop ramps in the northeast and northwest quadrants of the interchange. The loop ramps serve the traffic movements to and from the south and the "diamond" ramps serve the traffic movements to and from the north. Braiding of the diamond ramps and loop ramps enables the design to be compact and therefore maximize weaving lengths along I-5. All ramps intersect with Weidler with street connections to Broadway, providing full access between both arterial streets and I-5.

The Parclo AB configuration is often used in similar situations where lengthening of weaving sections is the design objective. In the application, the weaving sections between the Broadway/Weidler Interchange and I-84 would be lengthened significantly. In the southbound direction, the weaving section would be approximately 2,200 feet (1,000 feet longer than existing). In the northbound direction, the weaving section would be lengthened to 1,700 feet (500 feet longer than existing). Between Broadway/Weidler and the I-405 Interchange, the weaving sections remain essentially the same.

This design reflects sensitivity to the context by minimizing the footprint of ramps. Horizontal curvature on the ramp geometry would be less than AASHTO Policy, with the southbound entrance ramp having a minimum radius of 130 feet and the northbound exit ramp having minimum radius of 130' feet. Sufficient length is provided to enable adequate profile development. To mitigate operational concerns over small loop radii, additional width would be provided within the loops and the physical merge and diverge locations are several hundred feet away from the controlling ramp curvature.

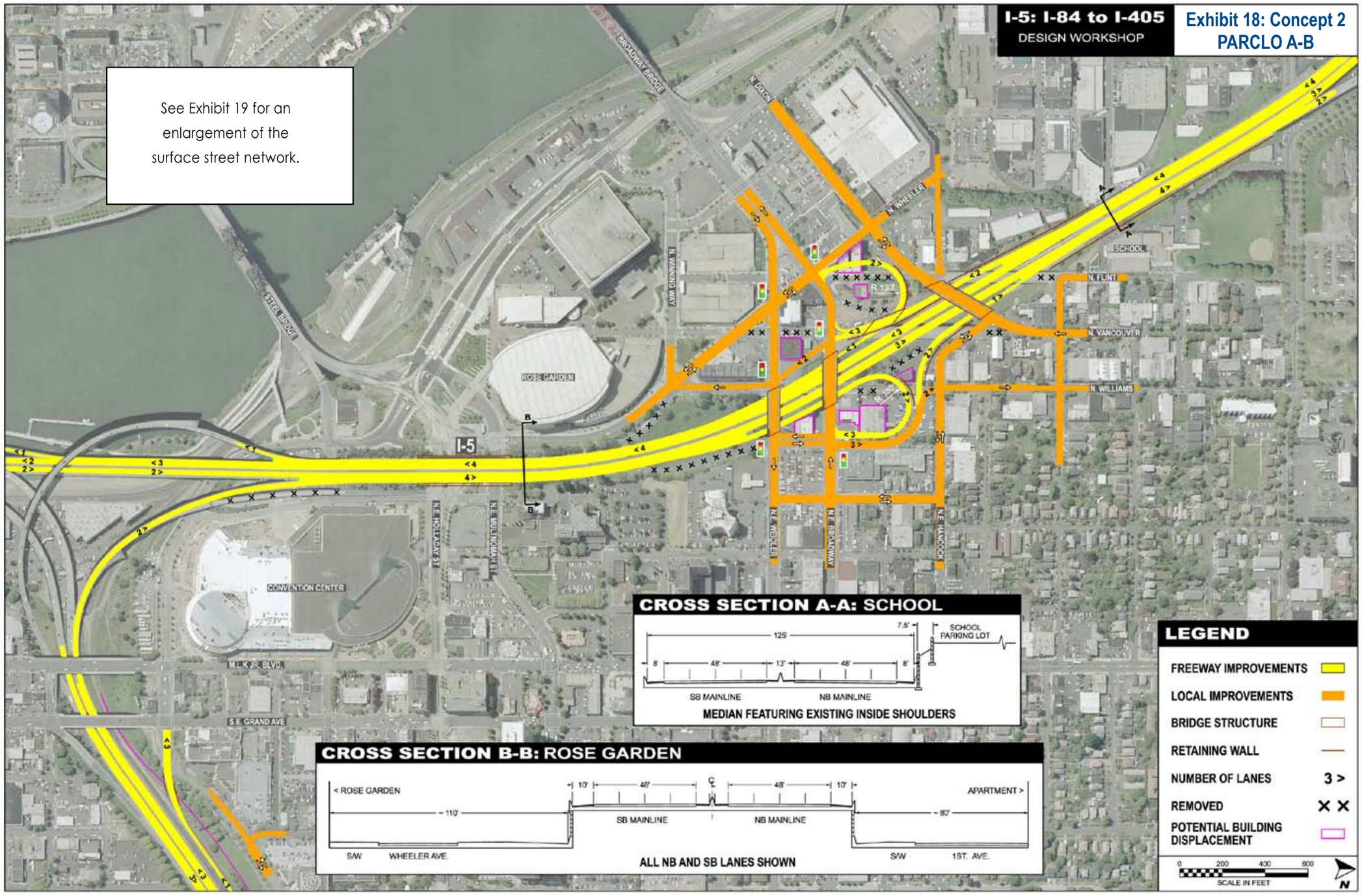
The interchange itself would take additional right-of-way because of the two loop ramps. Five buildings would be taken, including an auto dealership.

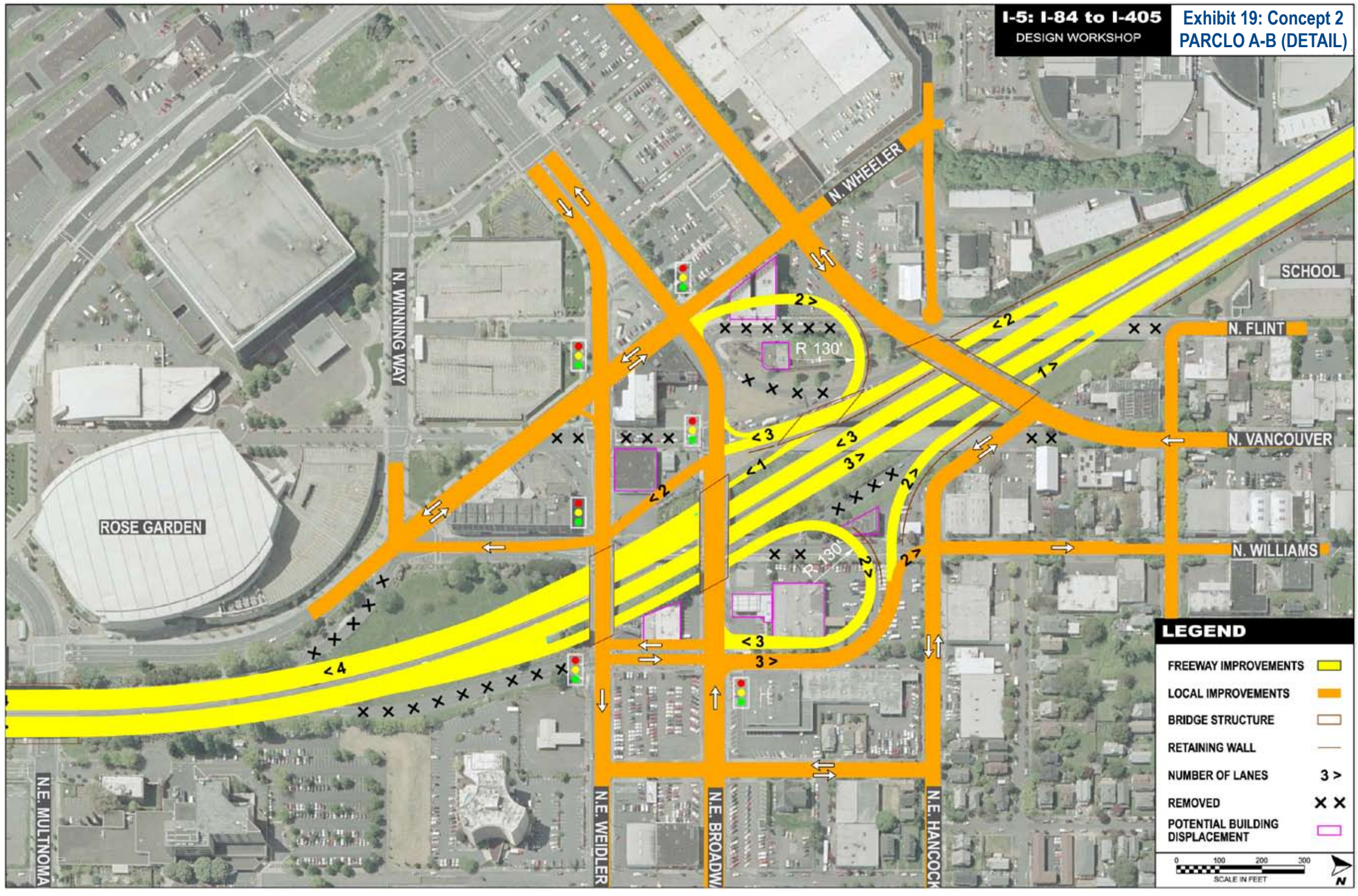
Street System Operations

As in Concept 1, all three existing arterial crossings of I-5 (Williams, Vancouver, and Flint) would be eliminated. Multi-leg intersections with I-5 ramp terminals would be eliminated. A new two-way arterial overcrossing of I-5 north of Broadway/ Weidler could connect Hancock, Vancouver, and Flint to Wheeler, Dixon, and Broadway, and then into the Rose Quarter and the Rose Quarter Transit Center.

Transit/Pedestrians/Bicycle Transportation

The bus routes along Williams and Vancouver accessing the Rose Quarter Transit Center would be routed over I-5 on the new overcrossing that combines the Williams/Vancouver one-way couplet and Hancock. Bicycles and pedestrians could also utilize this new crossing, thereby completely avoiding conflicts with the interchange ramps at Broadway. Also proposed is a new pedestrian crossing of I-5 one block south of Broadway into the Rose Quarter.


I-5: I-84 to I-405
DESIGN WORKSHOP
Exhibit 18: Concept 2
PARCLO A-B
See Exhibit 19 for an enlargement of the surface street network.
BROADWAY BRIDGE
STEEL BRIDGE
N. DIXON
N. WHEELER
N. WINNING WAY
ROSE GARDEN
I-5
N. FLINT
N. VANCOUVER
N. WILLIAMS
SCHOOL
N.E. HOLLADAY ST
N.E. MULTNOMAH ST
N.E. WEIDLER
N.E. BROADWAY
N.E. HANCOCK
CONVENTION CENTER
M.L.K. JR. BLVD.
S.E. GRAND AVE
CROSS SECTION A-A: SCHOOL
125'
7.5'
SCHOOL PARKING LOT
8'
48'
13'
48'
8'
SB MAINLINE
NB MAINLINE
MEDIAN FEATURING EXISTING INSIDE SHOULDERS
CROSS SECTION B-B: ROSE GARDEN
< ROSE GARDEN
~ 110'
10'
48'
48'
10'
APARTMENT >
~ 80'
SB MAINLINE
NB MAINLINE
S/W
WHEELER AVE.
ALL NB AND SB LANES SHOWN
S/W
1ST. AVE.
LEGEND
FREEWAY IMPROVEMENTS
LOCAL IMPROVEMENTS
BRIDGE STRUCTURE
RETAINING WALL
NUMBER OF LANES
REMOVED
POTENTIAL BUILDING DISPLACEMENT
0 200 400 600
SCALE IN FEET
N


I-5: I-84 to I-405
DESIGN WORKSHOP
Exhibit 19: Concept 2
PARCLO A-B (DETAIL)
N. WHEELER
N. WINNING WAY
SCHOOL
N. FLINT
N. VANCOUVER
N. WILLIAMS
ROSE GARDEN
R 130'
N.E. MULTNOMA
N.E. WEIDLER
N.E. BROADW
N.E. HANCOCK
LEGEND
FREEWAY IMPROVEMENTS
LOCAL IMPROVEMENTS
BRIDGE STRUCTURE
RETAINING WALL
NUMBER OF LANES
REMOVED
POTENTIAL BUILDING DISPLACEMENT
0 100 200 300
SCALE IN FEET
N

CONCEPT 3 – Partial Cloverleaf (Parclo-A) (Exhibits 20 and 21)

The third interchange concept is a partial cloverleaf (Parclo – A) with loop ramps in the southeast and northwest quadrants of the interchange. The loop ramp in the southeast quadrant serves the traffic movements from Broadway/Weidler to the north. The loop ramp in the northwest quadrant serves the traffic movements between westbound Broadway and southbound I-5. Both loop ramps are designed with minimum radii less than current AASHTO Policy values to avoid significant right-of-way impacts.

The right-turning ramp in the southwest quadrant of the interchange serves traffic eastbound on Broadway to southbound I-5. The southbound I-5 traffic exiting to Broadway/Weidler would use the southbound exit ramp intersecting with Broadway (two-phase signalized intersection) with a connection to Weidler (also a two-phase signalized intersection).

Southbound between Broadway/Weidler and the I-84 Interchange (the weaving section between the loop ramp and the I-84 exit ramp) is increased by 1,000 feet over existing. Moreover, a majority of the traffic using this loop ramp is destined to I-5 South. The weaving section between the southbound right-turning ramp from Weidler is increased by approximately 200 feet. A majority of this traffic is destined to I-84 and is not weaving traffic.

Between I-84 and Broadway/Weidler, the northbound weaving section remains the same as existing. In the northbound direction between Broadway/Weidler and I-405, the weaving section is increased by approximately 700 feet. Southbound between I-405 and Broadway/Weidler, the weaving section length remains the same.

The interchange would take additional right-of-way because of the two loop ramps. Four buildings would be taken, including the Ramada Inn at the corner of Williams and Weidler.

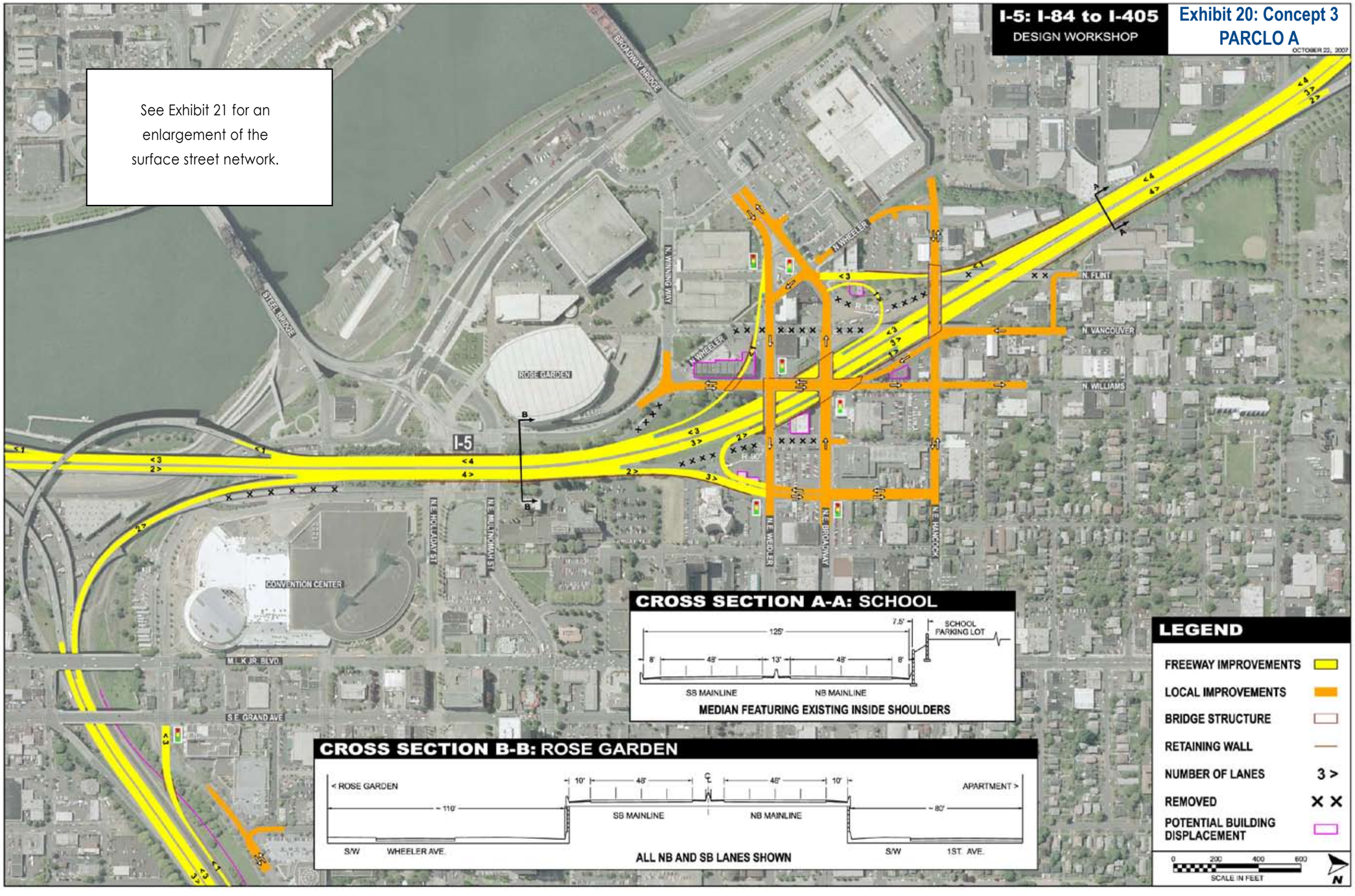
Street System Operations

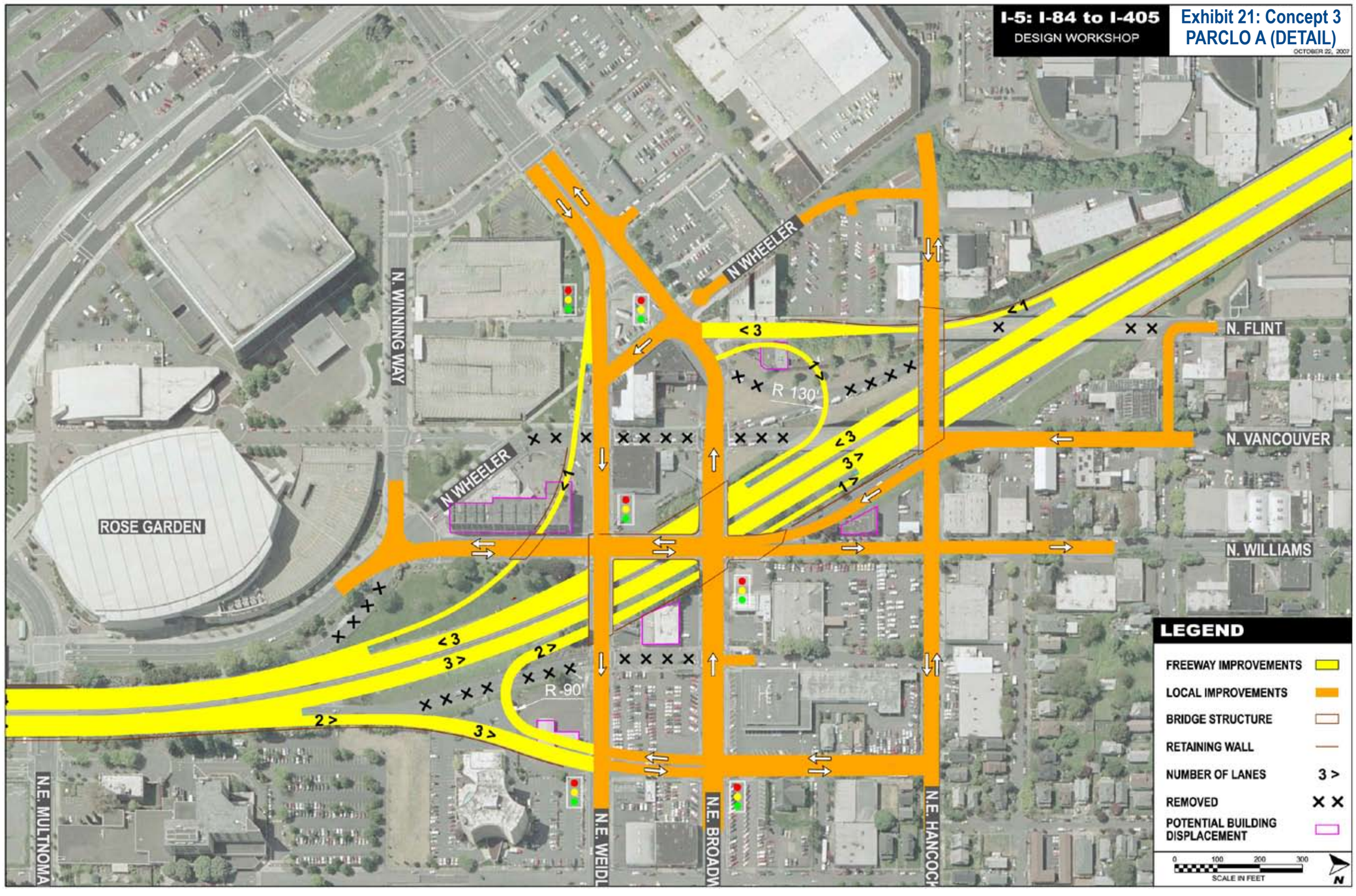
The Flint overcrossing of I-5 would be eliminated in this alternative and replaced with the Hancock overcrossing. The Vancouver and Williams one-way couplet would be joined and would use the existing Williams overcrossing alignment connecting into the Rose Quarter and to the Rose Quarter Transit Center. This would result in a north-south and an east-west crossing of I-5.

Transit/Pedestrians/Bicycles

The bus routes along Williams and Vancouver accessing the Rose Quarter Transit Center would be routed over I-5 on the new overcrossing that is on the existing Williams alignment. Bicycles and pedestrians could also utilize this new crossing without crossing the interchange ramps at Broadway. Pedestrians and bicycles could also use the new Hancock overcrossing of I-5. As with the other alternatives, a new pedestrian crossing of I-5 one block south of Broadway into the Rose Quarter would also provide pedestrian access across I-5 into the Rose Quarter.

See Exhibit 21 for an enlargement of the surface street network.




I-5: I-84 to I-405
DESIGN WORKSHOP
Exhibit 21: Concept 3
PARCLO A (DETAIL)
OCTOBER 22, 2007
N. WINNING WAY
N WHEELER
N. FLINT
N. VANCOUVER
N. WILLIAMS
N.WHEELER
ROSE GARDEN
N.E. MULTNOMA
N.E. WEIDL
N.E. BROADW
N.E. HANCOCK
R 130'
R 90'
< 3
< 1
3 >
2 >
1 >
LEGEND
FREEWAY IMPROVEMENTS
LOCAL IMPROVEMENTS
BRIDGE STRUCTURE
RETAINING WALL
NUMBER OF LANES
REMOVED
POTENTIAL BUILDING DISPLACEMENT
0 100 200 300
SCALE IN FEET
N

Interchange Concept 4 is a split diamond with four ramps accessing Broadway and Weidler and interconnecting roadways between the two arterial streets. This concept results in four efficiently operating intersections, each with two-phase signal control. The four ramps of the split diamond would serve traffic to and from the north on I-5 and to and from the south on I-5.

Additionally, a loop ramp in the northwest quadrant would exclusively serve westbound traffic on Broadway bound to I-84 eastbound. This loop ramp would join the southbound exit ramp from I-5 to I-84, braid with the southbound entrance ramp to I-5, and become a ramp extension only for traffic going eastbound on I-84. This completely eliminates the southbound weaving between Broadway/Weidler and I-84. In the northbound direction from I-84 to Broadway/Weidler, a collector-distributor (C-D) road would be developed to remove the weaving traffic from the mainline of I-5. Between the Broadway/Weidler Interchange and I-405, the weaving sections both northbound and southbound would be similar as existing.

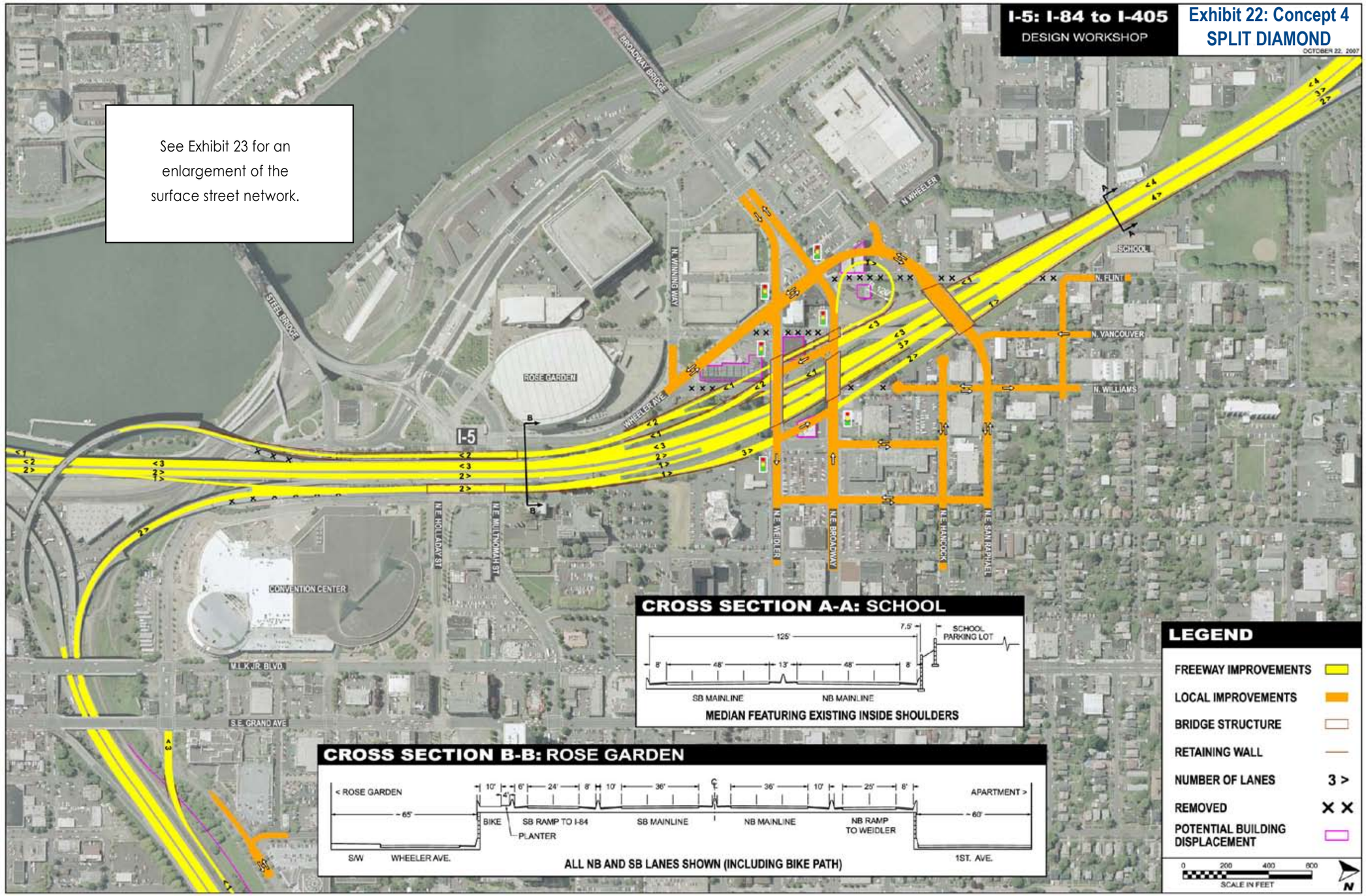
The interchange would take additional right-of-way because of the loop ramp. Five buildings would be taken, including the Ramada Inn at the corner of Williams and Weidler.

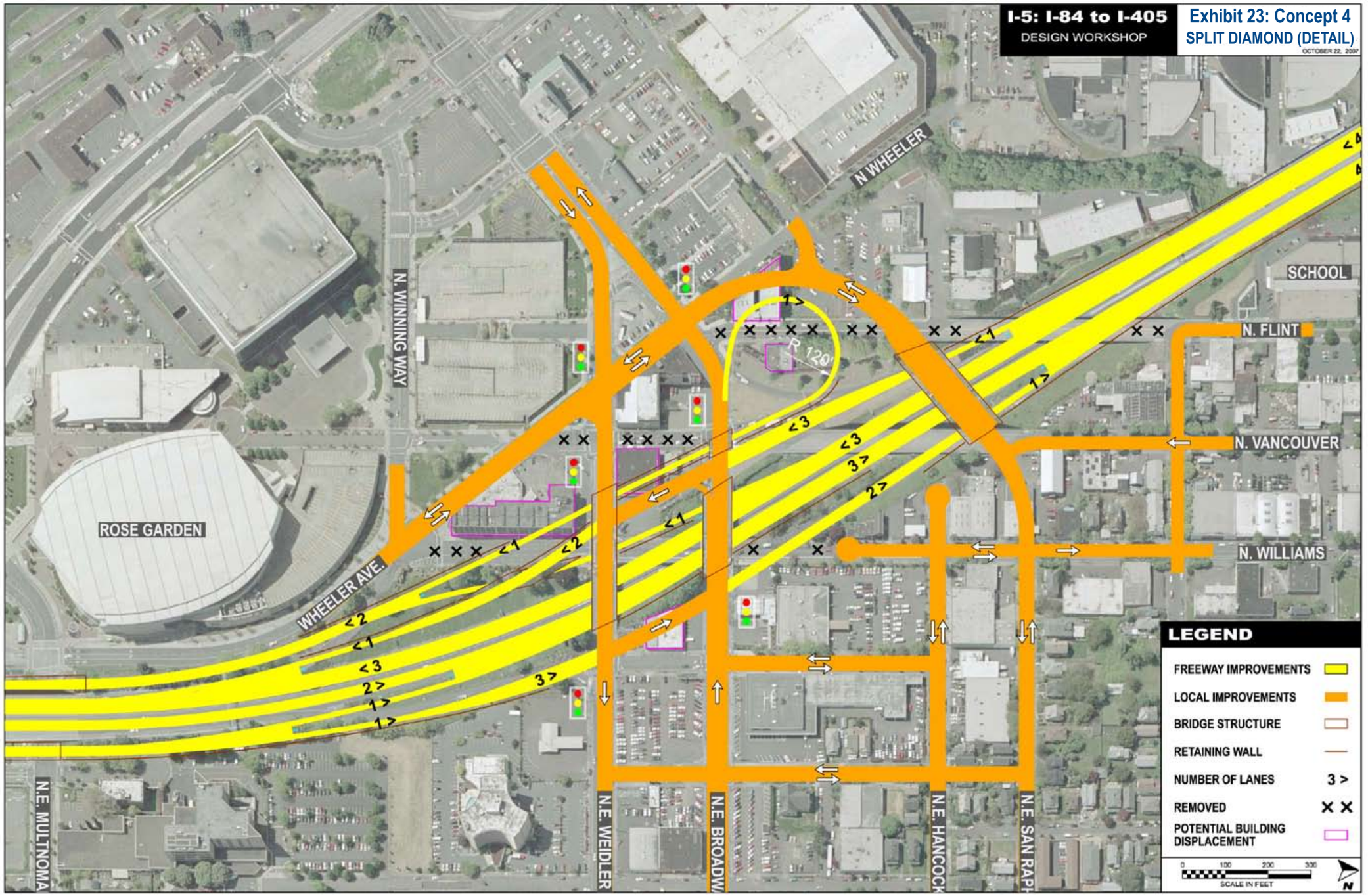
Street System Operations

As with two of the previous alternatives, all three existing arterial crossings of I-5 (Williams, Vancouver, and Flint) would be eliminated. These would be replaced with a two-way arterial overcrossing of I-5 north of Broadway/Weidler that connects Hancock, Vancouver, and Williams to Wheeler, Dixon, and Broadway, and then into the Rose Quarter and the Rose Quarter Transit Center.

Transit/Pedestrians/Bicycle Transportation

The bus routes along Williams and Vancouver accessing the LRT station would be routed over I-5 on the new overcrossing that combines the Williams/Vancouver one-way couplet and Hancock. Bicycles and pedestrians could also utilize this new crossing without crossing the interchange ramps at Broadway. Proposed also is a new pedestrian crossing of I-5 one block South of Broadway into the Rose Quarter.


I-5: I-84 to I-405
DESIGN WORKSHOP
Exhibit 22: Concept 4
SPLIT DIAMOND
OCTOBER 22, 2007
See Exhibit 23 for an enlargement of the surface street network.
BROADWAY BRIDGE
STEEL BRIDGE
N. WINNING WAY
N. WHEELER
SCHOOL
N. FLINT
N. VANCOUVER
N. WILLIAMS
ROSE GARDEN
WHEELER AVE
I-5
N.E. HOLLADAY ST
N.E. MULTNOMAH ST
N.E. MEDDLER
N.E. BROADWAY
N.E. HANCOCK
N.E. SAN RAFAEL
CONVENTION CENTER
M.L.K. JR. BLVD.
S.E. GRAND AVE
CROSS SECTION A-A: SCHOOL
125'
7.5'
SCHOOL PARKING LOT
8'
48'
13'
48'
8'
SB MAINLINE
NB MAINLINE
MEDIAN FEATURING EXISTING INSIDE SHOULDERS
CROSS SECTION B-B: ROSE GARDEN
< ROSE GARDEN
~ 65'
10'
6'
4"
24'
8'
10'
36'
36'
10'
25'
8'
APARTMENT >
~ 60'
BIKE
PLANTER
SB RAMP TO I-84
SB MAINLINE
NB MAINLINE
NB RAMP TO WEIDLER
S/W
WHEELER AVE.
1ST. AVE.
ALL NB AND SB LANES SHOWN (INCLUDING BIKE PATH)
LEGEND
FREEWAY IMPROVEMENTS
LOCAL IMPROVEMENTS
BRIDGE STRUCTURE
RETAINING WALL
NUMBER OF LANES
3 >
REMOVED
POTENTIAL BUILDING DISPLACEMENT
0
200
400
600
SCALE IN FEET
N


I-5: I-84 to I-405
DESIGN WORKSHOP
Exhibit 23: Concept 4
SPLIT DIAMOND (DETAIL)
OCTOBER 22, 2007
N WHEELER
N. WINNING WAY
SCHOOL
N. FLINT
N. VANCOUVER
N. WILLIAMS
ROSE GARDEN
WHEELER AVE.
N.E. MULTNOMA
N.E. WEIDLER
N.E. BROADW
N.E. HANCOCK
N.E. SAN RAPH
R 120'
LEGEND
FREEWAY IMPROVEMENTS
LOCAL IMPROVEMENTS
BRIDGE STRUCTURE
RETAINING WALL
NUMBER OF LANES
REMOVED
POTENTIAL BUILDING DISPLACEMENT
0 100 200 300
SCALE IN FEET
N

Grand Avenue Ramp

It was stated earlier that one of the classic solutions for not having a service interchange located between two very closely spaced system interchanges is to provide the local access outside of this area between the system interchanges. It was also stated that, for the most part, that is not an option in this case.

One step in that direction that may be possible would be to construct a westbound off-ramp from I-84 to Grand Avenue (Exhibit 24). This ramp would complement the existing eastbound on-ramp from Grand to form a half interchange.

The removal of the existing off-ramp to Holladay Street that exits from the I-84 westbound to I-5 northbound ramp would accompany the construction of a Grand Avenue ramp. Except for event periods, this ramp carries very low traffic volumes of only about 400 vehicles in the peak hour. This existing ramp is geometrically poor because it exits from the other ramp in the middle of a fairly sharp horizontal curve and just beyond the MLK undercrossing. This creates a poor sight distance situation for drivers approaching this ramp. This ramp is a lane drop where the system ramp goes from two lanes to one. This ramp configuration creates a situation where traffic bound for I-5 can be trapped in the right lane and must make a quick lane change to the left in the middle of this horizontal curve. The construction of the Grand Avenue ramp would allow the removal of this substandard situation and would remove some of the local access traffic out of the conflict area where system interchanging is occurring.

Two alternatives for the Grand Avenue ramp have been illustrated. Alternative 1 would connect directly to Grand Avenue at Lloyd Blvd. Westbound Lloyd Blvd. would need to be merged with this ramp as it approaches Grand, similar to Barbur Blvd. at the I-5 Interchange in Tigard. Eastbound Lloyd would need to be provided a separate alignment, probably passing under the ramp on the sideslope of Sullivan's Gulch.

Alternative 2 would curve north to an intersection with Lloyd at the 7th Avenue intersection. This signalized intersection would allow Lloyd to remain in its current alignment and function as one element of the ring road around the Lloyd District.

Exhibit 24: Ramp configuration

Lane Arrangements

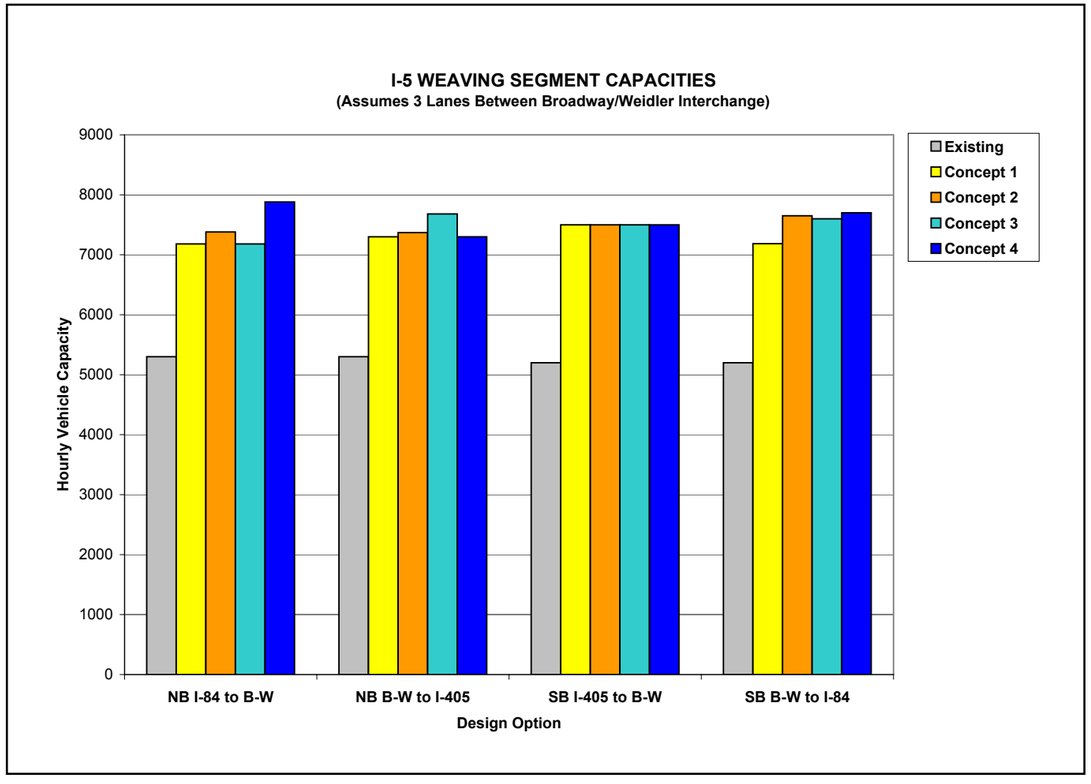
The difference between the two design scenarios is in the provision for and arrangement of auxiliary lanes along I-5 between I-84 and I-405.

By adding a lane in each weaving section without lengthening the weaving sections, the capacity would increase approximately 33% (three to four lanes). Lengthening the weaving sections and adding the fourth lane could increase the capacity by as much as 45%, dependent upon the increased length and the volume of weaving traffic (Exhibit 25).

By introducing collector-distributor roads or ramp braids, but maintaining the four-lane cross-section, capacity could possibly be increased by as much as 50%. All of the analysis assumed that there would be three lanes on I-5 northbound and southbound through the Broadway/Weidler interchange and that the proportion of weaving vehicles during the peak periods would remain the same (8%). The range of volumes for the various alternatives was 7,200 to 7,900 vehicles per hour.

If the concept designs were constructed without adding the third lane through the Broadway/ Weidler Interchange and the fourth lane in the weaving areas, the capacity increase above existing conditions would be 3 to 11%, dependent upon the increased length of the weaving section. The range in volumes at capacity would be 5,350 to 5,900 vehicles per hour.

Exhibit 25: I-5 Weaving Segment Capacities



Evaluation of Concepts

The purpose of this project was to determine if there are one or more concepts that improve the mobility and access while reducing the safety problems that exist in the I-5/I-84 interchange vicinity, in ways that are acceptable to the stakeholder agencies and do not preclude future design solutions. That answer is "yes." This report documents four interchange concepts married with two scenarios that retain the existing number of through lanes on I-5 and increase the number of through lanes by one. All of these situations improve the conditions over the existing operation.

Although the purpose of this project was not to select a solution, but only to determine if feasible solutions exist, this section does provide some evaluation of these scenarios and interchange concepts. A degree of preference can be shown, but a more complete and formal decision process would be required as part of a project development process to select a preferred alternative. That more complete project development process could very well identify additional potential solutions. The very limited budget and timeline for this study did not allow full alternative identification.

For reasons stated earlier, the interchange concepts focus on the Broadway/Weidler Interchange. The concepts directly address weaving and merging of vehicular traffic. Analysis has shown ways to accommodate these movements better and that the performance of these concepts is enhanced by an additional travel lane in both directions on I-5.

The Concept Evaluation table, Exhibit 26, contains information about each of the scenarios and concepts that have been developed. Scenario 1 assumes no additional through lanes on I-5. Scenario 2 assumes an additional (third) lane. Each scenario includes the same four interchange concepts: 1, Diamond; 2, Parclo AB; 3, Parclo A; and 4, Split Diamond.

The relative advantages of each concept have been summarized by comparing them in terms of a set of criteria shown in the first column of the table. Five criteria address the impacts of the concepts on the roadway: traffic safety, traffic operations, implementability, construction cost, and the extent to which the concept does not preclude other long-term solutions. An additional set of criteria address the impact of the concepts on the urban context, including access for vehicles, bicycles, pedestrians, and transit, as well as impacts on existing and future development and aesthetics.

Viewing the concepts at the broadest level, the addition of a third through lane substantially improves congestion and traffic operations while having essentially the same relationship to the urban environment as the current roadway. This is because the additional capacity in the mainline would occur within the existing right of way. Because the addition of a through lane (Scenario 2) does result in additional pavement width, this scenario was scored worse than Scenario 1 and the existing condition. For all of the rest of the evaluation criteria, it did not matter whether the concept was paired with Scenario 1 or Scenario 2.

Exhibit 26: The Concept Evaluation Table

Concept Evaluation	Existing	Scenario 1: 2 Lanes for I-5				Scenario 2: 3 Lanes for I-5			
		1	2	3	4	1	2	3	4
Traffic Safety									
Geometric Design Improvements									
Congestion Improvements									
Traffic Operations									
I-5 Traffic Operations									
(including Nbd CD road and Sbd braided ramps)									
I-5 Freight Movements									
Street System Operations									
Implementability									
Phasing Potential	NA								
Right-of-way									
Construction Cost ($ Million)									
Without Streetcar or Station Relocation	61-106	115-201	115-201	131-228	151-263	136-237	136-237	151-265	180-315
With Streetcar or Station Relocation	74-130	129-225	129-225	145-253	165-288	150-262	150-262	165-289	194-340
Urban Context									
Traffic Access									
Pedestrian and Bicycle Access									
Bicycle									
Pedestrian									
Transit Interface									
Bus Routing									
Streetcar									
Future Development Opportunities									
Preserve High Priority Sites									
Preserve Other Important Sites									
Access to Desired Development Parcels									
Aesthetics (Footprint Only)									
Not Preclude Alternative Long Term Solution to I-5									

Good
Fair
Poor
Bad

Traffic Safety – Geometric Design Improvements

All concepts offer geometric designs that would improve the existing roadway, as a result of lengthening the distance available for merging and weaving traffic. These benefits would occur with or without additional through lanes. It was mentioned earlier that some loop ramps may be tighter than full design standards, but those conditions can be mitigated. Overall, the geometric condition would be much improved over the existing conditions with any of the interchange concepts.

Traffic Safety – Congestion Improvements

It has been shown that there is a direct correlation between congestion and crash rates. The lengthening of the weaving sections accomplished by all concepts provides a degree of congestion reduction. Some concepts provide more weaving length than others, but the effect on congestion from the weaving length is relatively insignificant as compared to adding additional lanes, so there is no differentiation between concepts within each scenario. There is enough congestion improvement with any of the concepts to rate Scenario 1 better than the existing condition. A major improvement would be seen with the additional lane capacity in Scenario 2.

Traffic Operations – I-5 Traffic Operations

Because Concept 1 only slightly extends the weaving lengths south of Broadway/Weidler and makes no change north of that interchange, there would be no improvement over existing conditions under Scenario 1. Concept 1 with Scenario 2 would be significantly better than existing, but that is due mostly to the additional lane on I-5. All other concepts do extend the weaving sections, and Concept 3 removes most of the southbound weaving movements between the Broadway/Weidler Interchange and I-84.

All of the concepts and scenarios would add full right shoulders, which also adds to the safety and operational reliability of this section. There is a restricted area north of the the Broadway/Weidler Interchange where compromise may be needed in either the median or shoulder width because existing buildings are located near the right-of-way lines.

Traffic Operations – I-5 Freight Movements

Because the efficiency of freight movements is closely related to overall congestion, the rating for this criteria directly matches the Congestion Improvements criteria.

It is interesting to track the lane changes required for a southbound truck entering I-5 at the Greeley Ramp and going to I-84 eastbound or I-5 southbound. Under Scenario 2 for Concepts 1, 2, and 3, a lane change would be required to exit to I-84 and a lane change would be required with the lane drop south of the I-84 Interchange to continue on I-5. For Concept 3, the exit to I-84 is easier because the Broadway/Weidler entering traffic has been separated into two on-ramps. For Concept 4, no lane changes are required to go to I-84, and only the lane change associated with the lane drop is required to continue on I-5.

Traffic Operations – Street System Operations

A major enhancement of Concept 1 is to move all surface streets away from the interchange ramp terminals. Broadway and Weidler would be a little less efficient compared to others because the two-way couplet does not begin until the east edge of the I-5 interchange. The connection to Broadway and the Rose Quarter for Williams/Vancouver would not be as direct as with other concepts. This concept does have the advantage on opening up alternative access into the area northwest of the interchange. Access for the Rose Quarter would occur on Wheeler.

With Concept #2, the surface streets would be much less isolated from the interchange operation than the other concepts. Several streets intersect opposite ramp terminals, and the connection to Williams from Broadway would come off of the northbound on-ramp alignment. Broadway and Weidler would be continuous through this interchange and have the advantage of being a one-way pair through the interchange. As with Concept 1, this concept provides good access for the area northwest of the interchange via Williams/Vancouver.

Concept 3 scored the highest for this criterion, because the street system would be the most straightforward and efficient. Broadway and Weidler would maintain the two-way couplet all the way through the interchange. Williams and Vancouver would be are brought together into a two-way street and carried over the freeway on one structure. Williams would continue south as a direct connection to the Rose Quarter Transit Center and the rest of the Rose Quarter. The area northwest of the interchange would be served efficiently with an extension of Hancock over the freeway. All of the surface streets would be isolated from the interchange operation except that the northbound ramps intersect Weidler at 1st. This may require a design or policy exception, but should work well. If this connection is not acceptable, Victoria and 2nd, west and east of this intersection, could be made available for circulation, but with additional travel.

The street system for Concept 4 is very similar to Concept 2. A big advantage would be that all streets are isolated from the interchange operation.

Implementability – Phasing Potential

All concepts in both scenarios would lend themselves well to construction phasing. Because this effort focused on this interchange and away from the system interchange with I-84, this approach allows for the first major step toward phasing in what might be the ultimate solution involving the I-84 interchange and the section south of that interchange.

All of these interchange solutions are compatible with two or three through lanes on I-5, which also provides a potential for phasing.

Except for Concept 4, the removal of the Holladay ramp and replacement by the Grand Avenue ramp can be a standalone project. The space occupied by the Holladay ramp today is needed for the construction of the C-D road that is part of Concept 4.

As will be discussed in the cost criterion section, the complete cost of any of these interchange concepts may be affordable, eliminating the need for further phasing. As just explained, these concepts themselves could be part of a larger, long term strategy.

Implementability – Right-of-Way

The right-of-way requirements for all of the concepts under either scenario are relatively minor considering the urbanized setting. Although some building displacement would be required with any of the concepts, it is important to note that none of the high priority facilities would be displaced.

The right-of-way requirements for Concept 1 are somewhat less than the others, requiring the displacement of only three buildings.

Concept 2 would displace five buildings, including the truck sales facility portion of the Ford dealership on Broadway.

Concept 3 would displace four buildings, including the old Ramada Inn facility on Weidler just west of I-5.

Concept 4 would displace five buildings, including the old Ramada Inn facility.

The right-of-way requirements for the additional lanes along I-5 also appear to be minimal. This study effort has been done with very preliminary engineering working with aerial photography, but it appears that with the use of retaining walls, most of the I-5 widening could be built within the existing right-of-way. The C-D road associated with Concept #4 is the most likely solution to require additional right-of-way along I-5. Even if some minor strips of additional right-of-way are required for any widening of I-5, no buildings would be displaced as a result.

The complete list of estimated costs are:

Major maintenance	$61M to $130M
Scenario 1, Concept 1	$115M to $225M
Scenario 1, Concept 2	$115M to $225M
Scenario 1, Concept 3	$131M to $253M
Scenario 1, Concept 4	$151M to $288M
Scenario 2, Concept 1	$136M to $262M
Scenario 2, Concept 2	$136M to $262M
Scenario 2, Concept 3	$151M to $289M
Scenario 2, Concept 4	$180M to $340M
Grand Avenue ramp, Alt 1	$29M to $50M
Grand Avenue ramp, Alt 2	$23M to $40M

Does not include right-of-way costs. Estimated costs are in 2007 dollars.

Construction cost

Construction cost opinions in 2007 dollars were developed for all four interchange concepts with both widening scenarios. Cost opinions were also developed for Alternatives 1 and 2 for the Grand Avenue off-ramp. These cost estimates include new pavements and rehabilitating I-5 bridges and viaducts. In numerous areas, retaining walls were used to avoid the need for additional right-of-way. The cost of the walls is included, but the cost for any new right-of-way is not. Considering the age of this infrastructure, much of this pavement and structural work will be required in the future whether or not any of these other revisions are made. It became apparent that this "major maintenance" cost needed to be known to determine the incremental additional cost for the capacity and safety improvements.

The estimated cost for removing existing pavement and constructing new pavement was developed on a per-square-foot basis. The cost for earthwork, drainage, erosion control, traffic control, signing/markings, regular utilities, incidentals, landscaping, bicycle facilities, and traffic signals were all calculated as a percentage of pavement costs. Retaining walls were calculated on a per-square-foot basis with a 15% incidentals added on. Bridge removal, widening, and rehabilitation and new bridges were all calculated on a per-square-foot basis with a 15% incidental add-on. Railroad relocation was calculated per mile. A 35% contingency was added for all construction costs. 12% of total project cost was added for preliminary engineering through PS&E. 10% of total project cost was added for final engineering (construction engineering).

The estimated cost for just "major maintenance" (new pavements and bridge rehab) is between $61 million an $130 million.

Using Concept 3 for comparison because it does a little better job addressing the full spectrum of issues, the estimated cost with Scenario 1 (two through lanes) is between $131 million and $253 million. With Scenario 2 (three through lanes), the cost is between $151 million and $289 million. So, it costs between
$70 million and $123 million over the cost of just maintaining the infrastructure to provide the improvements of Concept 3. It would cost an additional $20 million to $36 million to provide the additional through lane on I-5 through this entire section in both directions (see estimated costs sidebar, this page).

Urban Context

Exhibits 27 to 30, presented at the end of this urban context discussion, illustrate the urban design aspects of the four interchange concepts. The sections immediately below discuss how these concepts address the urban design criteria that are listed in the Evaluation Matrix.

A number of factors were included in the Planning Framework that do not factor into how these concepts are evaluated against each other.

None of these concepts directly impact any of the high priority land uses in the study area. The Oregon Convention Center, Lloyd Center, and major office buildings in Lloyd District are not directly affected by the identified concepts. Access effects to the Rose Quarter are discussed below. If the Holladay ramp were replaced by a Grand Avenue ramp, the access pattern to the Convention Center would be modified, but none of the concepts have any direct physical impact to this facility. All of these facilities are affected positively by improved freeway access that would result from any of the concepts, but there are no direct impacts to these properties.

In the past, there has been concern about the visual impact from the previously identified solutions. There are no vertical elements of the solutions identified by this study that would have significant impacts on the visual qualities of the study area. All traffic movements are handled in just two vertical levels, including anywhere that ramp braiding is included.

While there are revisions to the bus system and a potential slight modification for the planned streetcar extension, the light rail network through the study area is not impacted by any of the interchange concepts or by adding a third through lane on I-5.

Urban Context: Traffic Access

Concept #3 is thought to provide the best local traffic access patterns. The local grid pattern is well defined and would be easily understood by drivers. The Broadway/Weidler couplet scheme remains, but the troublesome left turn at Vancouver to access I-5 southbound would be eliminated. The Vancouver/ Williams couplet would end in a straightforward manner and provides a direct connection into the Rose Quarter from the north. This concept also has the added benefit of extending Hancock over I-5 for improved access into the Portland Public School site. This element would be optional (not necessary for this concept to work).

Concept 2 is most disruptive to the local street system on the east side of I-5. There would be less separation between the freeway ramps and the north-south local streets than with other concepts. The northbound connection to Williams would be awkward from either the Broadway/Weidler couplet or the new overcrossing of I-5.

Concepts 1 and 4 received evaluations in-between the extremes of the other two concepts. Concept 1 would lose the direct connectivity between the Vancouver/ Williams couplet and the Broadway/Weidler couplet, and the connection from the north into the Rose Quarter would not be as direct as Concept 3. On the positive side, good access would be provided from the Eliot Neighborhood into the Portland Public School site. Concept 4 would retain the existing Broadway/Weidler couplet, but otherwise the local access pattern would be very similar to Concept 1.

Urban Context: Bicycle Access

Generally, bicycle access would improve in all concepts through the reconstructed Broadway and Weidler corridor and with the improved north-south connectivity.

Broadway and Weidler would be reconstructed to include adequate bike lanes. This includes the freeway overcrossing structures, whether it is the wide two-way structure of Concept 1 or the separate two-way structures of the other concepts. Concept 1 ranks a little higher for this criterion because the other three all include loop ramps that cause an issue for bicycle traffic. Concept 1 has the conflicts at the ramp terminals, but these would be controlled by traffic signals.

The north-south bicycle circulation from the N. Vancouver/Williams couplet connecting to Broadway or the Rose Quarter Transit Center would be improved from the existing conditions for all concepts. Concept 3 would provide the most direct connection in the north-south direction. The other three concepts would take bicycles across the freeway in an east-west direction on a new structure north of the interchange before connecting to Wheeler. The connection to Dixon should be studied for its merits as a bicycle route to the Broadway Bridge.

For all concepts, there is potential to include a dedicated off-street bicycle facility along the west side of the I-5 right-of-way from Weidler to Oregon. The vertical alignment of this separate facility should be kept high enough to cross over Holladay and Multnomah Streets, thereby avoiding bicycle conflicts at the Rose Quarter Transit Center. This bike trail connection could provide access to the Steel Bridge as well as the Eastbank Esplanade and the future bike trail planned for Sullivan's Bluff along I-84.

Urban Contex: Pedestrian Access

As is the case with the bicycle criterion, Concept 3 scores a little better than the other three concepts for pedestrian access. This is primarily because it would provide the most direct north-south pedestrian access through the area.

There are off-setting issues for east-west pedestrian movements for the various concepts. Concept 1 is better than the other three concepts in that it has no loop ramps to deal with. That benefit is probably off-set by the fact that there would be only one structure for the Broadway/Weidler pair and many pedestrians would have to walk an extra block to the north to cross I-5. For any of the pedestrian/vehicle conflicts points at intersections, proper signalization, signing, and markings would be provided.

In any of the concepts, the pedestrian environment could be enhanced by capping the freeway between Broadway and Weidler. For Concept 3, it would be cost effective to support the Broadway, Weidler, and Williams roadways on one wide structure. This results in a cap over I-5 between Broadway and Weidler, and this is reflected in the cost estimate for Concept 3. The cost of this potential capping is not included in the cost estimates for the other three concepts. Capping would provide much desirable green space and could make diagonal pedestrian movements possible at this freeway crossing. This diagonal path could be especially beneficial for the heavy volumes of pedestrians that use this area before and after events in the Rose Quarter. A cap would also dampen the visual and acoustical impact of more lanes on the freeway below.

If warranted, depending on new development on the east side of I-5, a pedestrian bridge could be added at Clackamas Street for any of the concepts to handle increased pedestrian traffic to the Rose Quarter during events. The structure length would have to longer for Concepts 4 than the other concepts, but that is quite doable, considering it would be only a pedestrian bridge.

For all of the concepts, the pedestrian experience would be diminished though compromised aesthetics, noise, and a greater awareness of the I-5 freeway cutting through the urban fabric.

For Concept 3, the southbound I-5 on-ramp would be a barrier for pedestrian movements and would impeed to redevelopment of these blocks. If the southbound I-5 traffic were designed to utilize the loop ramp in the NW quadrant, the pedestrian environment and redevelopment potential would be improved. However, that revision would reintroduce a weaving movement on I-5 that this concept was designed to eliminate.

For Concept 4, the pedestrian experience would be more fragmented and have more aesthetic concerns, noise, and awareness of a larger freeway section with its braided ramps as compared to the other concepts.

Urban Context: Transit Interface – Bus Routing

The issue of bus routing is primarily how well is the Rose Quarter Transit Center served from the north neighborhoods. The east-west bus traffic on Broadway/Weidler is not significantly affected. Concept 1 has the one-way couplet beginning on the east side of I-5, rather than the west side, so a bus stop or two may have to be moved. Otherwise, there is really not much difference in how the east-west bus traffic would be accommodated.

As stated earlier, Concept 3 has the most direct north-south route connecting the Vancouver/ Williams couplet to the Rose Quarter Transit Center via a new bridge over I-5. The Vancouver/Williams line could interface with Line #9 at Weidler and Broadway. For that reason,
Concept 3 is rated higher than the other three concepts.

For Concept 2, the southbound direction for the north-south bus routes is relatively direct, crossing I-5 on a new bridge and connecting to Wheeler. If the northbound bus follows this same route, the connection to northbound Williams would not be direct. For this reason, Concept #2 is rated the lowest of the concepts for bus routing.

Concepts 1, 2 and 4 do not offer an interface with Line #9 east of I-5. They would cross #9 west of I-5. To interface with #9, they would need to turn right from Wheeler onto Weidler, travel two blocks east and then proceed north on Williams, following a route that might be difficult for bus stops and wayfinding.

Urban Context: Transit Interface – Streetcar

Concepts 2, 3 and 4 do not affect the planned streetcar extension to the eastside along Broadway and Weidler.

Concept 1 does affect the alignment for several blocks since the one-way couplet would begin on the east side of I-5, rather than the west side. That revision would move any stop at the north parameter of the Rose Quarter one block further away. Other than that, the operation would not be affected. If the streetcar were to be constructed earlier on Weidler, is would need to be moved to Broadway in this short section.

Urban Context: Future Development Opportunities – Preserve High Priority Sites

As stated above, none of the concepts directly affects any of the high priority land use sites.

The Rose Quarter complex is the closest to the interchange and would see some effects. None of the buildings would be directly impacted. The access patterns to the facility vary between the concepts and those have been discussed. Concept 3 probably has the most direct access pattern. Concept 3, however, also includes the most negative element regarding the Rose Quarter: an on-ramp to I-5 that would make further storefront redevelopment along the north edge of the Rose Quarter difficult. The on-ramp would require an extensive retaining wall starting at Flint. The blocks between Flint and Williams could be combined for redevelopment if one block of Vancouver is vacated. Access to the two parking garages at the Rose Quarter just south of Weidler would be further complicated at this intersection. Another block could potentially be gained north of the Rose Quarter if a block of Wheeler is vacated; however, it is cut off from Weidler by the on-ramp and would be served by Winning Way.

Urban Context: Future Development Opportunities – Preserve Other Important Sites

The former Ramada Inn site was mentioned as a potentially important land use site. Concepts 3 and 4 would displace this building.

The culturally significant former Jazz club site at Wheeler and Broadway was also listed as an important site. This building would not be displaced under any of the concepts. Concept 1 would put all of the Broadway/Weidler traffic on the north side of this building. All of the other concepts retain the existing Broadway/Weidler pattern on each side of the building. All of the concepts utilize Wheeler on the west side of the building as one of the major circulator streets.

Urban Context: Future Development Opportunities – Access to Desired Development Parcels

Concept 1 would remove three blocks of Weidler from the existing Broadway/Weidler couplet. This would create the potential for a more intensive retail district along Broadway as suggested in the Broadway Weidler Corridor Plan (Lindley 1996). Through the local street vacations of Williams and Weidler on the west side of I-5, there is potential for a larger, however, somewhat isolated, development parcel adjacent to the Rose Quarter on the remaining triangular blocks.

The diamond configuration of Concept 1 would have a fairly compact footprint and would not require as much additional right-of-way as the other concepts. Development patterns of the vicinity and redevelopment potentials would remain somewhat similar to existing conditions, with the one positive exception just stated above.

For Concept 1, the vacation of Weidler would enable a larger redevelopment parcel to be assembled on the immediate east side of I-5 adjacent to the Holiday Inn site. However, the block between the Broadway/ Weidler couplet and 1st and 2nd Avenues may have diminished development potential because of the angled street slicing through it.

The loop ramps of Concept 2 require additional right-of-way that will change the current block configuration on the north side of Broadway. Areas affected extend from Broadway to Hancock and from 1st to Flint. The area devoted to loop ramps—along with the loss of the Williams, Vancouver, and Flint bridges over I-5—will create a void in the urban fabric that is greater than existing conditions. The blocks along Broadway and Weidler have less potential to achieve the connectivity of a Main Street retail district along the corridor. The gap between the Rose Quarter and the businesses and neighborhoods to the east is increased in Concept 2.

On the positive side, the new I-5 crossing of Hancock offers some interesting opportunities to connect the Eliot Neighborhood to the Portland Public School site, which may enhance development opportunities.

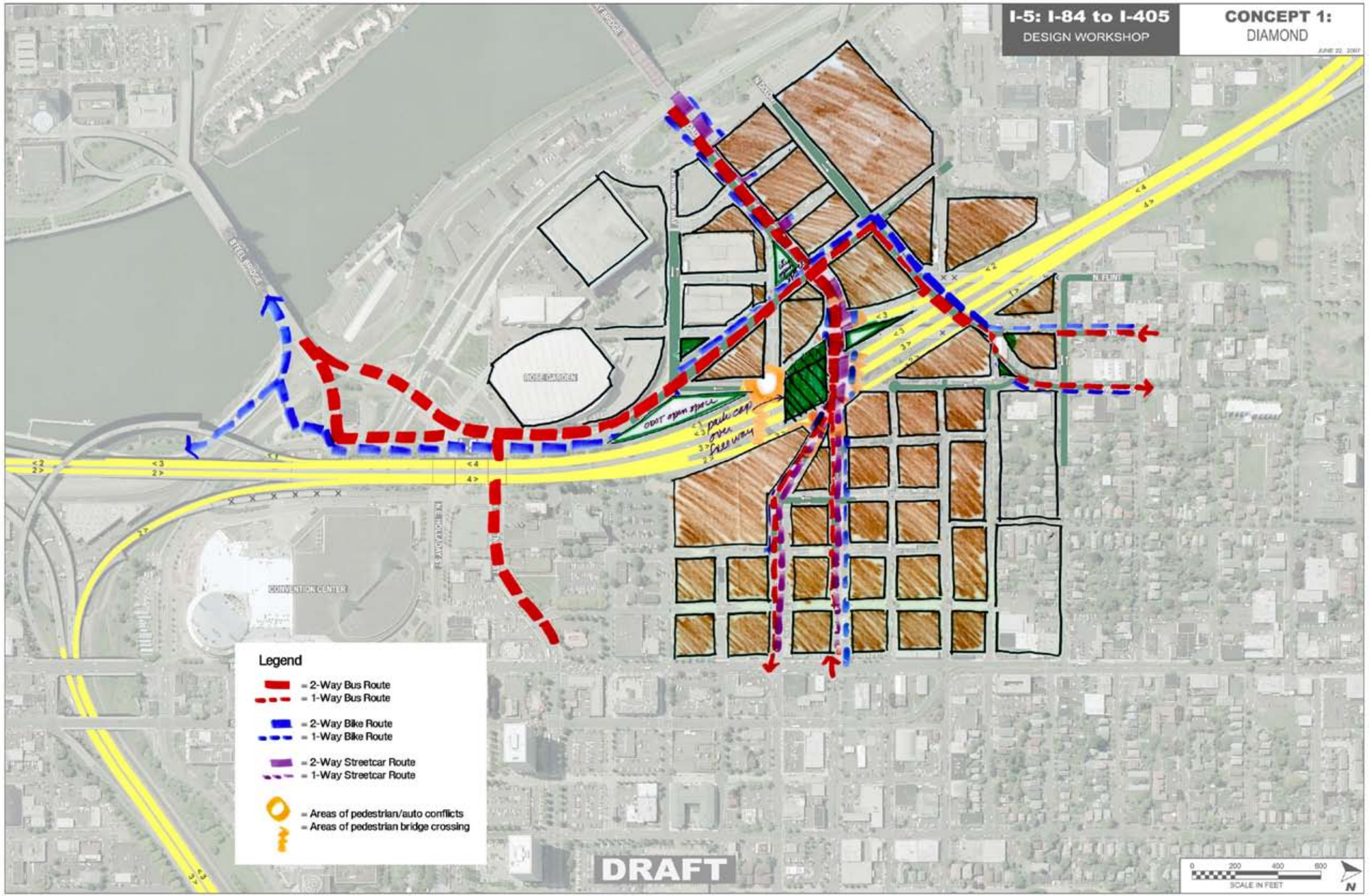
For Concept 3 this was mentioned above when discussing the Rose Quarter, but the blocks between Flint and Williams could be combined for redevelopment if one block of Vancouver is vacated. Another block could potentially be gained north of the Rose Quarter if a block of Wheeler is vacated; however, it is cut off from Weidler by the on-ramp. If the I-5 on-ramp were eliminated and that traffic put on the loop, Concept 3 would provide better connectivity and redevelopment potential for the area west of I-5. That revision, however, would introduce a weaving movement on I-5 that this concept was designed to eliminate.

Concept 4 has the largest footprint of all the alternatives and requires additional right-of-way on the east and west sides of I-5. This concept creates the greatest disruption of this area's urban fabric resulting from a widened freeway corridor traveling though it. The retail environment along the Broadway/Weidler corridor would be cut into two very distinct districts.

Part of the land acquisition required for Concept 4 would displace the former Ramada Inn site south of Weidler. Redevelopment of the block between Williams and Flint would be very difficult under this scenario. Similar to the other concepts, a new bridge over I-5 connecting Williams and Vancouver to Wheeler would provide positive enhancement for the redevelopment potential for the Portland Public School site.

Evaluation of Concepts

Exhibit 27: Concept 1



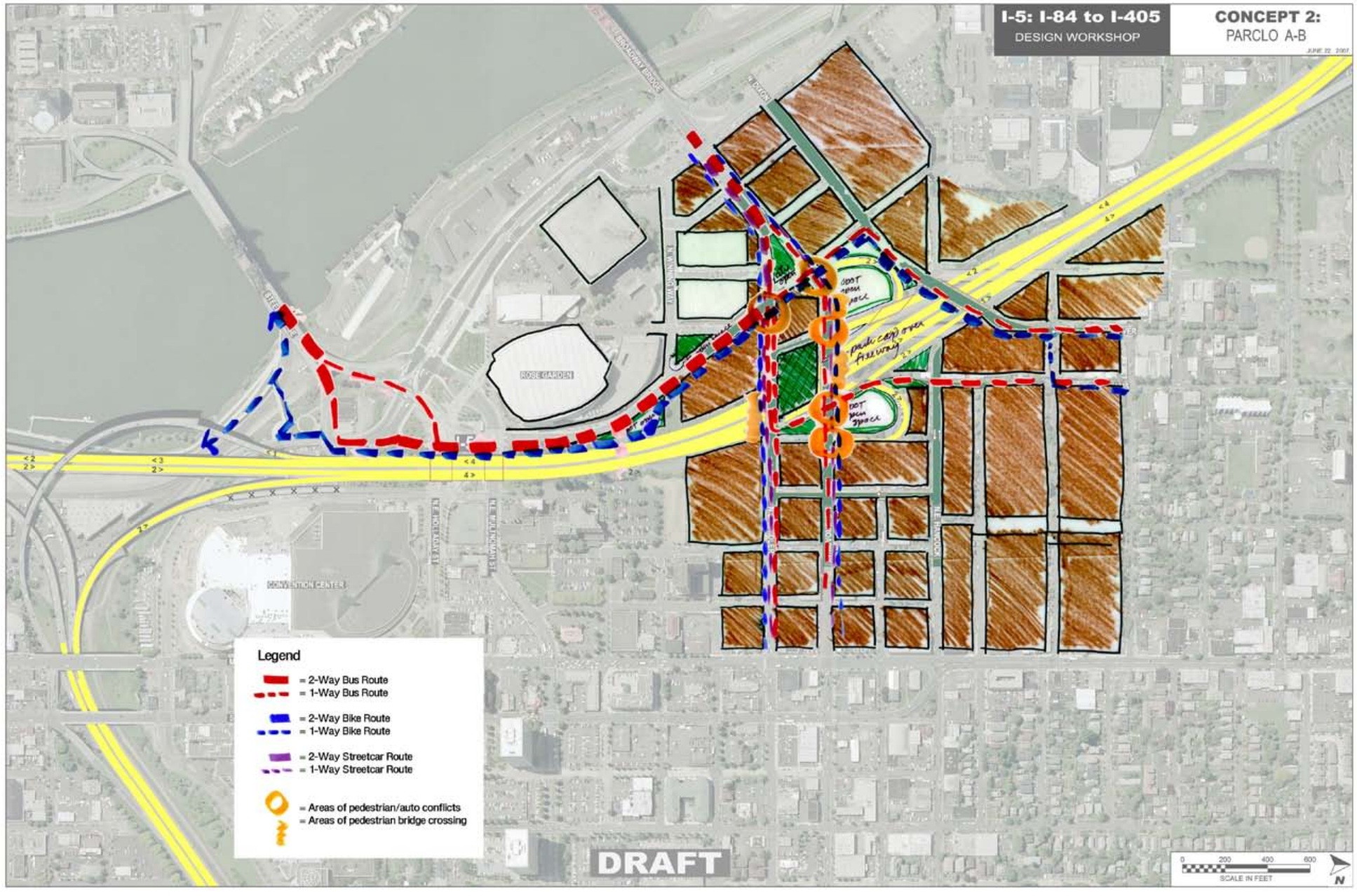
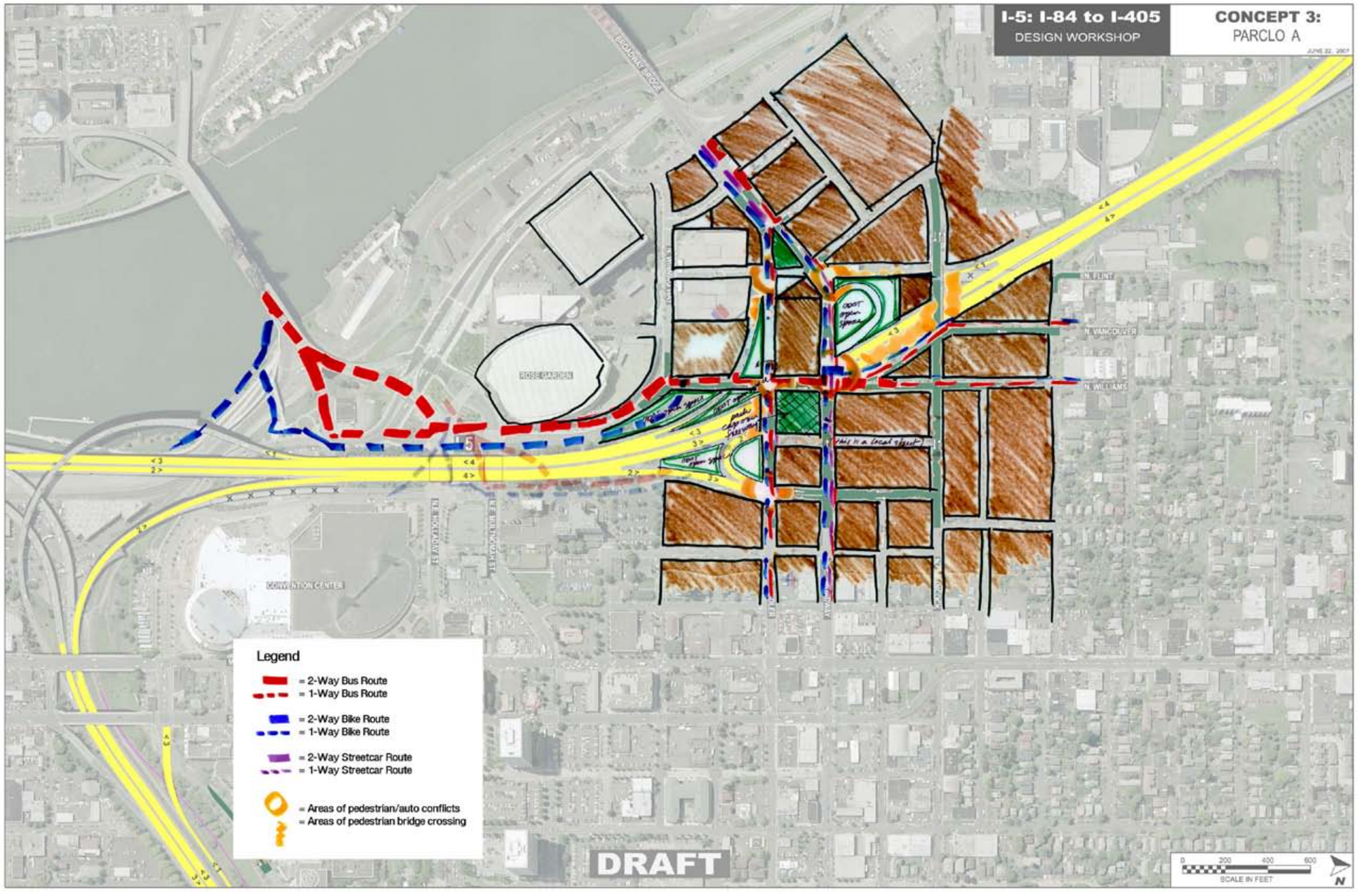


Exhibit 28: Concept 2

Evaluation of Concepts

Exhibit 29: Concept 3



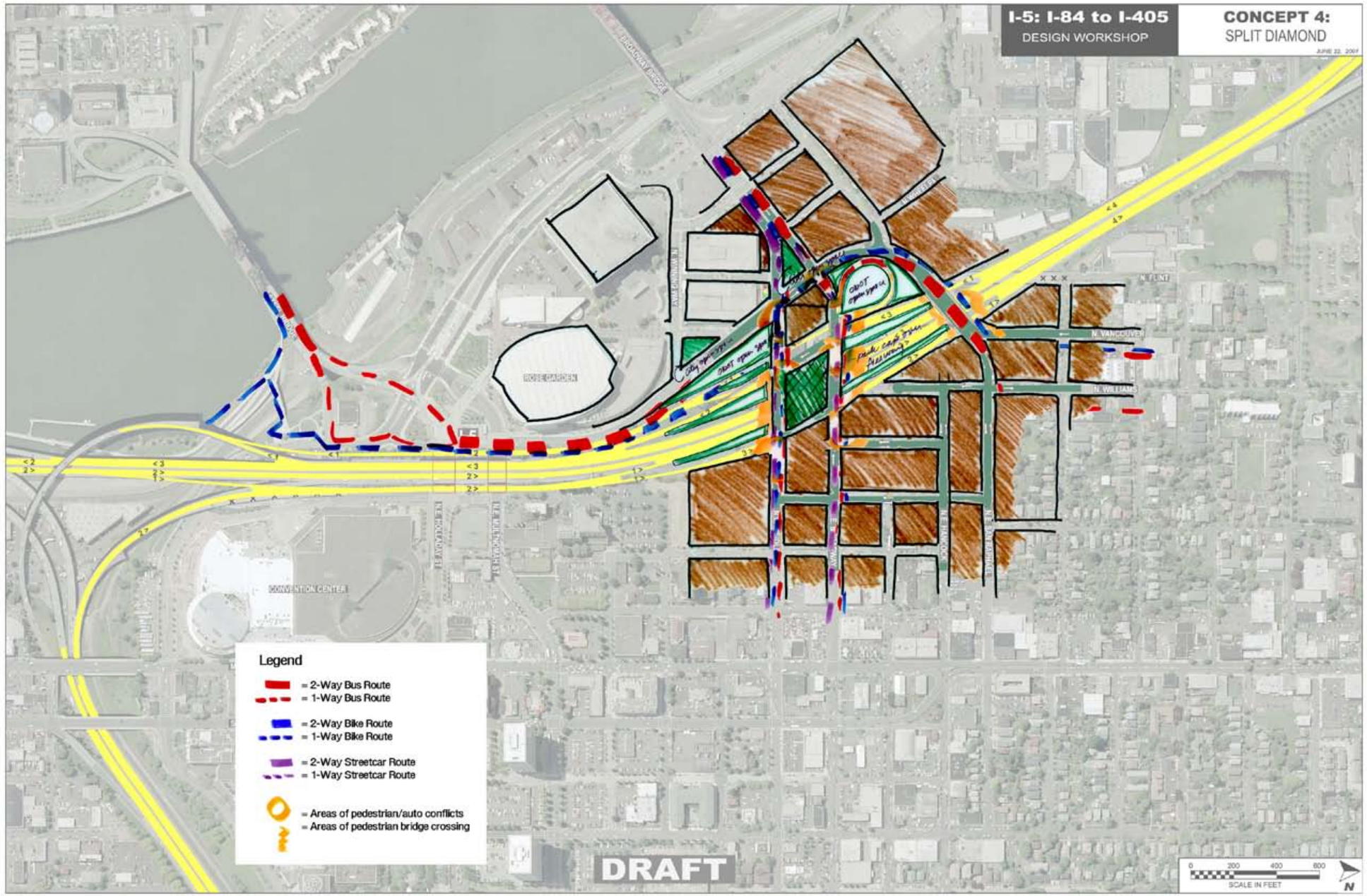


Exhibit 30: Concept 4

Aesthetics (Footprint Only)

None of the concepts have vertical impacts; all will operate at essentially current elevations.

Ramp designs do pose horizontal impacts, particularly for Concepts 2 and 4 because of the size of the loop ramps. This is more of an issue with Concept 2 because it includes loop ramps in both the NW and NE quadrants.

The lanes of I-5 for Scenario 2 can be constructed generally within the existing right-of-way, so there is little aesthetic degradation from the lineal portion of I-5. For Scenario 2, the I-5 lanes can essentially be constructed within the existing right-of-way, but this scenario received a poor evaluation based primarily on the greater expanse of travel lanes visible to the drivers on I-5. Scenario 2 would require all of the right-of-way and retaining walls. This would mean the elimination of the poor quality and poorly maintained existing landscaping and would afford the opportunity to replace it with higher quality, more pleasing landscaping for this urban setting. Examples would be the Stadium Freeway or the Sunset Highway at the Zoo Interchange.

Not Preclude Alternative Long Term Solution to I-5

All of the concepts scored well on this criterion because they do not preclude the implementation of solutions to the segment of I-5 south of the I-84 Interchange. The solutions identified by this study were purposely selected to improve the conditions associated with the section between I-84 and I-405 without making major modifications to the I-84 Interchange or the I-5 alignment south of there.

Depressing I-5 between the Marquam Bridge and I-84 may be a future potential. Without knowing more about how that would be done, it is not possible to know where that vertical alignment would match into the existing profile on the north end. If that point were to fall somewhere in the I-84 to Broadway/Weidler section, some portion of the I-5 through lanes may have to be rebuilt. It seems unlikely that this revised profile would extend far enough to the north to require rebuilding the interchange concepts that have been suggested by this report.

Constructability

Although not one of the evaluation criterion, constructability of any solution will be critical in this restricted section.

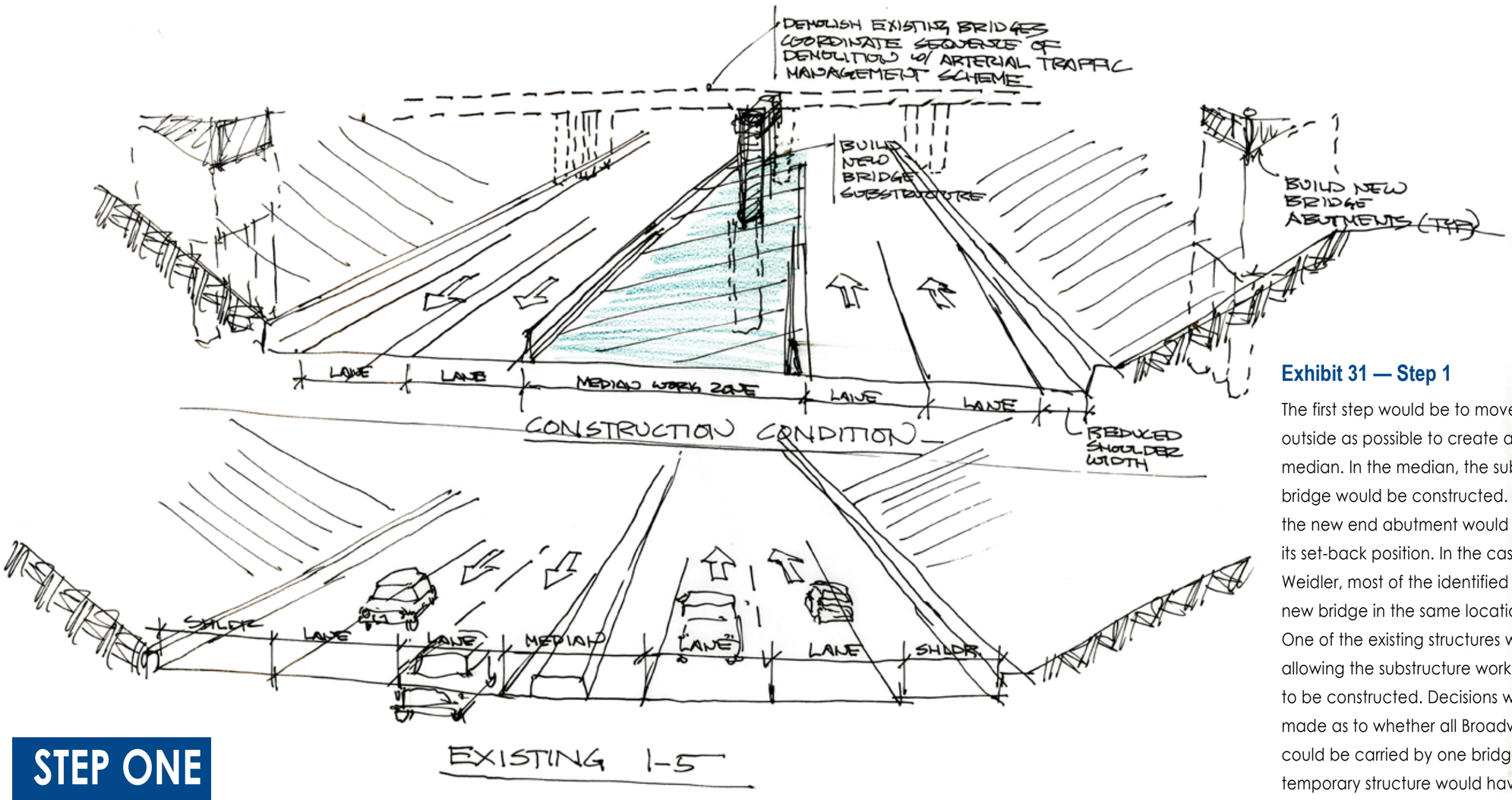
Parts of this section are on embankment areas and structures. It is expected that the embankment areas would be widened by constructing fill walls, and then filling them. The structures at Multnomah and Holladay are pre-cast girders allowing for the widening of these bridges. Likewise, the viaduct between Broadway/Weidler and I-405 may have to be widened with different scenarios and concepts.

The area currently occupied by the Broadway/ Weidler Interchange—including the Flint, Vancouver, and Williams structures—is in a depressed section. Exhibits 31 through 33 show how the widening of I-5 could be accomplished in three basic steps.

Compatibility with Permit Requirements

The ability to secure construction permits was also mentioned as an issue in the planning workshop. Nothing about any of the four concepts or the scenarios creates an insurmountable obstacle to permitting. One of the more major concerns was work in or around the Willamette River. The solutions being proposed by this study do not affect the river.

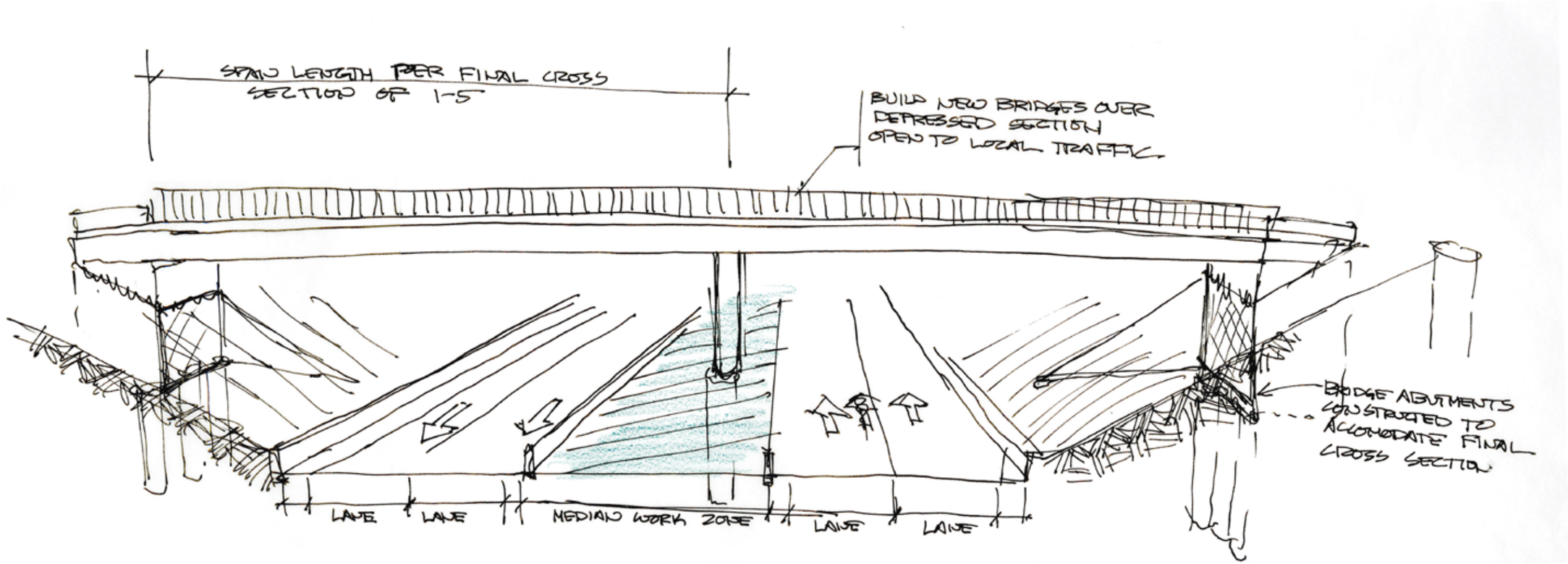
Securing permits from the railroad could also pose a problem. Except for the potential of a Grand Avenue ramp, none of this work will affect the railroad.



STEP ONE

Exhibit 31 — Step 1

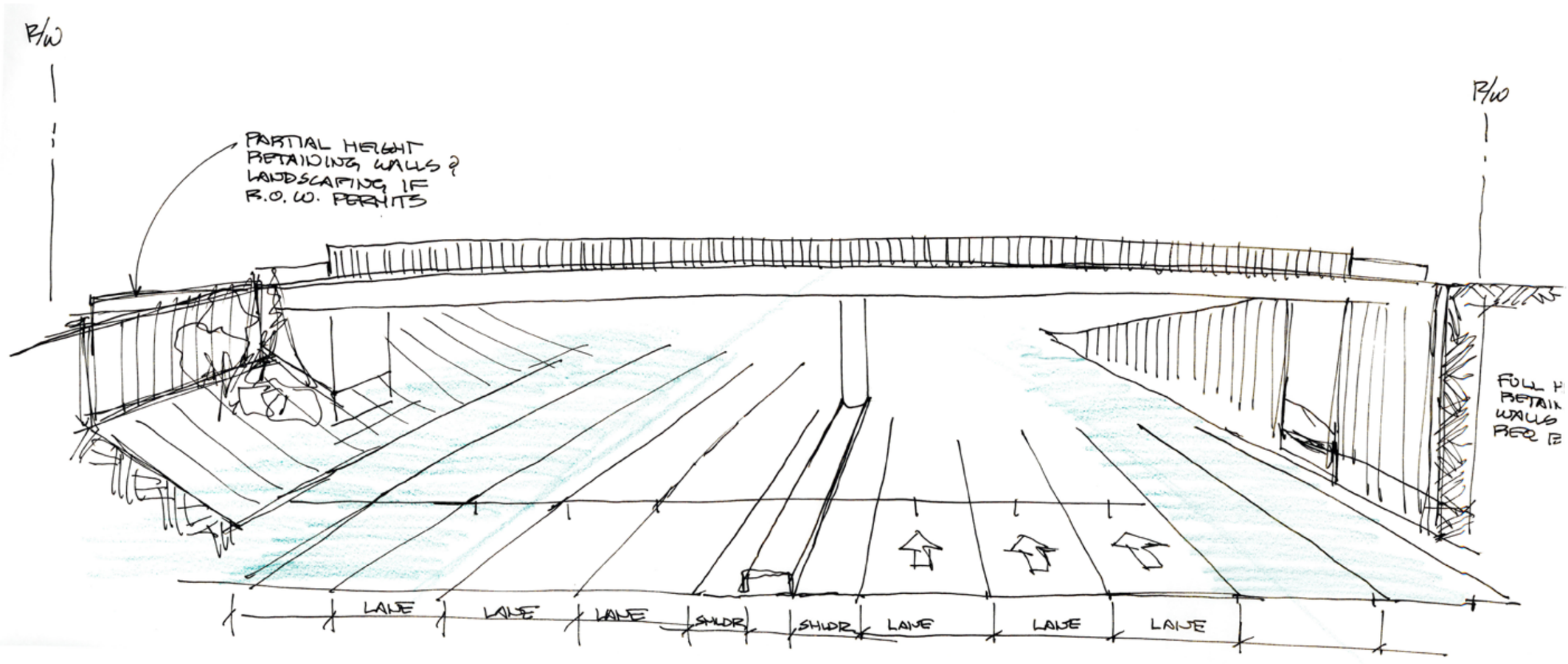
The first step would be to move traffic as far to the outside as possible to create a work zone in the median. In the median, the substructure for the new bridge would be constructed. At the same time, the new end abutment would be constructed in its set-back position. In the case of Broadway and Weidler, most of the identified concepts have the new bridge in the same location as the old bridge. One of the existing structures would be removed, allowing the substructure work for the new bridge to be constructed. Decisions would have to be made as to whether all Broadway/Weidler traffic could be carried by one bridge or whether a temporary structure would have to be built. For all of the existing structures, the old structure would be removed before traffic was moved out to eliminate the restricted clearance to the old shoulder piers.



STEP TWO

Exhibit 32— Step 2

The next step would be to build the superstructure of the new bridge.



STEP THREE

Exhibit 33 — Step 3

The third step would be to excavate to the new abutment location and construct the required retaining walls. With the retaining walls in place, the widened pavement could then be built.

Findings Summary

The purpose of this study was to determine if there were potential solutions to the recognized operational problems in this section of I-5 that could be feasible, affordable, not overly disruptive to the adjacent land use, and mutually acceptable to the stakeholder agencies.

This study shows that there are at least several solutions that do fit this bill. While this report does include an evaluation matrix, and there is discussion about how well the various concepts perform against a set of criteria, the intent was not to select a preferred alternative. A formal project delivery process would be required to make that level of decision. There is much "mixing and matching" that could be done among the various components that have been discussed in this report. A project delivery process would be needed to determine those details as well. Additionally, there is no guarantee that these are all of the possible solutions. These concepts were developed in a week-long conceptual design process with several public agencies, but no public involvement.

The attributes of a successful concept were listed on page 12 of this report. Those attributes came from the interviews and planning workshop. To one degree or another, the improvements identified in this report fulfill those attributes: They are:

- **Measurable, significant improvement in traffic operations along I-5 over a reasonable time period**

  The increased lanes on I-5 and the increased weaving distances would very significantly improve operations.

- **Improve or increase the reliability of traffic flow**

  The reduction or elimination of conflict points resulting from all of these improvements would produce a more reliable flow and reduce the occurrence of incidents.

- **Reduce crashes**

  Crashes are directly related to congestion levels and narrow shoulders. Congestion would be reduced by these improvements and full-width shoulders would be provided.

- **Be affordable, including the ability to construct usable portions over multiple phases**

  The estimated costs for any of these solutions is thought to be affordable. In addition to that, the elements could be built in phases. The Broadway/Weidler Interchange can be built independently of I-5 widening. The C-D road and the Grand Avenue ramp are also independent of other elements.

- **Not preclude advancement of long term visions for I-5 that would result in its re-alignment or relocation**

  The design team worked hard to find operational improvements that did not revise the I-84 interchange or the section of I-5 south of that interchange. The chance that any of the identified improvements would interfer with the potential for major revisions to I-5 south of the study area is low.

- **Create and/or support opportunities for desired land development adjacent to the corridor**

  These improvement do not remove much land from the "development bank", and in some cases, could create additional new areas for redevelopment.

- **Enhance and facilitate pedestrian and bicycle networks and movements**

  In many cases, the routes for pedestrians and bicycles would be more direct than existing conditions. Beyond that, the construction of new bridges and roadways present the opportunity to construct adequate facilities for both pedestrians and bicycles.

- **Accommodate or enhance transit movements**

  Light rail would not be directly affected by any of these improvements and for the most part, the planned streetcar extension would not be affected. Bus access to the Rose Quarter Transit Center would improve with Concept 3, probably degraded with
  Concept 2 and would be on par with the existing situation under the other concepts.

- **Respect existing land uses (minimize new right-of-way required for interchange or highway improvements)**

  The right-of-way requirements and building displacements are very minimal, especially considering this is a major facility in a densely urbanized area.

- **Respect key cultural and historic sites near the corridor**

  The cultural site located between Broadway and Weidler west of I-5 would not be displaced with any of the concepts.

- **Be constructable, enabling reasonable maintenance of traffic flow and access during reconstruction**

  The text and sketches contained in this report briefly describe how I-5 could be widened with a three-step process.

  The attributes listed above were identified in the planning workshop. There are several other ones that also were important in developing these potential solutions:

- **Minimize environmental impacts**

  This mainly relates to the Willamette River. Because the solutions do not include revisions to the portion of the I-5/I-84 Interchange that is near the river, all of these impacts were avoided. Many other environmental impacts were also avoided by staying largely within the existing right-of-way.

- **Support community goals**

  While there certainly are some impacts to community goals and urban fabric, there are also many opportunities for enhancing those goals. Those include better local access to adjacent land uses, opportunities for new development, more open space potential, better non-auto local circulation, better neighborhood connectivity, and no significant visual impacts. All of this can be done with very little increase in the barrier effect posed by I-5.

- **Improve freight movement**

  As explained earlier, the efficient movement of freight is really dictated by the overall efficiency of the highway system. So, the improved operation that would result from any of these solutions would also improve the situation for freight movement.

There has been a desire for more detail on a number of issues related to these scenarios and concepts. That level of detail is beyond the scope and budget for the current effort. Since it appears that there are feasible solutions and there is a desire for additional detail, it seems that the next step would be a formal refinement plan process, including advisory committees and a formal public involvement process.

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