APPENDIX O

NEPA Determinations

FTA and FHWA prepared NEPA determinations to analyze changes in the project and project impacts that have occurred since the DEIS. Two NEPA re-evaluations, a technical memorandum and a documented categorical exclusion (DCE), were prepared. The NEPA re-evaluations addressed the changes in project impacts from 1) the selection of the composite deck truss bridge type and 2) all other changes in design between the DEIS and FEIS. The technical memorandum addressed the changes in impacts from the 17th Street transit alignment, and the DCE addressed the impacts from the track work on the Steel Bridge.

The public was involved in the decision-making process that led to these design changes (as described in Chapter 2, Section 2.7 of the FEIS). Both agencies concluded from these determinations that these changes and new information would not result in any new significant environmental impacts that were not previously considered in the DEIS.

This appendix includes:

1. 17th Street Technical Memorandum and appendices (March 2010)
2. Composite Deck Truss Bridge Type NEPA Re-evaluation and appendices (March 2011)
3. Environmental NEPA Re-evaluation and appendices (May 2011)
4. Steel Bridge Documented Categorical Exclusion and appendices (November 2010)

This page intentionally left blank.

ATTACHMENT

17th Street
Technical Memorandum
and appendices

March 2010

Background

The CRC project has been considering a revised east-west connection for light rail to the terminal station at the Clark College park and ride in Vancouver. The DEIS issued in May 2008 included an evaluation of two alignment options, McLoughlin Boulevard and 16th Street to provide this east-west connection. Since the DEIS, there has been on-going discussion and analysis aimed at further improving and refining these options. This analysis has included consideration of using 17th Street, located between McLoughlin Boulevard and 16th Street (Figure 1). After the DEIS, the CRC team worked with the Vancouver Working Group (VWG; a group of local stakeholders) to refine the design of the McLoughlin alignment and to evaluate the 17th Street alignment as a potential option. Following several weeks of analysis, public input and discussion, the VWG ultimately endorsed the McLoughlin alignment over the 17th alignment, albeit by a very narrow margin. The 16th alignment was dismissed by the VWG due to cost considerations, transit travel time, safety concerns, and other reasons. Both the 17th and McLoughlin alignments would work well and, while each has tradeoffs, neither option has a significant advantage over the other.

Since the VWG completed its study and made its recommendation, the McLoughlin alignment has continued as the preferred option. However, the 17th Street alignment still garners support from a number of stakeholders. City staff have asked for additional consideration of the 17th Street alignment, and the Vancouver City Council and C-TRAN Board are considering making a formal recommendation in March that will either confirm the McLoughlin alignment as the preferred option or recommend that the project switch to the 17th Street alignment.

Comparison of Impacts

To further inform the decision-making process for the east-west connection to the LRT terminus, City staff and the project team have conducted additional analysis of the impacts and performance of the 17th alignment. Many of the impacts from the 17th Street alignment would be very similar in magnitude and character to the impacts from the options evaluated in the DEIS. As summarized in Figure 2, impacts would be the same or lower for nearly every element of the environment, and would be potentially higher for three elements:

- acquisitions/displacements
- noise impacts
- on-street parking

The following compares the impacts of the 17th Street alignment relative to the impacts of the options that were evaluated in the DEIS.

Transportation

There would be very minimal differences in transit performance between the three options. The 17th Street option is expected to add 9 seconds to the total trip time compared to the McLoughlin Boulevard option. The 16th Street option would add 11 seconds compared to the McLoughlin Boulevard option. The DEIS reported that the 16th Street option would convert the street to one-way westbound traffic. The revised 16th street design that was presented to the VWG maintained two-way traffic on 16th Street. The McLoughlin Boulevard and 17th Street options would maintain two-way traffic as well (Figure 3).

Traffic Operations

A traffic analysis was conducted on the 17th alignment in March 2010. Traffic operations for the McLoughlin alignment were analyzed for the FEIS. Traffic operations for 16th Street were analyzed in the DEIS, and were not updated since 16th Street was dropped as a viable candidate.

None of the three highest-volume, most-impacted intersections are within any of the three east-west alignment options. The Level of Service for all intersections within the three alignments meet city standards for both a.m. and p.m. peak hours.

Parking and Access

All options remove on-street parking. Design modifications since publication of the DEIS have revised the number of parking spaces that would be removed for each alignment. Under the current design, the 17th Street option would remove 114 parking spaces. The McLoughlin Boulevard option would remove 95 spaces. The 16th Street option would remove 96 spaces. However, the 16th option would eliminate 11 driveways or access points while the McLoughlin Boulevard and 17th Street options would remove none. All options would require right-in right-out movements onto the street.

Bike and Pedestrian Impacts

The 16th Street option would construct a new LRT-only tunnel with portals adjacent to a neighborhood, which could produce an unsafe environment for pedestrians, The McLoughlin Boulevard and 17th Street options would widen the existing McLoughlin Boulevard underpass, including sidewalks and bicycle paths. McLoughlin Boulevard currently has designated bicycle lanes and the McLoughlin option would retain them. The 17th Street and 16th Street options do not include designated bicycle lanes. All options would feature 12-foot sidewalks.

Aviation and Navigation

None of the alignment options would affect the Columbia River bridge crossing design, therefore there would be no difference in impacts to aviation and navigation for the 17th option compared to the DEIS options.

Property Acquisitions and Displacements

The 17th Street option would displace five single-family homes located near I-5. It would also require six partial property acquisitions. The 17th Street option would avoid the eight businesses that would be displaced with the McLoughlin Boulevard option. Total area of property acquisitions with the 17th alignment would be 0.67 acres (Figure 4).

The DEIS reported that the McLoughlin alignment could require partial acquisitions of approximately 33 parcels along McLoughlin, and would result in the displacement of two commercial buildings. The McLoughlin alignment design has been modified since the publication of the DEIS. The current design would require 18 partial acquisitions and three full acquisitions. The number of commercial buildings displaced has been increased to three, containing eight businesses. Most of the partial acquisitions would be relatively minor; generally, a narrow strip of property would be required from front yards to accommodate the widening of McLoughlin. No residential properties would be displaced. Total area of property acquisitions with the McLoughlin alignment would be 0.76 acres.

The DEIS also reported that the 16th Street alignment would result in the partial acquisition of the parcel on which the Clark County Historical Museum is located, but would not displace the use. As reported in the DEIS, the 16th Street option would displace two businesses. No residential properties would be displaced.

In the context of the project, the number of displacements with the 17th Street option results in a relatively minor additional impact to residential displacements and a relatively minor reduction in business displacements.

Land Use and Economic Activity

All five residential displacements with the 17th Street option are located in commercial zones and are designated Commercial and Mixed Use in the comprehensive plan. Four of the five residential displacements are in the City Center zone which is “designed to provide for a concentrated mix of

retail, office, civic and housing uses in downtown Vancouver" according to the Vancouver Municipal Code (VMC). One property is in the Community Commercial zone which is "designed to provide for retail goods and services purchased regularly by residents of several nearby neighborhoods." (VMC) Ground floor residential is not an allowed use in this location under the current zoning designation.

Zoning

The 17th Street alignment is entirely within the "City Center" Commercial Downtown (CX) District. The same is true for 16th Street. McLoughlin Boulevard, however, is only zoned CX on the south side of the Boulevard, west of C Street. The remainder of the frontage along McLoughlin is zoned Community Commercial (CC). North of McLoughlin, between I-5 and the middle of the block between G and H streets, the zoning is residential, with both R-9 and R-18 zoning (Figure 5).

The Community Commercial (CC) designation is intended for retail development near residential neighborhoods. This designation allows for structures that include some offices, institutions, and upper floor housing. Development is intended to be pedestrian-friendly, while promoting bicycle and transit travel. The Commercial Downtown District (CX) zoning district provides for a concentrated mix of retail, office, civic and housing uses in downtown Vancouver. The broad range of allowed uses is intended to promote Vancouver as the commercial, cultural, financial and municipal center of Clark County. In certain cases, the CX zone allows more intense uses and encourages a more urban development form. Specific land uses that are regulated differently in these zones are highlighted in the table below.

The selection of 17th or 16th Street, compared to McLoughlin Boulevard, could thereby facilitate different uses with redevelopment. For example, only parcels along McLoughlin Boulevard could be used for self-service storage. Similarly, only CX zoned land could accommodate a major event entertainment venue or ground floor residential units.

Summary of Differences in uses allowed by zoning code Section 20.430.030

	Community Commercial (CC)	Commercial Downtown District (CX)
Residential On Ground Floor	Residential must be located above the ground floor of the structure	Ground floor residential is allowed within the CX zone
Medical Centers	Conditional	Permitted
Commercial Lodging	Conditional	Permitted
Major Event Entertainment	Not Permitted	Permitted
Self-Service Storage	Permitted	Not Permitted
Industrial Services	Conditional	Not Permitted
Wholesale Sales	Not Permitted	Conditional

Building Heights

The Community Commercial (CC) designation is intended for retail development near residential neighborhoods. This designation allows for structures that include some offices, institutions, and upper floor housing. But within this zone, structures cannot exceed 50 feet in height (likely about four stories maximum). In the CX District, the maximum building height is 75 feet. For buildings in CX, near other zones (such as the north side of 17th Street) heights can be the same as that of the abutting zone within a distance of the same number of feet from the property line. Farther from the property line, height may increase by 2 feet for every additional 1 foot that a structure is set back from the property line to a maximum height of 75 feet. (For example, where the CX district abuts CC (with a maximum height of 50 feet), the maximum height in the CX district would be 50 feet for the first 50 feet from the property line. The height may then be increased by 2 feet for every additional 1 foot the structure or portion of the structure is removed from the property line to a maximum of 75 feet.

Plan Consistency

A number of policies in many plans refer to a balance of transit modes, including the Metro 2040 Growth Concept, the Regional Framework Plan, the Vancouver Comprehensive Plan, and the Clark County Comprehensive Plan. Certain local and regional plans support light rail transit, in general ways. Other plan policies specifically call for light rail on Hayden Island or in Vancouver. Adding light rail stations in Hayden Island and downtown Vancouver could result in more mixed-use and compact housing development around transit stations, which is also consistent with plan policies and goals.

There is little guidance in adopted plans that would inform the selection of the transit alignment. The Vancouver City Center Vision (VCCV), adopted originally in June 18, 2007 was amended by the Vancouver City Council on Monday, February 01, 2010. Their amendment changed the planned light rail alignment from a 2-way Washington option to the Washington-Broadway couplet. The same map (In appendix Part 3 of the VCCV) shows the light rail alignment on McLoughlin, though a footnote explains that the plan document is not binding on the selection of a preferred alignment.

Economic Impacts

16th Street

The DEIS reported that a portion of 16th Street would be converted to a westbound one-way street with parking on the north side of the street only. Since publication of the DEIS, the 16th Street alignment was modified so light rail would be center-running, 16th Street would be maintained as a two-way street, and all on-street parking would be removed. As a result, the access, visibility, and parking availability for businesses along 16th Street would decrease, potentially resulting in reduced sales for businesses that rely on drive-by sales and convenient parking. The majority of businesses along this section of 16th Street are professional and service-oriented businesses that do not rely on drive-by sales; therefore, this impact is expected to be small.

According to the DEIS Technical Report, the 16th Street alignment would require relocation of an estimated 10 employees at two businesses with well less than $1 million in annual sales. Relocated businesses would include office and retail. Design revisions since the DEIS report that the 16th Street option would remove 96 on-street parking spaces along 16th Street between Washington Street and G Street; two of these are disabled parking spaces, and none of them are loading zones. It would also eliminate 11 access points in this segment. No loading zones would be affected.

McLoughlin Boulevard

Currently, McLoughlin Boulevard is a two-way street with on-street parking. During operation of this alignment, McLoughlin Boulevard would remain a two-way street but would only have on-street parking where feasible. The current design would remove 95 on-street parking spaces between Washington Street and G Street. None of these are disabled parking spaces or loading zones. No access points would be lost, but drivers would be prohibited from making left turns across the guideway, except at signalized intersections. According to the DEIS Technical Report, the McLoughlin alignment would require relocation of an estimated 30 employees at eight businesses with approximately $3 million in annual sales.

17th Street

Currently, 17th is a two-way street with on-street parking. With this alignment, the street would remain two-way, but would remove 114 parking spaces between Washington Street and G Street. No access points would be lost, but drivers would be prohibited from making left turns across the guideway, except at signalized intersections. The 17th Street option requires the displacement of no businesses. It would, however, displace a group of houses, thereby reducing tax revenues.

Business Displacements

Option	No. Businesses Impacted	No. Employees Impacted	Affected Annual Sales (Millions)
16th Street	2	10	<$1
McLoughlin Boulevard	8	30	$3
17th Street	0	0	$0

While there would be some differences in the zoning and economic impacts of the three alignments, the 17th option would be within the range of impacts of the DEIS options.

Neighborhoods and Environmental Justice

The east-west alignments are in the Arnada neighborhood, and the table below illustrates the demographics of the neighborhood's residents compared to Vancouver and Clark County. The Arnada neighborhood is located immediately west of I-5 between Fourth Plain Boulevard and 15th Street, with Main Street as its western boundary. It is one of the earliest neighborhoods in Vancouver. Cohesion in Arnada appears to be moderate.

The Uptown Village shopping area and commercial downtown district allow residents a chance to connect to one another. However, a slightly higher crime rate than the city or county and moderate home ownership rates may reduce cohesion. The Arnada Neighborhood is relatively small, occupying approximately 55 square blocks. It is highly unlikely that the displacement if five houses on the outer edge of the neighborhood would change the neighborhood's overall cohesion.

The Arnada Neighborhood Action Plan was adopted in August 1996 and significantly updated in 2009. It includes many objectives addressing topics from crime prevention to speeding vehicles. The neighborhood's pursuit of many of these objectives could be aided by the introduction of light rail, so long as the design is context sensitive, street trees are preserved, and the pedestrian network is improved. One Action Step of the Plan is to *Work with City and CRC on establishing a LRT alignment that fosters redevelopment of Arnada south of McLoughlin.* The displacement of five houses associated with the 17th alignment would violate one of the Objectives of the plan: *Preserve the neighborhood's existing housing stock.*

The Arnada neighborhood has a higher proportion of low income residents than the City of Vancouver as a whole or Clark County. While this does not point to an Environmental Justice impact (a disproportionate high and adverse impact to low income residents) this data does suggest the need for further analysis, and the collection of demographic profiles from the potentially displaced businesses and residents.

	Arnada	Vancouver	Clark County
Minority Population	4%	18%	14%
Below Poverty Level	15%	12%	9%
Disabled	20%	19%	18%
Age 65 or Older	8%	11%	10%
No Car	11%	8%	6%

McLoughlin Boulevard may serve as a pedestrian route for student of the Washington State School for the Blind and School for the Deaf and the addition of light rail may add safety concerns for those users of McLoughlin. Transit on 16th and 17th would alter the existing residential character of these portions of the neighborhood.

The Arnada Neighborhood would be similarly impacted by any of the alignment options. Surveys of potentially impacted households (currently underway) will provide data to complete the Environmental Justice analysis.

Public Services and Utilities

Impacts on utilities and public services would be low for all three options. Due to the location of a 20-inch water main on 16th Street and the necessity to build a tunnel for this option, the 16th Street alignment would have the

highest impacts to utilities. The 17th Street alignment would have comparable impacts to utilities as the McLoughlin alignment.

Traffic impacts on McLoughlin would be slightly lower with the 16th or 17th option than with the McLoughlin option, allowing for slightly faster response times for emergency vehicles using McLoughlin, which is the main east-west connection across I-5.

Based on the above description of impacts, the impacts to public services and utilities would not be higher with the 17th Street option than with the range of DEIS options.

Parks and Recreation

The nearest park to the three alignment options is Marshall Park, located east of I-5 on both sides of McLoughlin Boulevard. The McLoughlin and 17th Street options would both be located fully within the existing McLoughlin Boulevard right-of-way on the east side of I-5, so neither option would have an adverse effect on Marshall Park. The 16th option would cause slightly higher impacts to Marshall Park due to the new tunnel under I-5 which would require acquisition of a portion of the park. No other parks or recreation facilities would be impacted by the three alignment options, therefore, there would be no meaningful difference in impacts to parks and recreation between the 17th Street option and DEIS options.

Historic and Archaeological Resources

The 17th Street option would not result in any permanent direct effects to NRHP-listed or eligible properties. As presented in the DEIS, the 16th Street option required a minor permanent property acquisition from one NRHP-listed property, though this was preliminarily determined to have no adverse effect. The McLoughlin Boulevard option, as presented, required the permanent property acquisition from five NRHP-eligible properties resulting in two potential adverse effects. It has since been determined that one of the properties on McLoughlin is not NRHP-eligible, so the McLoughlin option now requires permanent property acquisition from four NRHP-properties resulting in one potential adverse effect (Figure 4).

The DEIS reported that high-capacity transit would travel on the south side of 16th Street from Mill Plain to I-5. Access to the Carnegie Library which is now used as the Clark County Historic Museum would be adversely affected by the loss of ADA and delivery access from 16th Street. This adverse affect would need to be mitigated through a Memorandum of Agreement. There is one historic resource on 16th Street, whose access would be blocked but which would not constitute an adverse effect.

The DEIS identified four NRHP-eligible properties which would have permanent acquisitions on the McLoughlin alignment. Design refinements have reduced the number to three. At the Carpenters Union Building (612 E McLoughlin) the front planter box, which is part of the original design of building, would be removed. The feature is currently within the public right-of-way, and will be further into the public right-of-way following

the required acquisition. This will result in the removal of this feature. This acquisition would constitute an adverse effect to the historic resource because it would change the integrity of the building's original design (Figure 6).

Access to McLoughlin from one commercial building (a former single-family house) would be changed to right-in-right-out only for vehicles following construction of the light rail alignment. The change in access results in no effect to the historic resource. Additionally, the sidewalk in front of the house has the original contractors stamp. The stamped portion of the sidewalk should be incorporated into the rebuilt sidewalk. Relocation of their original contractor's stamp will not result in an adverse impact.

There are numerous early 20th century houses on 17th Street, of which four have been determined to be NRHP-eligible. There will be no acquisitions from these properties. Two of these resources would have their driveway access changed to right-in and right-out only. These historic resources will not be affected by a modification of their driveway use. The houses which will be displaced are not NRHP-eligible because they never had historic significance or have lost design integrity through inappropriate rehabilitations.

Some of the sidewalks along 17th Street have the original contractors' stamps as well as angle irons. The angle irons protected curbs from the hardened wheels utilized in the early 20th century. The stamped portions of the sidewalk should be incorporated into the rebuilt sidewalk. Relocation of original street features will not result in an adverse impact.

Potential impacts to archaeological resources are expected to be similar (low) for all of the alignment options. Archaeological investigations under existing roadbeds have been limited to archival research and review of previous studies. The 17th Street option would have less excavation than the 16th Street option, and similar excavation to that for the McLoughlin Boulevard option.

Based on the above description of impacts, the impacts to historic and archaeological resources would not be higher with the 17th Street option than with the range of DEIS options.

Visual and Aesthetic Qualities

All three potential light rail alignments are within the same landscape unit (Vancouver-Downtown). There are many historic or vintage buildings and homes throughout the landscape unit (LU) that contribute to a distinctive residential urban character. Commercial uses have clustered along portions of McLoughlin Boulevard.

The street system is a north-south and east-west oriented grid that is broken occasionally by large lots. The grid allows long views up and down the streets and contributes to the sense of overall cohesion. Streets range in size from narrow two-lane residential street to wider boulevards in downtown. Because of the continuity of the street trees and the presence of mature park vegetation, the overhead appurtenances (wires, signage, lighting, etc) are not obvious. The residential area has a fine texture because of the generally small-scale street

grid, and the small to moderate scale of building footprints and lot sizes. Viewers in this landscape unit are travelers on I-5 and local streets including commuters, shoppers, visitors, tourists, and residents, as well as slower moving observers including recreationists and residents.

The necessary striping or tracks, rumble strips and curbs, and advisory signage would not produce a large change or introduce incompatible structures and furnishings into the streetscape. As stated in the DEIS, changes to the character and quality of 16th Street from installing transit facilities are expected to be low level. The same would be true for 17th Street because of the similar residential character of the two streets. The visual character of McLoughlin Boulevard could change more noticeably, as there would be impacts to the recently redesigned streetscape, its crosswalks and diagonal parking. However, the higher intensity use (of frequent running light rail vehicles) would result in a higher degree of change from the currently quiet, underutilized, local roads (16th and 17th Streets) (Figure 7).

Based on the above description of impacts, the impacts to visual and aesthetic qualities would not be higher with the 17th Street option than with the range of DEIS options.

Air Quality

The 17th alignment would not affect traffic volumes on the I-5 mainline or ramps, and therefore would have the same effect on I-5-related emissions as the other options (no violations of ambient air quality standards, and emissions would be 30 to 90 percent lower than they are today).

An analysis of localized carbon monoxide (CO) concentrations was performed for the three highest volume, most impacted intersections in Vancouver. However, these three intersections (E 39th Street and Main Street, Mill Plain Boulevard and C Street, and Mill Plain Boulevard and I-5 interchange) are unaffected by the east-west LRT alignment option, and therefore the selection of the east-west alignment has no bearing on the CO hotspot analysis. The CO hotspot analysis has been prepared for the FEIS and indicates that there would be no violation of CO hotspot standards with any of the east-west alignment options.

Based on the above description of impacts, there would be no meaningful difference in impacts to air quality for the 17th option compared to the DEIS options.

Noise and Vibration

According to the DEIS, the 16th Street option would have noise impacts to four residences and vibration impacts to five residences and the McLoughlin Boulevard option would have noise impacts to 12 residences and vibration impacts to 12 residences. Noise and vibration modeling was conducted for the 17th Street and McLoughlin options in March 2010. This modeling determined that the 17th Street option would have noise impacts to 20 residences and vibration impacts to 19 residences and

the McLoughlin option would have noise impacts to 19 residences and vibration impacts to 19 residences. While the number of residences with noise impacts by the 17th Street alignment would be one higher than the McLoughlin alignment, the level of impact to each receiver is within the range of the DEIS options (ranging from 72-78 VdB and 56-63 dBA). All impacts are predicted to be moderate and none are predicted to be severe per FTA impact criteria (Figure 8).

With all three alignments, noise and vibration impacts could be mitigated to below the FTA criteria for residential land uses. The 17th Street option has a slightly higher number of residences impacted by noise than the McLoughlin option prior to mitigation. Similar to the DEIS options, noise levels on 17th Street would be mitigated with Residential Sound Insulation to bring the noise levels to within FTA criteria.

Vibration levels would be mitigated with rail boots within the embedded track. Rail boots typically reduce vibration levels by 4 to 6 VdB, which would bring all the predicted vibration levels to below the FTA 72 VdB criteria for residential land uses.

Given that a number of the existing residences on 17th Street are vacant, and given the on-going transition of this street from residential to commercial uses, the actual number of residences needing mitigation would likely be lower. Mitigation measures for noise and vibration would reduce all impacts to below FTA criteria.

Energy

Transit energy consumption with the 17th Street alignment would be similar to the 16th Street option and slightly higher than the McLoughlin option. The curves in the 17th and 16th Street options result in slight higher LRT travel times which would slightly increase operational energy consumption. Therefore, the 17th Street option would be within the range of the DEIS options.

Electric and Magnetic Fields

Electrical substation location would not be impacted by the east-west alignment options, therefore there would be no difference in impacts from electric and magnetic fields for the 17th Street alignment option compared to the DEIS options.

Ecosystems

All of the proposed alignments are in locations that are already fully urbanized and contain no habitat other than street trees, mowed lawns and incidental landscaping. Therefore, there would be no meaningful difference in impacts to ecosystems for the 17th Street option compared to the DEIS options.

Wetland and Jurisdictional Waters

All of the proposed alignments are in locations that are already fully urbanized and contain no wetlands or surface water. Therefore, there would be no

meaningful difference in impacts to wetlands and jurisdictional waters for the 17th Street option compared to the DEIS options.

Hydrology and Water Quality

All three options would have minimal new impervious surface area. The McLoughlin option would narrow the parking strip on McLoughlin Boulevard, and on the 17th Street alignment the guideway would cross two parcels that are currently partially landscaped. Storm water management would be the same for the 17th Street alignment as for the 16th Street and the McLoughlin options. Therefore, there would be no meaningful difference in impacts to hydrology and water quality for the 17th Street option compared to the DEIS options.

Geology and Soils

The 17th Street alignment would be at-grade, requiring no tunneling or elevated structures and therefore no deep excavations or shafts, very similar to the McLoughlin option. Impacts would be higher with the16th Street option because it would require a new tunnel to cross under I-5. Therefore, the 17th option would be within the range of the DEIS options.

Hazardous Materials

Potential hazardous material sites are primarily located in the Washington-Broadway corridor. Because the McLoughlin option would travel the furthest within this corridor, the McLoughlin alignment would be associated with the most potential hazardous materials sites, followed by the 17th Street alignment and the 16th Street alignment (Figure 4). As shown in the table below, the number of potential hazardous materials sites on 17th Street is within the range of the DEIS options.

Potential Hazardous Materials Sites on Each Alignment

Alignment	Number of potential hazardous materials site based on historic uses (Number that may be significant)	Number of potential hazardous materials sites based on state/ federal database (Number that may be significant)
16th Street	3 (2)	0 (0)
17th Street	8 (4)	1 (0)
McLoughlin Boulevard	15 (9)	4 (1)

Construction Impacts

Construction impacts for all options would include increased truck traffic, equipment noise, temporary and partial detours, lane closures and sidewalk restrictions. Access would be maintained to existing uses on each of the streets but would be restricted or more circuitous at times to maintain safety during construction. Construction of the McLoughlin alignment would cause higher temporary traffic impacts than the 17th or 16th Street options, because McLoughlin Boulevard is the main east-west connection in the area. The 16th

Street option would have higher construction noise and truck traffic associated with building a new tunnel under I-5. Since construction-related impacts would be similar for all the options, the 17th Street option is within the range of the DEIS options.

Revised Documentation or Determinations under Federal Regulations

Consultation and other federal regulatory processes for the CRC project are only partially complete, and the project will not submit permit applications until after the Record or Decision. Therefore, any changes to the east-west LRT alignment at this time will cause little or no change in regulatory documentation or determinations.

There would be no meaningful difference between these options associated with the Endangered Species Act, Magnuson-Stevens Act, Farmland Preservation Act, Section 404-Clean Water Act, Floodplain Management Act, or with CERCLA, 6(f) Lands, Wild and Scenic Rivers, Coastal Barriers, Coastal Zone, Sole Source Aquifer, or National Scenic Byways regulations.

The changed conditions would have a minor impact to documentation associated with Section 106 National Historic Preservation Act (reduced impacts), Section 4(f) (reduced impacts), and Uniform Relocation Act (fewer business relocations and more residential relocations).

Section 106 of the National Historic Preservation Act documentation is not yet completed. The preliminary determination is that the project will have an overall adverse effect. The 17th Street option will not change this determination. Some of the preliminary determinations of adverse impacts to specific resources associated with 16th Street or McLoughlin Boulevard would be removed because the 17th Street option will not affect NRHP-listed or-eligible properties. The 17th Street option would also result in removing one historic resource from the 4(f) Evaluation.

The project will require displacements and acquisitions regardless of the potential change in alignment. The 17th Street option would not require revisions to existing Uniform Relocation Act documentation but it would result in minor differences in future documentation associated with Uniform Relocation Act compliance. With the 17th Street option, the total number of businesses requiring relocation (64) would decrease to 56; and the total number of residences needing relocation (46) would increase to 51.

NEPA Compliance

The DEIS did not include a 17th Street option. Therefore, additional public and agency coordination, as well as documentation of the option's impacts and tradeoffs, are warranted.

Outreach and public involvement related to 17th Street as an east-west alignment option began through a citizen advisory committee, the Vancouver Working Group (VWG). In reviewing the alternatives included in the DEIS for east-west alignments, the group requested the project consider 17th Street as an additional alignment option. During this preliminary review, the group was provided with information and a bus/walking tour in advance of developing a group recommendation. On May 14, 2009, VWG members voted on their preferred east-west alignment. Nine members favored McLoughlin and eight favored 17th Street.

To follow-up on the split decision, project staff attended multiple Arnada neighborhood association meetings. The neighborhood took a vote in favor of the 17th Street alignment. Over the summer, staff also attended Hough, Esther Short and Uptown Village Association meetings.

The VWG recommendations were brought to the City of Vancouver Council on October 19, 2009 and the C-TRAN Board of Directors on November 10, 2009. Upon learning about the VWG's split vote of the east-west alignment, members of both bodies directed CRC staff to more thoroughly investigate both the McLoughlin Boulevard and 17th Street alignments. Both of these meetings were open to the public.

From November 2009 until February 2010 CRC project staff conducted extensive technical work and public outreach regarding the alignment options. The public outreach process included the following:

- All potentially impacted property owners and tenants, along the couplet as well as along 17th Street and McLoughlin Boulevard, were mailed a letter on February 2, 2010 which included a map and description of the proposed alignments, as well as invitations to open houses on February 23 and 24, and a one-on-one meeting with project staff to discuss potential property impacts. A total of109 letters were sent to tenants and owners of 73 properties.
- In addition, project staff conducted door-to-door outreach throughout the week of February 15, 2010.

The VWG was brought back together on February 4, 2010 for an update. Members were encouraged to attend the transit open houses on February 23rd and 24th.

Based upon both verbal and written comments, general patterns can be seen in the east-west light rail opinions:

- Property owners/tenants on both McLoughlin Boulevard and 17th Street are concerned about the loss of access and parking.

- Important to ensure safe pedestrian, bicycle, and automobile crossing if light rail does cross over from 17th Street to McLoughlin Boulevard.
- There are more economic development opportunities on 17th Street due to vacant land and zoning requirements.
- There is concern that it is fiscally irresponsible to destroy the financial investment that the City of Vancouver has recently put into McLoughlin Boulevard streetscape improvements.
- There is a more substantial business community on McLoughlin Boulevard that relies on on-street parking than on 17th Street.
- There is less available right-of-way on McLoughlin Boulevard than on 17th Street because bike lanes will be maintained on McLoughlin. This makes a 17th Street alignment more attractive.
- McLoughlin Boulevard provides a more direct route to the terminus station and is designated the transit street.

Information gathered to date will be sent to the Vancouver City Council and C-TRAN Board who will be convening in March and April respectively to make recommendations. The project will continue to schedule one-on-one meetings and will follow-up with property owners and tenants not reached to date via phone.

As discussed above, impacts from the 17th Street option have already been evaluated and compared to the other alignment options. This analysis shows that the 17th Street alignment would not result in any new significant adverse environmental impacts, and would be very similar in character, performance and impacts to the range of options evaluated in the DEIS. Based on the series of neighborhood meetings, VWG meetings, hearings and other outreach associated with this option, it also appears that it is not the subject of any new public controversy or opposition. These factors indicate that an appropriate approach for completing NEPA documentation for the 17th Street alignment would be:

1. Document the impact analysis (and comparison to the DEIS options) through a Re-evaluation, then
2. Incorporate the findings into the Final EIS, along with a summary of the agency and public process used to gather input on the alignment.

Appendix A

Figures

Figure 1. Light Rail Transit East-West Alignment Options

Figure 2. Comparison of Environmental Impacts of East-West Alignment

Figure 3. Transportation Impacts

Figure 4. Property Acquisitions/Historic Resources/Hazardous Materials

Figure 5. Zoning and Comprehensive Plan Designations

Figure 6. Carpenters Union Building

Figure 7. Existing Streetscapes

Figure 8. Noise Impacts

Columbia River CROSSING

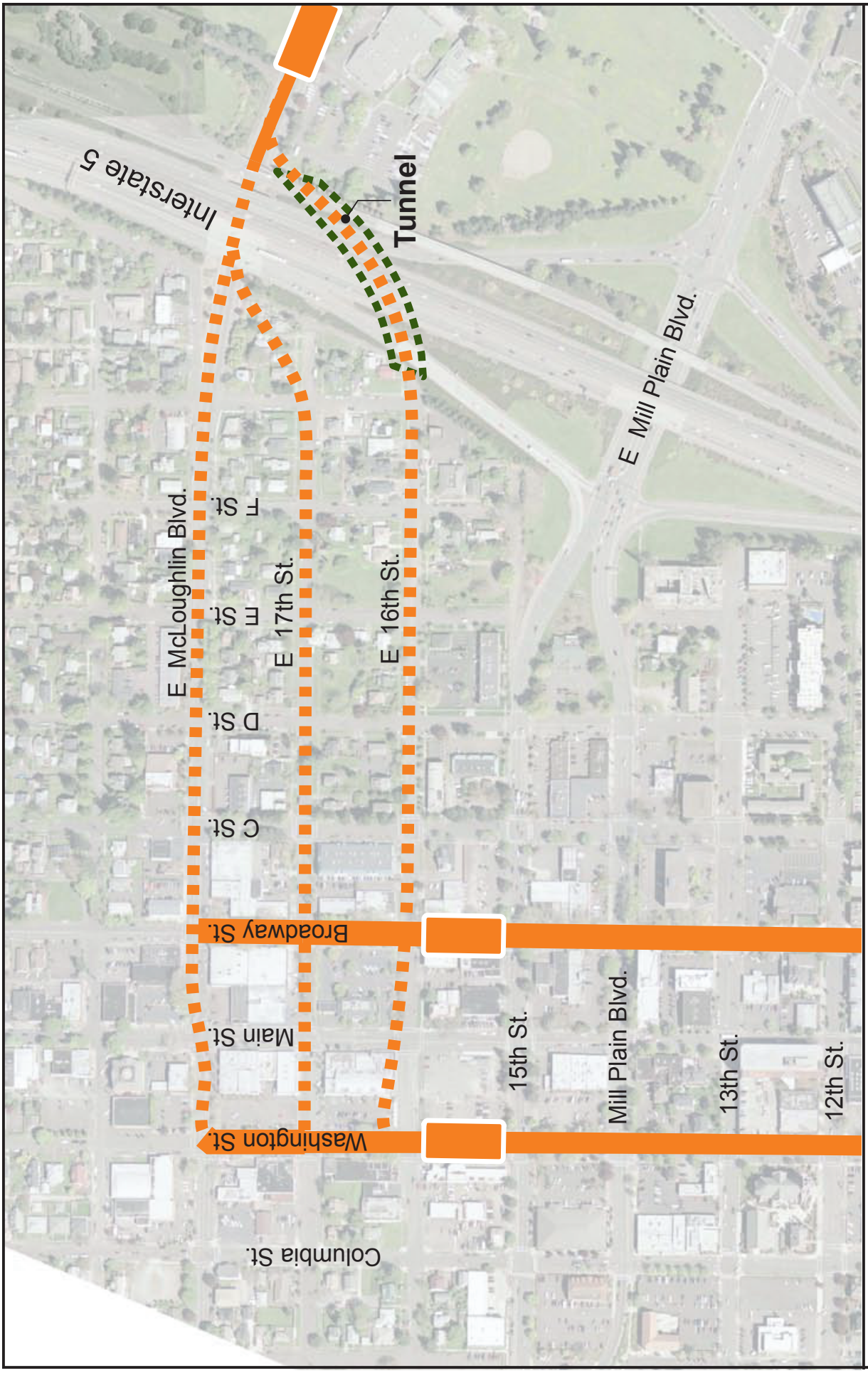


Figure 1.
Light Rail Transit East-West Alignment Options

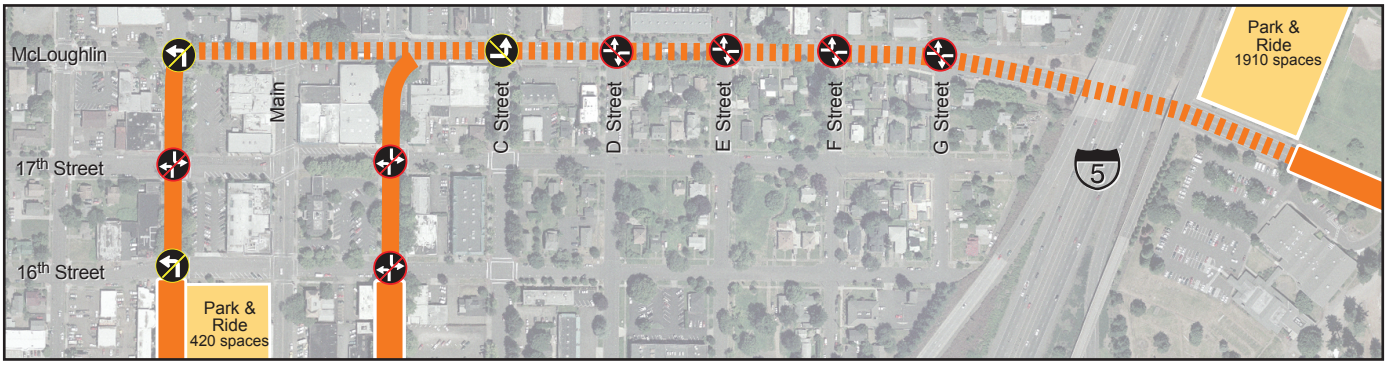
Columbia River CROSSING

	16th Street[2]	McLoughlin Boulevard[5]	17th Street[5]
3.1 TRANSPORTATION			
Transit performance	+11 seconds compared to McLoughlin[3]	N/A[3]	+9 seconds compared to McLoughlin[3]
Local street performance	• Maintain two-way traffic[5] • Level of service for all intersections meet city standards	• Maintain two-way traffic • Level of service for all intersections meet city standards	• Maintain two-way traffic • Level of service for all intersections meet city standards
Parking and access	• Remove 96 on-street parking spaces[5] • Eliminate 11 access points	• Remove 95 on-street parking spaces • Eliminate no access points	• Remove 114 on-street parking spaces • Eliminate no access points
Safety and security	Tunnel portals can provide an unsafe environment	No tunnel portals	No tunnel portals
Bicycle/Pedestrian	12-foot sidewalks	12-foot sidewalks	12-foot sidewalks
3.3 PROPERTY ACQUISITION AND DISPLACEMENTS			
# of residential property displacements	0	0	5
# of business displacements	2	8	0
# of partial property acquisitions	0	18	6
# of full property acquisitions	0	3	5
Total area of acquisitions	<0.01 acres	0.76 acres	0.67 acres
3.4 LAND USE AND ECONOMIC ACTIVITY			
	Commercial Downtown Zone	Commercial Downtown Zone, Community Commercial, and Residential	Commercial Downtown Zone
	Displacement of 2 businesses with 10 employees and less than $1 million in annual sales	Displacement of 8 businesses with 30 employees and $3 million in annual sales	Displacement of no businesses
3.5 NEIGHBORHOODS AND ENVIRONMENTAL JUSTICE			
	Increase traffic congestion and noise in a residential and commercial area	May serve as pedestrian route for Washington State School for the Blind and School for the Deaf which may add safety concerns	Increase traffic congestion and noise in an residential and commercial area
3.6 PUBLIC SERVICE AND UTILITIES			
	Highest impact to underground utilities[4]	• Low impact to underground utilities4 • Could result in greater impacts to mobile public services than 16th or 17th alignment	Low impact to underground utilities[4]
3.7 PARKS AND RECREATION			
	Slight impact to Marshall Park	No impact to parks	No impact to parks
3.8 HISTORIC AND ARCHAEOLOGICAL RESOURCES			
Acquisitions of NRHP-listed or -eligible properties	• Acquisition related impact to NRHP-listed Clark County Historical Museum. • Would not result in displacement of building. • ADA and delivery access eliminated. • Preliminary finding of adverse effect	• Three partial acquisitions of NRHP-eligible properties. • Would not result in displacement of historic buildings. • Preliminary finding of one adverse acquisition.	• No acquisition related impacts to NRHP-listed or -eligible properties • Would not result in displacement of historic buildings.
3.9 VISUAL AND AESTHETIC QUALITIES			
	Potential for change in character of underutilized local street	Potential for change in character of recently redesigned streetscape	Potential for change in character of underutilized local street
3.11 NOISE AND VIBRATION			
	• Noise impacts: 4 residences • Predicted dBA level: 59 to 62 • Vibration impacts: 5 residences • Predicted VdB level: 78 • No crossing bell	• Noise impacts: 19 residences • Predicted dBA level: 57 to 63 • Vibration impacts: 19 residences • Predicted VdB level: 72 to 73 • No crossing bell	• Noise impacts: 20 residences • Predicted dBA level: 61 to 63 • Vibration impacts: 19 residences • Predicted VdB level: 72 to 76 • Crossing bell at intersection of light rail tracks and McLoughlin
3.18 HAZARDOUS MATERIALS			
Number of potential hazardous materials sites based on historic uses (number that may be significant):			
	3 (2)[5]	15 (9)	8 (4)
Number of potential hazardous materials sites based on State/Federal database (number that may be significant):			
	0 (0)[5]	4 (1)	1 (0)

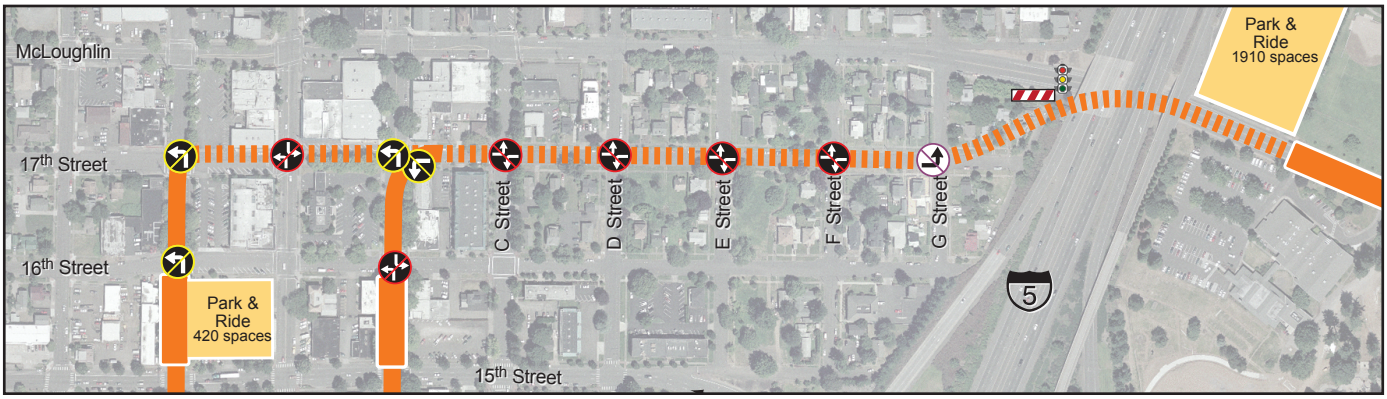
1 FEIS sections 3.2 Aviation and Navigation, 3.10 Air Quality, 3.12 Energy, 3.13 Electric and Magnetic Fields, 3.14 Ecosystems, 3.15 Wetlands and Jurisdictional Waters, 3.16 Water Quality and Hydrology, and 3.17 Geology and Soils have no meaningful difference in impacts.
2 Information is from DEIS or associated technical reports unless otherwise noted.
3 DEIS states "transit alignment options…would not substantially affect the transit performance metrics." Data produced for the VWG states that transit performance for 16th Street is +11 seconds and 17th St. is +9 seconds (both compared to McLoughlin).
4 Information is based on analysis of utility location since publication of the DEIS.
5 Since publication of the DEIS, design has been refined. Information is from refined alignment design unless otherwise noted.

Figure 2. Comparison of Environmental Impacts of East-West Alignment

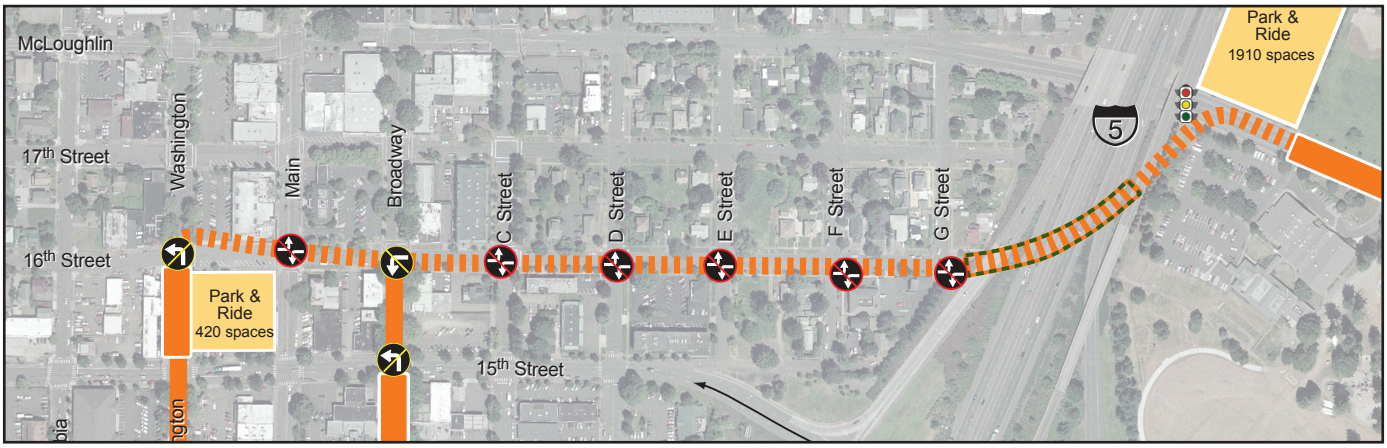
McLoughlin Boulevard



17th Street



16th Street



Broadway/Washington Alignment
East/West Alignment Option
Tunnel

No Left Turns
No Left Turns (North to West)

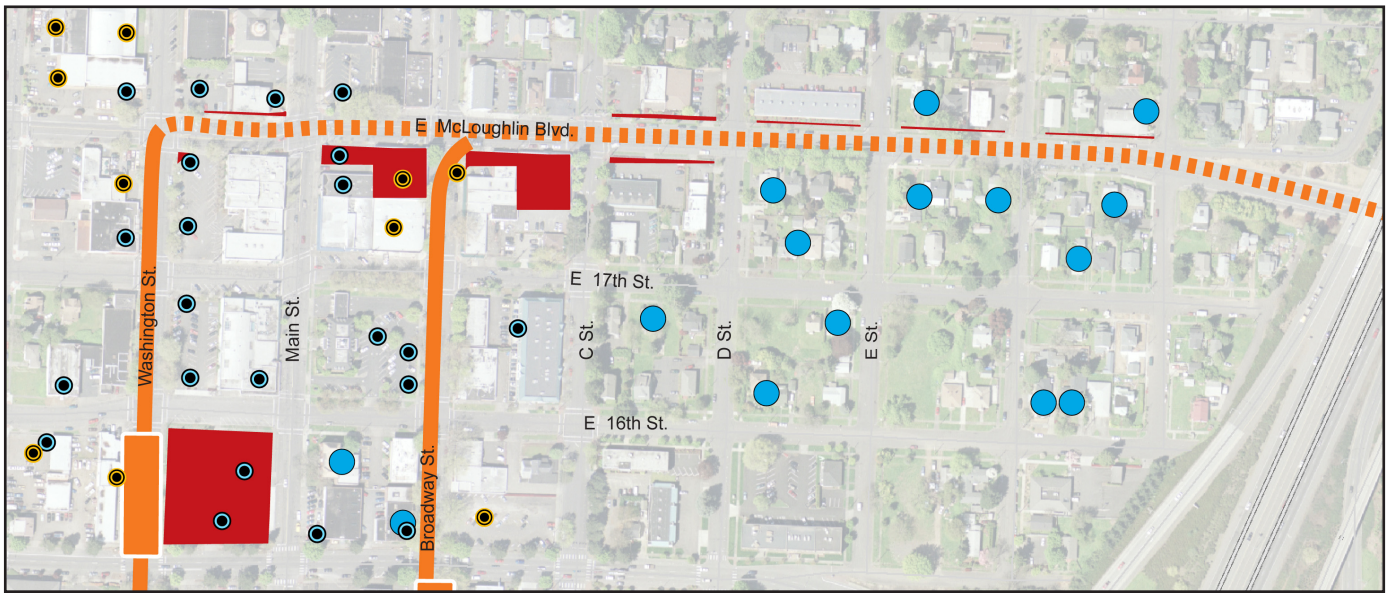
No Left Turns (North or South)
No Left Turns (West to South)

Add Signal
Crossing Gate

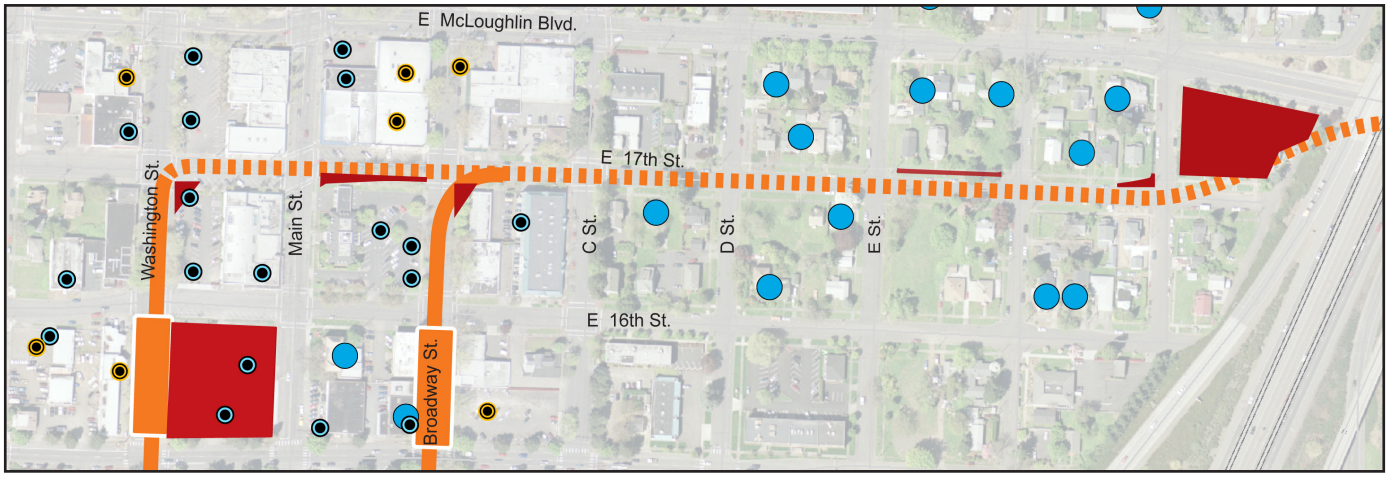
Figure 3. Transportation Impacts

Columbia River CROSSING

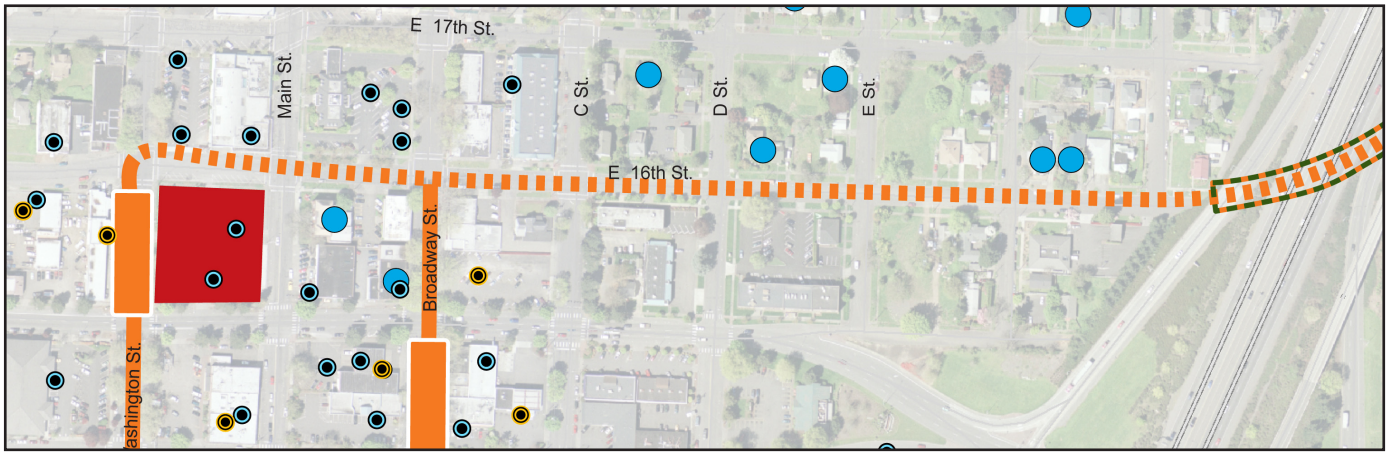
McLoughlin Boulevard



17th Street



16th Street



Broadway/Washington Alignment
East/West Alignment Option
Property Acquisition

Determined NRHP Eligible
Potential Hazardous Materials Site
State/Federal Database Hazardous Materials Site

Figure 4. Property Acquisitions/ Historic Resources/Hazardous Materials

Columbia River CROSSING

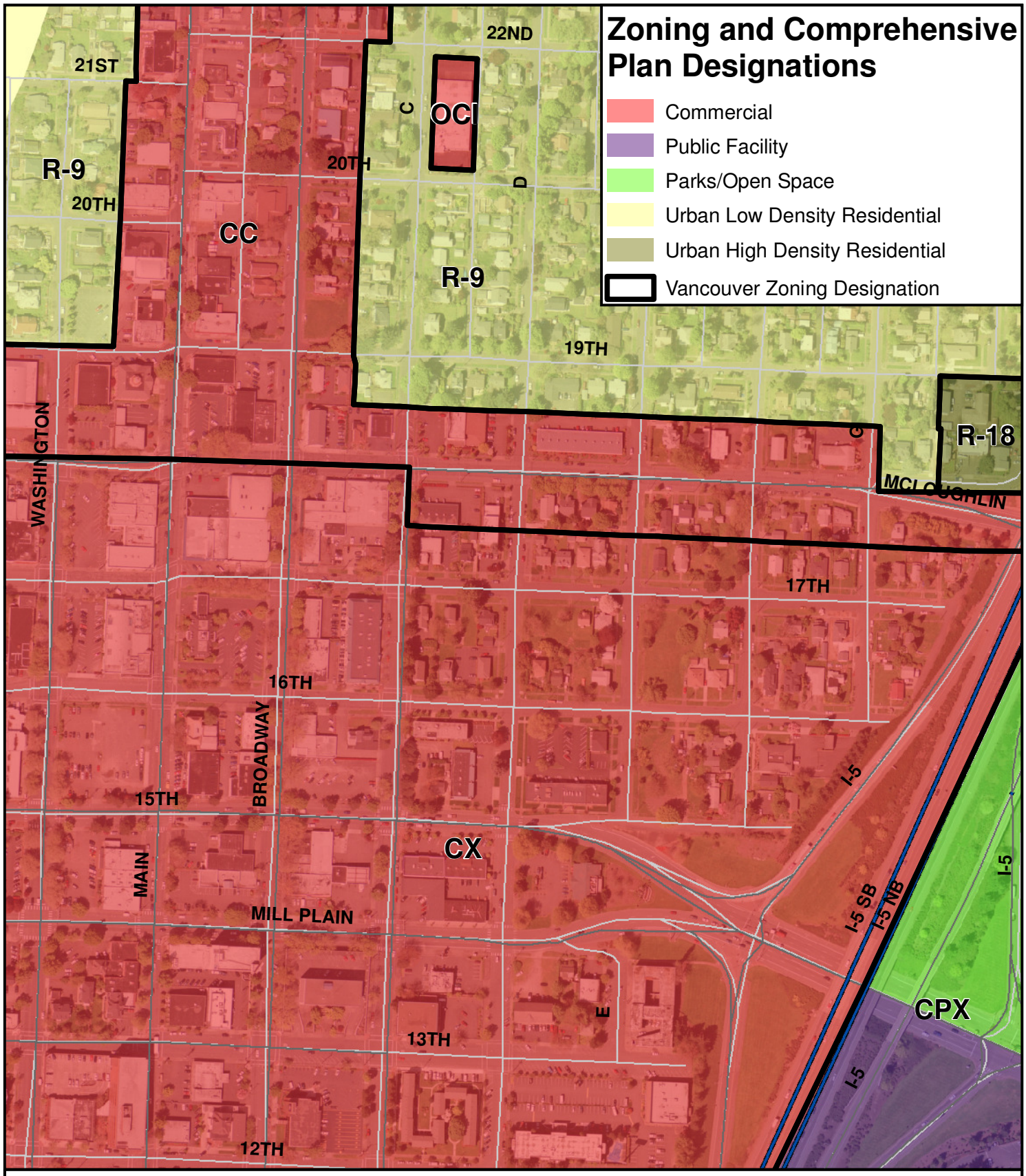


Figure 5. Zoning and Comprehensive Plan Designations

Source: Clark County, WA, Assessors Office, GIS Digital Data, complan.shp, 2009.

Analysis by J. Koloszar; Analysis Date: Mar. 5, 2010; File Name: Complan_DC212.mxd

612 E McLoughlin

Figure 6. Carpenters Union Building

Columbia River CROSSING

McLoughlin Boulevard from C Street (facing east)

17th Street from C Street (facing east)

16th Street from C Street (facing east)

Figure 7. Existing Streetscapes

Columbia River CROSSING

Figure 8. Noise Impacts

Columbia River CROSSING

Analysis by J. Koloszar; Analysis Date: Mar. 5, 2010; File Name: Complan_DC212.mxd

Note: Predicted noise impacts from train operation only. Does not include impacts from potential crossing bell on 17th alignment.

ATTACHMENT

Composite Truss Bridge Type
NEPA Re-evaluation
and appendices

March 2011

U.S. DEPARTMENT OF TRANSPORTATION

Federal Highway Administration
Oregon Division Office
530 Center Street, Suite 100
Salem, Oregon 97301
503-399-5749

Federal Transit Administration
Region 10
915 Second Avenue, Room 3142
Seattle, Washington 98174-1002
206-220-7954

April 19 2011

RECEIVED
APR 25 2011
Columbia River Crossing

Nancy Boyd
Project Director
Columbia River Crossing
700 Washington Street, Suite 300
Vancouver, WA 98660

RE: CRC's NEPA Re-evaluation for Composite Truss Bridge Type

Dear Ms. Boyd:

The Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA) have received the Environmental Re-Evaluation Worksheet, including supporting documentation, dated March 29, 2011, and supplemental information, submitted on April 11, 2011 regarding the Columbia River Crossing project's recommendation to change the design for the main river crossing bridge type from an open web box (OWB) girder to a composite truss. The design changes considered are between Oregon Interstate 5 milepost 308.38 and Washington Interstate 5 milepost 0.52. You have offered this information seeking FHWA's and FTA's position on whether this change in bridge design will require a Supplemental Draft Environmental Impact Statement (SDEIS) under the National Environmental Policy Act (NEPA).

While the Draft Environmental Impact Statement (DEIS) for the project, dated May, 2008, did not evaluate a specific bridge type, it did however dismiss "high level" and "low level" bridges due the impacts on navigation and air traffic. What remained for bridge types that would fit within the DEIS project description are considered "mid-level" bridges. Both the OWB girder and the composite truss can be designed to fit within the "mid-level" range for overall height and river clearance. The composite truss is very similar to the open web box (OWB) girder regarding footprint and environmental impacts and is considered a "mid-level" bridge, thus avoiding the environmental constraints related to navigation and air traffic identified in the DEIS. The submitted Re-evaluation is based on the assumption that the composite truss bridge will remain on the same over-water, curved alignment and will touch down on land in the same locations that was presented in the DEIS. The primary differences between the composite truss and the OWB girder are that vertical concrete elements will be replaced with steel diagonal members, and that the structure will be lighter, resulting in a smaller in-water footprint due to smaller foundations. Other than (the potential lessening of) impacts related to the smaller water

footprint, and minor changes to pedestrian connections on the Washington shore, the submitted Re-evaluation indicated no changes in environmental impacts due specifically (and only) to this change in bridge design.

The purpose of the March 29, 2011 Re-evaluation is to evaluate the narrow question of whether the change from an open web box girder to a composite truss bridge will require a Supplemental DEIS. In that evaluation, we must consider whether the new bridge design presents significant environmental impacts which were not reviewed in the DEIS. (23 CFR Section 771.129). Based on the specific information you have provided, FHWA and FTA concur that the change from an OWB girder bridge type to a composite truss bridge type does not create new significant environmental impacts that would require a Supplemental DEIS.

Please note that we offer this position solely on the limited question of whether NEPA would require a Supplemental DEIS only focusing on the bridge type change due to potential significant impacts that a change in bridge design could create. However, we also understand that the project is considering other project changes that may also bring into question the need for supplemental environmental reviews -- including a Supplemental DEIS. We ask that any future request for environmental review re-evaluation include, as much as possible, all project changes and refinements that have been implemented since the May, 2008 DEIS so that we can make one final determination as to whether or not a Supplemental DEIS will be required for the project.

Sincerely,

R.F. Krochalis
Regional Administrator
Federal Transit Administration

for Phillip Ditzler
Division Administrator - Oregon
Federal Highway Administration

Daniel Mathis
Division Administrator – Washington
Federal Highway Administration

Columbia River CROSSING

700 WASHINGTON STREET
SUITE 300
VANCOUVER, WA 98660
360-737-2726 | 503-256-2726

March 29, 2011

R.F. Krochalis
Federal Transit Administration, Region 10
915 2nd Avenue, Suite 3142
Seattle, WA 98174-1002

John McAvoy
Federal Highway Administration-Oregon Division
610 E 5th Avenue
Vancouver, WA 98661

Subject: CRC Composite Truss NEPA Re-evaluation

To Mr. McAvoy and Mr. Krochalis,

Attached is a NEPA Re-evaluation to cover a change in bridge type from the current open web box girder (OWBG) to a composite truss. The bridge would still be on the same downstream curved alignment that was analyzed in the Draft Environmental Impact Statement. The DEIS did not actually specify a particular bridge type. Rather, the DEIS described the basic location, size, height and clearance assumptions for the bridge, noting that the specific design would be determined later. A key limitation on the DEIS analysis was that the bridge would not include tall towers. The OWBG, composite truss, and other similar bridge types all fit within the bridge parameters and impacts described and analyzed in the DEIS.

The OWBG and composite truss are almost identical in terms of environmental impacts, size and look. The primary difference is that the composite truss has a lighter weight superstructure, which results in a slightly smaller footprint in the water because the pier foundations can be smaller. The OWBG is a concrete box structure with portions of the webs (vertical walls) removed and replaced with diagonal steel members. By contrast, a composite truss is comprised of primarily steel framing (similar to a traditional truss structure) with concrete slabs on upper and lower levels.

Based on the information contained in the attached re-evaluation, we conclude that there are no new significant environmental impacts from changing bridge types to a composite truss and a Supplemental Environmental Impact Statement is not warranted.

We request, in writing, FHWA and FTA concurrence on the conclusion that a Supplemental DEIS is not necessary for a composite truss bridge type on the downstream curved alignment.

Thank You,

Heather Wills, CRC Environmental Manager
cc: Steve Saxton, FTA
Project Controls

ENVIRONMENTAL RE-EVALUATION CONSULTATION

Note: The purpose of this worksheet is to assist sponsoring agencies in gathering and organizing materials for re-evaluations required under the National Environmental Policy Act (NEPA). Submission of the worksheet by itself does not meet NEPA requirements. FTA & FHWA must concur in writing with its determination and/or the sponsoring agency's NEPA recommendation. Contact the FTA Region 10 office at (206) 220-7954 or FHWA CRC Project Manager at (360) 619-7591 if you have any questions regarding this worksheet. We strongly encourage you to contact us to discuss your project changes before you fill out this worksheet.

For Agency Use *Date Received:*	
Recommendation by FTA Planner or Engineer: ☐ *Accept* ☐ *Return for Revisions* ☐ *Not Eligible* *Recommendation by FHWA Planner or Engineer:* ☐ *Accept* ☐ *Return for Revisions* ☐ *Not Eligible*	*Reviewed By:* *Date:* *Reviewed By:* *Date:*
Comments:	
Concurrence by FTA Counsel: ☐ *Accept Recommendation* ☐ *Return with Comments* *Concurrence by FHWA Counsel:* ☐ *Accept Recommendation* ☐ *Return with Comments*	*Reviewed By:* *Date:* *Reviewed By:* *Date:*
Comments:	
Concurrence by Approving Officials: FTA: FHWA:	*Date:* *Date:*

Please answer the following questions, fill out the impact chart and attach project area and site maps. Using a site map from the previously approved NEPA document, show project changes using a different color. Include additional site maps to help reviewer understand project changes.

PROJECT TITLE Columbia River Crossing-BRP Alternative-Composite Truss-Existing Alignment – This is only for the truss bridge type on the existing alignment; any other changes would require an additional re-evaluation.

LIST CURRENT, APPROVED ENVIRONMENTAL DOCUMENTS (e.g. EIS/ROD, EA/FONSI, BA, RE-EVALUATION, etc.) If Re-evaluation, briefly describe.		
Title: DEIS	**Date: May 2008**	**Type and Date of Last Federal Action**
Title: Biological Assessment	**Date: June 2010**	**Type and Date of Last Federal Action: Received Biological Opinion in January 2011**
Title: Biological Opinion	**Date: January 2011**	**Type and Date of Last Federal Action**

HAS THE MOST CURRENT AND OTHER PERTINENT APPROVED ENVIRONMENTAL DOCUMENTS BEEN *RE-READ* TO COMPARE PROPOSED PROJECT CHANGES?

☐ **NO (STOP! The most current approved environmental document MUST be re-read prior to completing a re-evaluation.)**

☒ **YES NAME: Seth English-Young DATE: March 24, 2011**

IS THE PROJECT CURRENTLY UNDER ☒ **DESIGN OR** ☐ **CONSTRUCTION?**

REASON FOR RE-EVALUATION The CRC project was analyzing an innovative truss bridge type called an "open web box girder" for the Final Environmental Impact Statement. An independent review panel suggested that the project convene a bridge type review panel to analyze potential risk associated with the open web design. The bridge panel made several recommendations. First, they recommended that further design work on the open web box design be halted. They also recommended three alternative bridge types for the CRC project to analyze and move forward with on the project (see Bridge Review Panel report at http://www.columbiarivercrossing.com/FileLibrary/GeneralProjectDocs/BRP_Report.pdf). One of the recommended bridge types is the composite truss. This document re-evaluates the impacts of the composite truss bridge on the existing alignment analyzed in the DEIS.

DESCRIPTION OF PROJECT CHANGES OR NEW INFORMATION

This re-evaluation worksheet will analyze the composite truss bridge type on the current downstream curved alignment as depicted in the DEIS. The changes with the bridge type only occur on the Columbia River over water structure. All touchdown points, highway lane configurations, interchange improvements, and transit alignments, remain the same as the open web. The bicycles and pedestrians would still be located under the highway lanes as well as the transit inside the box.

The open web box girder (OWBG) is a concrete box structure with portions of the webs (vertical walls) removed and replaced with diagonal steel members. By contrast, a composite truss is comprised of primarily steel framing (similar to a traditional truss structure) with concrete slabs on upper and lower levels.

The DEIS remains silent on the type of bridge that would ultimately be selected (see DEIS pages 2-16 to 2-17). Specifically, it says, "If a replacement crossing is chosen, this will not yet determine the bridge type (for example, three parallel bridges or a stacked transit/highway bridge…) or bridge material (for example, concrete, steel, or composite)." However, high level bridge types were specifically discarded

(See page 2-46 to 2-47 of DEIS for alternatives discarded). It is still important to complete this re-evaluation of impacts of the composite truss in case this bridge type has additional environmental impacts.

HAVE ANY NEW OR REVISED LAWS OR REGULATIONS BEEN ISSUED SINCE APPROVAL OF THE LAST ENVIRONMENTAL DOCUMENT THAT AFFECTS THIS PROJECT? If yes, please explain.

☐ **NO**
☒ **YES**
The FHWA published a final rule updating 23 CFR 772 on "PROCEDURES FOR ABATEMENT OF HIGHWAY TRAFFIC NOISE AND CONSTRUCTION NOISE" on July 13, 2010. This final rule does not affect the bridge type discussion, but will impact the noise analysis in the FEIS.

IS THE LIST OF THREATENED AND ENDANGERED SPECIES (NMFS AND USFWS) MORE THAN 6 MONTHS OLD?
☒ **NO**
☐ **YES (STOP! Endangered Species lists and analysis MUST be updated.)**

WILL THE NEW INFORMATION HAVE THE POTENTIAL TO CAUSE A CHANGE IN THE DETERMINATION OF IMPACTS FROM WHAT WAS DESCRIBED IN THE ORIGINAL ENVIRONMENTAL DOCUMENT FOR ANY OF THE AREAS LISTED BELOW? For each impact category, please indicate whether there will be a change in impacts. For all categories with a change, continue to the table at the end of this worksheet and provide detailed descriptions of the impacts as initially disclosed, new impacts and a discussion of the changes. The change in impact may be beneficial or adverse.

Transportation	☐ **Yes**	☒ **No**
Land Use and Economics	☐ **Yes**	☒ **No**
Acquisitions, Displacements, & Relocations	☐ **Yes**	☒ **No**
Neighborhoods & Populations (Social)	☐ **Yes**	☒ **No**
Visual Resources & Aesthetics	☒ **Yes**	☐ **No**
Air Quality	☐ **Yes**	☒ **No**
Noise & Vibration	☐ **Yes**	☒ **No**
Ecosystems (Vegetation & Wildlife)	☒ **Yes**	☐ **No**
Water Resources	☐ **Yes**	☒ **No**
Energy & Natural Resources	☐ **Yes**	☒ **No**
Geology & Soils	☐ **Yes**	☒ **No**
Hazardous Materials	☐ **Yes**	☒ **No**

Public Services	☐ Yes	☒ No
Utilities	☐ Yes	☒ No
Historic, Cultural & Archaeological Resources	☐ Yes	☒ No
Parklands & Recreation	☐ Yes	☒ No
Construction	☐ Yes	☒ No
Secondary and Cumulative	☐ Yes	☒ No

Will the changed conditions or new information result in revised documentation or determination under the following federal regulations?

Endangered Species Act	☐ Yes	☒ No
Magnuson-Stevens Act	☐ Yes	☒ No
Farmland Preservation Act	☐ Yes	☒ No
Section 404-Clean Water Act	☐ Yes	☒ No
Floodplain Management Act	☐ Yes	☒ No
CERCLA (Hazardous Materials)	☐ Yes	☒ No
Section 106 National Historic Preservation Act	☐ Yes	☒ No
Uniform Relocation Act	☐ Yes	☒ No
Section 4(f) Lands	☐ Yes	☒ No
Section 6(f) Lands	☐ Yes	☒ No
Wild & Scenic Rivers	☐ Yes	☒ No
Coastal Barriers	☐ Yes	☒ No
Coastal Zone	☐ Yes	☒ No
Sole Source Aquifer	☐ Yes	☒ No
National Scenic Byways	☐ Yes	☒ No
Other Marine Mammal Protection Act	☐ Yes	☒ No

If you checked yes to any of these, describe how the changes impact compliance and any actions needed to ensure compliance of the new project:
Will these changes or new information likely result in substantial public controversy?

☒ **Yes** ☐ **No**

Comments: The bridge type has been a topic of discussion and disagreement since the NOI was issued in September 2005. There is a portion of the public that wants a bridge with above deck features even though they were dismissed from consideration in 2006 due to aviation safety issues (See Page 2-46 to 2-47 of the DEIS). There is also a portion of the public that wants the streamlined bridge without above deck features to move forward. Either way, there is public controversy around the aesthetics conversation. There will continue to be public discourse about aesthetics if we move forward with the composite truss design or if a high bridge is chosen.

ADDITIONAL COMMENTS: Attached is the DEIS comment letter from FAA concurring with dismissal of high level bridges in the DEIS.

CONCLUSIONS AND RECOMMENDATIONS: The composite truss bridge type on the downstream, curved alignment is similar in appearance and form to the OWBG. Also, the quantity, configuration, and impact of permanent piles necessary to support the composite truss are similar to that of the open web box girder design. Finally, the impacts related to construction methods, in-water work and permanent structure are less with the composite truss bridge type than what was analyzed in the Biological Assessment for Endanger Species Act Section 7 consultation. The DEIS was written broad enough around bridge type to include differing types that carry similar impacts. The new information regarding the composite truss bridge type does not require a Supplemental DEIS because there are no new significant environmental impacts that were not already disclosed to the public in the DEIS.

LIST OF ATTACHMENTS:

1. DEIS Pages 2-16, 2-17, 2-46, 2-47
2. Bridge review panel report - contains preliminary information about the difference between the open web box girder design and the truss design. http://www.columbiarivercrossing.com/FileLibrary/GeneralProjectDocs/BRP_Report.pdf
3. Deck truss preliminary foundation study - validating the information in the bridge report that the piers would be smaller is size than the open web box girder
4. Plan view drawings of the pier size and layout for the open web and composite truss bridge types
5. Plan view of truss touchdown points on the north and south sides of the river
6. FAA DEIS comment letter

SUBMITTED BY:

By signing this, I certify that to the best of my knowledge this document is complete and accurate.

Name / Title	Date
Name: Herb Weiss Title: Environmental Manager	3/29/11

Submit two paper copies of this form, attachments, and a transmittal letter recommending a NEPA finding to the address below. Submit an electronic version to your area FTA Community Planner and FHWA Project Manager. Contact FTA or FHWA at the number below if you are unsure who this is or if you need the email address. Modifications are typically necessary. When the document is approved, FTA and FHWA may request additional copies.

Federal Transit Administration, Region 10
915 2nd Avenue, Suite 3142
Seattle, WA 98174-1002
phone: (206) 220-7954
fax: (206) 220-7959

Federal Highway Administration Oregon Division
530 Center Street NE., Suite 100
Salem, OR 97301
phone: (503) 399-5749
fax: (503) 399-5838

Federal Highway Administration Washington Division
711 S. Capitol Way, Suite 501
Olympia, WA 98501
phone: (360) 753-9480
fax: (360) 753-9889

Impact Category	Impacts as Initially Disclosed	New Impacts	Change in Impacts
Water Resources/Impervious Surface/	Up to six lanes of traffic in each direction. A four lane and six lane configuration was analyzed for the DEIS.	The LPA now assumes five lanes in each direction, which has less impervious surface than the six lane configuration.	The composite truss bridge type is within the range of impacts reported in the DEIS.
Transportation	The stacked transit highway bridge was analyzed as an option in the DEIS with bikes/peds and transit inside the box.	The composite truss bridge type still accommodates the stacked transit highway bridge configuration	No change from the DEIS. There would be no difference in traffic or transit alignment or performance between the OWBG and the composite truss.
Land Use and Economics			None
Acquisitions, Displacements, & Relocations			There is no additional ROW required for the composite truss. The touchdown points and interchanges analyzed in the DEIS will still apply (see plan view of truss touchdown points on the north and south sides of the river).
Neighborhoods & Populations (Social)			None

Visual Resources & Aesthetics	The DEIS did not specify bridge type beyond the three bridge or stacked transit highway bridge options. The substructure of the stacked transit highway configuration can accommodate v-shaped columns.	The substructure of the composite truss can still accommodate the v-shaped columns and the stacked transit highway configuration	Since the DEIS did not specify bridge type either the composite truss or the OWBG could accommodate the v-shaped columns and stacked transit highway configuration and have very similar visual impacts. When viewed from a distance, the OWBG and composite truss superstructures will be similar. When viewed from up close, steel framing and associated connections will be more evident for the composite truss. The pier shape for the composite truss bridge is yet to be determined, but will be similar in nature to the OWBG (columns).
Air Quality			No change in traffic impacts, therefore no change in emissions and air quality.
Noise & Vibration			None
Ecosystems (Vegetation & Wildlife)	A three bridge option and stacked transit highway bridge were discussed in the DEIS. The stacked transit highway bridge had less permanent in-water structure than the three bridge option--six piers on each structure for a total of 12 in water piers.	A stacked transit highway bridge would still be used for the composite truss bridge type. However, because the new bridge type is mostly steel with less concrete, the permanent in-water structures would be lighter than the OWBG (See plan drawings and calculations attached).	The change from OWBG to composite truss would result in fewer impacts to fish. The composite truss would result in a decrease in permanent in-water structure and temporary works, and a reduction in in-water construction duration compared to the OWBG.

	The DEIS disclosed there would be impacts from pile driving to fish, but the detailed analysis did not come until the Biological Assessment development.	Additionally, since the composite truss is lighter than the OWBG, it would result in approximately 15% fewer permanent in-water drilled shafts and a 10% footprint reduction in-water shaft caps. Due to the reduced size of the drilled shafts, the composite truss would have less temporary work structures and a shorter construction duration.	
Water Resources			Only the ecosystems impacts described above would be different.
Energy			None
Geology & Soils			None
Hazardous Materials			None

Public Services			None
Utilities			None
Historic, Cultural & Archaeological Resources	The near shore construction has a high probability of finding archeological resources on the north side of the river.	The near shore construction has a high probability of finding archeological resources on the north side of the river.	No change
Parklands & Recreation	The touchdown points and the SR-14 interchange impact the VNHR.	The touchdown points and the SR-14 interchange can be configured the same way as the OWBG.	No change
Construction	In water pile driving would have an impact on fish.	In-water pile driving will have an impact on fish, but slightly less than what was disclosed in the BA.	Less impact from the composite truss than the OWBG, as described in ecosystems (above).
Secondary and Cumulative			None
Other			

ENVIRONMENTAL RE-EVALUATION CONSULTATION

SUPPLEMENTAL INFORMATION TO COMPOSITE TRUSS RE-EVALUATION

Note: The purpose of this worksheet is to assist sponsoring agencies in gathering and organizing materials for re-evaluations required under the National Environmental Policy Act (NEPA). Submission of the worksheet by itself does not meet NEPA requirements. FTA & FHWA must concur in writing with its determination and/or the sponsoring agency's NEPA recommendation. Contact the FTA Region 10 office at (206) 220-7954 or FHWA CRC Project Manager at (360) 619-7591 if you have any questions regarding this worksheet. We strongly encourage you to contact us to discuss your project changes before you fill out this worksheet.

For Agency Use *Date Received:*	
Recommendation by FTA Planner or Engineer: ☐ *Accept* ☐ *Return for Revisions* ☐ *Not Eligible* *Recommendation by FHWA Planner or Engineer:* ☐ *Accept* ☐ *Return for Revisions* ☐ *Not Eligible*	*Reviewed By:* *Date:* *Reviewed By:* *Date:*
Comments:	
Concurrence by FTA Counsel: ☐ *Accept Recommendation* ☐ *Return with Comments* *Concurrence by FHWA Counsel:* ☐ *Accept Recommendation* ☐ *Return with Comments*	*Reviewed By:* *Date:* *Reviewed By:* *Date:*
Comments:	
Concurrence by Approving Officials: FTA: FHWA:	*Date:* *Date:*

Please answer the following questions, fill out the impact chart and attach project area and site maps. Using a site map from the previously approved NEPA document, show project changes using a different color. Include additional site maps to help reviewer understand project changes.

PROJECT TITLE
Columbia River Crossing-BRP Alternative-Composite Truss-Existing Alignment – *This document is a supplement to the Composite Truss Re-evaluation submitted to FTA & FHWA on April 4, 2011. This document provides information in response to an email request from FTA.*

LIST CURRENT, APPROVED ENVIRONMENTAL DOCUMENTS (e.g. EIS/ROD, EA/FONSI, BA, RE-EVALUATION, etc.) If Re-evaluation, briefly describe.
Title: Date: Type and Date of Last Federal Action
Title: Date: Type and Date of Last Federal Action:
Title: Date: Type and Date of Last Federal Action

HAS THE MOST CURRENT AND OTHER PERTINENT APPROVED ENVIRONMENTAL DOCUMENTS BEEN *RE-READ* TO COMPARE PROPOSED PROJECT CHANGES?

☐ **NO (STOP! The most current approved environmental document MUST be re-read prior to completing a re-evaluation.)**

☐ **YES NAME: DATE:**

IS THE PROJECT CURRENTLY UNDER ☐ **DESIGN OR** ☐ **CONSTRUCTION?**

REASON FOR RE-EVALUATION

DESCRIPTION OF PROJECT CHANGES OR NEW INFORMATION

HAVE ANY NEW OR REVISED LAWS OR REGULATIONS BEEN ISSUED SINCE APPROVAL OF THE LAST ENVIRONMENTAL DOCUMENT THAT AFFECTS THIS PROJECT? If yes, please explain.

☐ **NO**
☐ **YES**

IS THE LIST OF THREATENED AND ENDANGERED SPECIES (NMFS AND USFWS) MORE THAN 6 MONTHS OLD?
☐ **NO**
☐ **YES (STOP! Endangered Species lists and analysis MUST be updated.)**

WILL THE NEW INFORMATION HAVE THE POTENTIAL TO CAUSE A CHANGE IN THE DETERMINATION OF IMPACTS FROM WHAT WAS DESCRIBED IN THE ORIGINAL ENVIRONMENTAL DOCUMENT FOR ANY OF THE AREAS LISTED BELOW? For each impact category, please indicate whether there will be a change in impacts. For all categories with a change, continue to the table at the end of this worksheet and provide detailed descriptions of the impacts as initially disclosed, new impacts and a discussion of the changes. The change in impact may be beneficial or adverse.

Transportation	☐ **Yes**	☐ **No**
Land Use and Economics	☐ **Yes**	☐ **No**
Acquisitions, Displacements, & Relocations	☐ **Yes**	☐ **No**
Neighborhoods & Populations (Social)	☐ **Yes**	☐ **No**
Visual Resources & Aesthetics	☐ **Yes**	☐ **No**
Air Quality	☐ **Yes**	☐ **No**
Noise & Vibration	☐ **Yes**	☐ **No**
Ecosystems (Vegetation & Wildlife)	☐ **Yes**	☐ **No**
Water Resources	☐ **Yes**	☐ **No**
Energy & Natural Resources	☐ **Yes**	☐ **No**
Geology & Soils	☐ **Yes**	☐ **No**
Hazardous Materials	☐ **Yes**	☐ **No**
Public Services	☐ **Yes**	☐ **No**
Utilities	☐ **Yes**	☐ **No**
Historic, Cultural & Archaeological Resources	☐ **Yes**	☐ **No**
Parklands & Recreation	☐ **Yes**	☐ **No**
Construction	☐ **Yes**	☐ **No**
Secondary and Cumulative	☐ **Yes**	☐ **No**

Will the changed conditions or new information result in revised documentation or determination under the following federal regulations?

Endangered Species Act	☐ **Yes**	☐ **No**
Magnuson-Stevens Act	☐ **Yes**	☐ **No**
Farmland Preservation Act	☐ **Yes**	☐ **No**
Section 404-Clean Water Act	☐ **Yes**	☐ **No**
Floodplain Management Act	☐ **Yes**	☐ **No**
CERCLA (Hazardous Materials)	☐ **Yes**	☐ **No**
Section 106 National Historic Preservation Act	☐ **Yes**	☐ **No**
Uniform Relocation Act	☐ **Yes**	☐ **No**

Section 4(f) Lands	☐ **Yes**	☐ **No**
Section 6(f) Lands	☐ **Yes**	☐ **No**
Wild & Scenic Rivers	☐ **Yes**	☐ **No**
Coastal Barriers	☐ **Yes**	☐ **No**
Coastal Zone	☐ **Yes**	☐ **No**
Sole Source Aquifer	☐ **Yes**	☐ **No**
National Scenic Byways	☐ **Yes**	☐ **No**
Other Marine Mammal Protection Act	☐ **Yes**	☐ **No**

If you checked yes to any of these, describe how the changes impact compliance and any actions needed to ensure compliance of the new project:
Will these changes or new information likely result in substantial public controversy?

☐ **Yes** ☐ **No**

Comments:

ADDITIONAL COMMENTS:

CONCLUSIONS AND RECOMMENDATIONS:

LIST OF ATTACHMENTS:

SUBMITTED BY:
By signing this, I certify that to the best of my knowledge this document is complete and accurate.

Name Title	Date

Submit two paper copies of this form, attachments, and a transmittal letter recommending a NEPA finding to the address below. Submit an electronic version to your area FTA Community Planner and FHWA Project Manager. Contact FTA or FHWA at the number below if you are unsure who this is or if you need the email address. Modifications are typically necessary. When the document is approved, FTA and FHWA may request additional copies.

Federal Transit Administration, Region 10
915 2nd Avenue, Suite 3142
Seattle, WA 98174-1002
phone: (206) 220-7954
fax: (206) 220-7959

Federal Highway Administration Oregon Division
530 Center Street NE., Suite 100
Salem, OR 97301
phone**: (**503) 399-5749
fax: (503) 399-5838

Federal Highway Administration Washington Division
711 S. Capitol Way, Suite 501
Olympia, WA 98501
phone: (360) 753-9480
fax: (360) 753-9889

Impact Category	Impacts as Initially Disclosed	New Impacts	Change in Impacts
Water Resources/ Impervious Surface/			
Transportation			**Bridge Crossing Mileposts:** Oregon: MP 307.96 to MP 308.38 Washington MP 0.00 to MP 0.52 **Multi-Use Path:** The change in bridge type between the OWBG and the composite truss will not have an effect on the multi-use path design or profile. . The change from the MUP concept in the DEIS to the current design is a result of refinements developed in coordination with the two cities and the pedestrian bicycle advisory committee (PBAC). (Please see exhibits submitted with original re-evaluation illustrating DEIS 2-bridge and 3-bridge designs and the current LPA) Below is a description of the changes in pedestrian connection between the DEIS and the current design. These changes will be covered in the "overall" NEPA Re-evaluation which is being produced separate from this document. In the DEIS the path was conceived to connect near 5th Street on the Washington

			side. The length needed to connect varied based on whether it was 3-bridge or 2-bridge. The 2-bridge path concept was lower crossing the river so it needed less length to touch down in Vancouver. The switchback at the touch down on the 3-bridge concept provided the additional length needed as a result of the higher profile across the river (the path was on the top deck with the 3-bridge option and was under the top deck with the 2-bridge option). Through coordination with stakeholders, the current path has been designed to be under the north bound highway deck. The connection to Vancouver is by way of a loop down to the waterfront connecting at Columbia Street which is the existing designated north-south bike route in downtown Vancouver. It connects near the Waterfront Trail. In Oregon a similar process has occurred and is still on-going. The multi-use path was originally conceived in the DEIS to be west of the LRT alignment with options to connect down to Hayden Island with ramps, loops and stairs. With the path now located under the north bound highway bridge, the alignment is located to the east of the LRT alignment. Currently a loop down to Hayden Island Drive is conceived with ramps and stairs connecting at the LRT station. However, the location of the path as it crosses Hayden Island and the location

			of the Oregon connections continue to be refined through coordination with the City of Portland, PBAC and the public. **Roundabouts:** The roundabouts have evolved through input from and coordination with the City of Vancouver. They are independent from and not a function of bridge type. A discussion of the roundabouts and other design changes will be captured in the "overall" NEPA Re-evaluation which is being produced separate from this document.
Land Use and Economics			
Acquisitions, Displacements, & Relocations			
Neighborhoods & Populations (Social)			
Visual Resources & Aesthetics			
Air Quality			

Noise & Vibration			
Ecosystems (Vegetation & Wildlife)			
Water Resources			
Energy			
Geology & Soils			
Hazardous Materials			
Public Services			
Utilities			
Historic, Cultural & Archaeological Resources			
Parklands & Recreation			
Construction			
Secondary and Cumulative			
Other			

Aviation and Navigation	The DEIS reported a range of impacts for aviation and navigation. The highest impact reported to aviation was that with the Supplemental and No Build alternatives the lift spans on the existing bridge would be retained and would remain a hazard to aviation at Pearson Field. The highest impact reported to river navigation was an adverse impact due to the addition of the supplemental bridge making the S-curve maneuver more difficult. There would be more piers in the water and narrower channels.	The top of deck elevation of the composite truss bridge would be approximately five feet higher than the OWBG, but would still be below the Pearson Field Part 77 surfaces. The Part 77 surface is the standard by which obstructions in navigable airspace are determined. No bridge type option would penetrate Pearson Airfield Part 77 surfaces with the bridge deck or above deck features. Above deck features, such as light poles and signs, have not been designed yet and the actual heights will be determined through design refinements and coordination with the FAA. However, above deck features would not intrude into Pearson Field Part 77 surfaces. Penetrations into the Obstacle Clearance Surfaces (OCS) are considered when developing departure procedures and calculating climb gradients. Since the new bridge types considered would significantly reduce the penetration into the OCS compared to the lift towers of the existing bridge, new climb gradients would be calculated with any replacement bridge type. The composite truss would impact the OCS by approximately five feet more than the OWBG, but it would still be significant improvement compared to No-Build.	The aviation impacts from the composite truss would be much less than the highest impacts reported in the DEIS for the supplemental bridge, and comparable to the impacts from the replacement bridge. The above deck features (lighting and sign structures) will have similar heights relative to the highway surface (top of deck) for both the composite truss and OWBG. However, due to the increased structure depth associated with the composite truss, the highway surface is anticipated to be approximately five feet higher than that of the OWBG. Despite the higher elevation, the structure and above deck features of the composite truss will not penetrate the Pearson Field Part 77 surfaces. Above deck features have not been designed yet and the actual heights will be determined through design refinements and coordination with the FAA. Penetration into the OCS will be significantly improved compared to No-Build. The composite truss will be approximately five feet higher than the OWBG. New climb gradients for western departure at Pearson Airfield will have to be calculated with any new bridge type and the height of the bridge will be taken into consideration when calculating climb gradients.

		The composite truss would have slightly less impact to river navigation than the OWBG due to the smaller in-water footprint. The piers would be in the same location with either bridge type, eliminating the S-curve maneuver (see plan view drawings of the pier size and layout for the open web and composite truss bridge types provided with the original re-evaluation).	The navigation impacts from the composite truss would be less than the highest impacts reported in the DEIS from the supplemental bridge and the same or slightly less than the impacts from the replacement bridge.
4(f) Resources			Both composite truss and OWBG would cause the same impacts to 4(f) resources. Any difference in impacts to 4(f) resources between the FEIS and the DEIS is not a function of bridge type and will be described in the "overall" Re-evaluation being produced separate from this document. Overall, impacts to the Vancouver Historic Reserve would be lower with the current design than they were in the DEIS.

COLUMBIA RIVER CROSSING

MAIN RIVER CROSSING

CONCEPTUAL DESIGN

COMPOSITE DECK TRUSS FOUNDATION

March 2011

TABLE OF CONTENTS

1. Foundation Study Overview 1-1
2. LARSA Global Analysis 2-1
3. FB-MultiPier Foundation Analysis 3-1
4. Appendix 4-1
   4.1. Excerpts from Open Web Calculations 4-2
   4.2. LARSA Input Files 4-16
   4.3. FB-MultiPier Output Files 4-223

HDR | ONE COMPANY *Many Solutions*℠

Foundation Study

Project:	Columbia River Crossing	Computed:	C. Werts	Date:	March 23 2011
Subject:	River Bridge Conceptual Design	Checked:	R. Turton	Date:	March 23, 2011
Task:	Composite Deck Truss Foundation	Sheet:		of	

1. FOUNDATION STUDY OVERVIEW

Task Description:

The purpose of this task is to provide preliminary design calculations for the composite steel deck truss alternative to determine the required size of foundations and number of shafts at each foundation for the Columbia River Crossing (CRC) river bridge.

Method:

An elastic response spectrum analysis (RSA) was performed on the global bridge model using LARSA, through an iterative process with foundation springs generated from an inelastic foundation analysis of each pier using FB-MultiPier, to estimate the foundation demands and capacities and determine the adequacy of the design foundations.

Assumptions:

In order to perform an expedited foundation analysis, the following assumptions were made:

1. The overall bridge length, pier locations and resulting span lengths were taken to be the same as the locally preferred alternative (LPA) that was previously analyzed as the open web alternative. The typical spans are 465' and the end spans are approximately 270' for a total bridge length of approximately 2865'.
2. The plan and profile for the composite deck truss was the same as the LPA.
3. Model geometry was rotated in plan so that the X axis is a line from Pier 1 to Pier 8 and the longitudinal earthquake is in line with the structure.
4. The superstructure geometry and properties for the open web were used to model the composite deck truss. The RSA analysis and substructure response is not particularly sensitive to the changes in superstructure stiffness for this bridge structure. The flexural stiffness about the weak axis of the superstructure cross section would be the most different, however, the bearings do not transfer moment between the superstructure and the substructure at any piers so this does not have a significant effect on the longitudinal mode shapes. The flexural stiffness about the strong axis would be very similar to the open web cross section, and is relatively rigid in comparison with the substructure, so it should not have a significant impact on the transverse mode shapes. Vertical modes are not considered at this time.
5. All piers consist of 2 columns sloped at 1:5, as shown in the previous LPA, with a pier cap beam at the top connecting them and bearings on top of the pier cap beam. The pier cap beams for Piers 1, 2, 7 & 8 were sized according to the previous design for the LPA. The pier cap beams for Piers 3, 4, 5 & 6 were 14' wide and 15' tall.
6. The columns for Piers 1, 2, 7 & 8 were sized according to the previous design for the LPA.
7. Piers 1, 2, 7 & 8 include guided bearings and shear keys that can transfer load vertically and normal to the bridge, but allow the superstructure to move along station without transmitting shear force to the substructure.

8. The columns for Piers 3, 4, 5 & 6 were similar to the previous design for the LPA with a 12' octagonal cross section. The effective flexural moment of inertia of the columns was taken as 0.4 times the gross inertia.
9. Piers 3, 4, 5 & 6 include pinned bearings that can transfer load in all directions but do not transfer moments along station.
10. A uniform dead load (mass) was applied to the superstructure in lieu of using the dead load self weight.
11. The additional load for the diaphragms at each pier was estimated as one half the weight of the diaphragms used in the previous design for the LPA. The previous design utilized very large, heavy concrete frame elements to transfer the loads from the substructure to the superstructure. The composite deck truss will rely on steel frame elements to transfer these loads and will be much lighter. Using one half the weight is conservative.
12. Foundation design using RSA for the Columbia River Crossing is controlled by the soil condition considering full liquefaction and 10' of contraction scour. Previous analysis for the open web alternative indicated that the highest demand to capacity ratios for the shaft foundations were associated with this soil condition. This also included large deformations and shaft moments. The highest demands for the columns were associated with stiffer soil conditions with the no scour condition, however, the no scour condition was always associated with lower demand to capacity ratios for the shaft foundations. Since this task was focused on the sizing of the shaft foundations, only the liquefaction condition was considered.
13. The response spectra used for this task was based on FEE Site Class E, which is the recommended curve in the Geotechnical Report for Piers 2 to 5. Site Class E is the FEE curve with the highest spectral accelerations for any of the site classes. SEE curves are not used since they are used to analyze displacement demands for a displacement ductility analysis of the columns.
14. See geotechnical assumptions summary for the open web alternative (included in Appendix 4.1) for other general assumptions.
15. Vessel collision loading was not considered for this task, however, during the previous Type, Size & Location study performed on the open web alternative and the three bridge segmental alternative it was determined that 6 shafts was adequate for a foundation 45' wide shaft cap. The "Predictions of Vessel Collision Forces on Highway Bridge Piers" report by The Glosten Associates was based on contact area and therefore lower forces are associated with the smaller width shaft cap.
16. The shaft caps are based on the same 3D spacing and 7'-6" edge spacing included in the open web alternative.

Limitations:

The following limitations should be observed:

1. The design of the columns will have an impact on the stiffness of the substructure and the overall demands. Larger columns will increase the overall stiffness of the structure and may therefore increase the demands on the shaft foundations. Therefore, the demands are approximate and may differ from the final demands.
2. The geometry and properties of the superstructure cannot be used to determine any forces or stresses for the superstructure members, although they are adequate to provide forces at the foundation level.
3. Strength loads have not been checked for the composite deck truss on the shaft foundations, but they are not anticipated to be critical to the design.
4. Vessel collision forces have not been checked for the shaft foundations on the composite deck truss, but they are not anticipated to be critical to the design.
5. No analysis has been performed for the no scour condition, but it is assumed that this will not control the foundation design based on prior analysis completed during the Type, Size & Location Study.

Discussion:

The conceptual foundation analysis performed indicated that shaft caps with 6 – 10' diameter shafts would be adequate to support the composite deck truss structure given the LPA layout and the assumptions as discussed above.

The weight of the composite deck truss alternative is significantly less than the open web alternative which leads to a number of advantages (Refer to table on page 2-4). First, the lighter weight structure has lower dead load so that the AASHTO Strength I and Strength IV demands on the foundation are significantly less and fewer shafts are required for service loads. Second, the smaller strength and service level demands on the columns means that the column size and reinforcement may be decreased. Smaller columns with less reinforcement decrease the plastic hinging demands on the shaft foundations. Third, the lighter superstructure and smaller caps decrease the elastic seismic demands on the structure. The weight of the shaft caps is significant for this structure and the influence of the shaft cap mass on the foundation demands is increased with the liquefaction condition.

In addition to the decrease in weight and the decrease in foundation stiffness, the substructure stiffness in the longitudinal direction decreased due to the change in articulation at the top of the columns. Piers 3, 4, 5 & 6 have pinned bearings at the top of the pier caps which is gives stiffness 4 times less in the longitudinal direction. The calculated stiffness of the columns in the longitudinal direction is based on $3*E*I/L^3$. The open web alternative had integral pier caps for Piers 3, 4, 5 & 6 which relates to a column stiffness of $12*E*I/L^3$. Therefore, the change in articulation has a significant impact on the longitudinal pier stiffness. Piers 1,2, 7 & 8 remained unchanged in the model. The decrease in longitudinal stiffness leads to a change in the longitudinal structure period to just over 4 seconds. This longer period is associated with a lower acceleration coefficient on the response spectrum, and therefore lower demands.

The actual demand to capacity ratios in the conceptual foundation analysis performed for the composite deck truss structure were less than 0.75 in both the transverse and the longitudinal direction. The demand to capacity ratio included in the output for the FB-MultiPier analysis is based the interaction diagram for biaxial loading of the drilled shaft and uses AASHTO resistance factors for the interaction. Therefore, given the margin between 0.75, the limit of 1.0 and the AASHTO resistance factors there is room for any minor changes in seismic demands due to changes in the column geometry.

Further analysis would include the updated modeling of the superstructure and the concurrent design of the columns, along with loading that would include service loading and vessel collision loading.

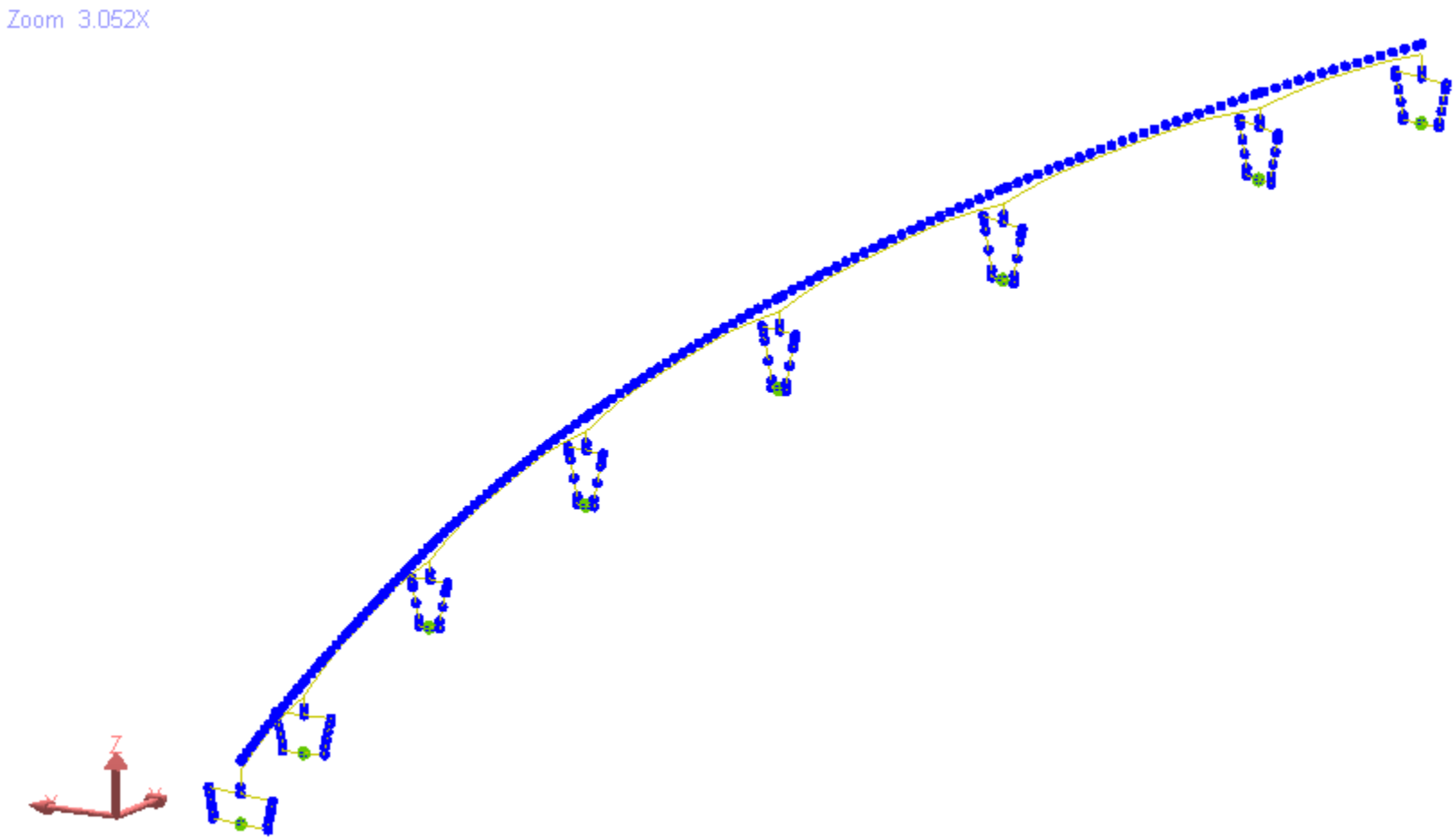
ONE COMPANY
Many Solutions℠

LARSA Global Analysis

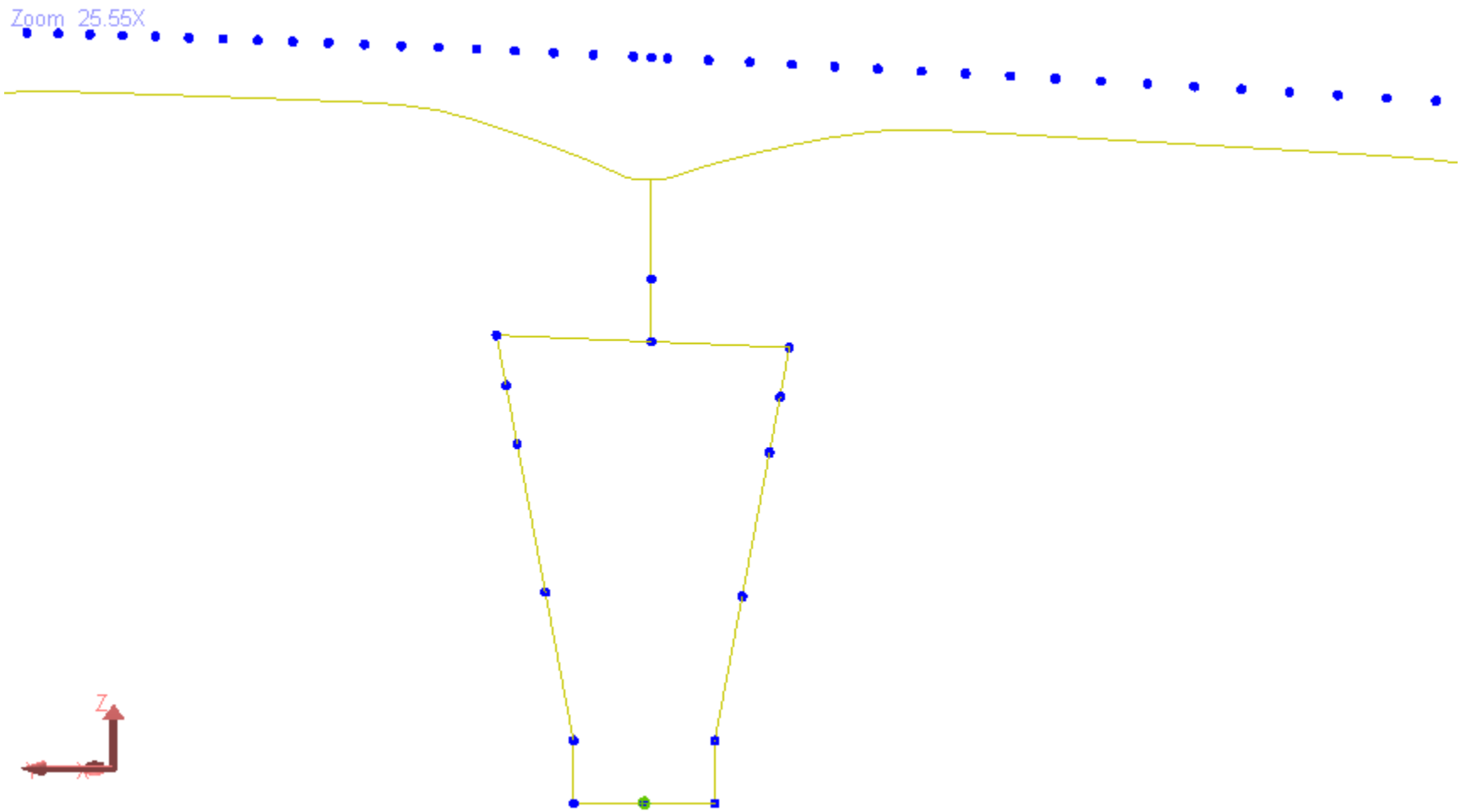
Project:	Columbia River Crossing	Computed:	C. Werts	Date:	03-23-2011
Subject:	River Bridge Preliminary Design	Checked:		Date:	
Task:	Composite Deck Truss Alternative	Sheet:		of	

2. LARSA Global Analysis

Graphics View 1



Graphics View 1



	DC (self weight)		
	Vertical Force Z (kips)		
Pier	Composite Deck Truss	Open-Web	%Difference
RC1	11176	13144	17.6
RC2	19391	29134	50.2
RC3	20844	28775	38.0
RC4	20942	29058	38.8
RC5	21095	28752	36.3
RC6	22007	32805	49.1
RC7	20186	29524	46.3
RC8	10907	12495	14.6

DC

NEW

LARSA Output LCS_FEE EQ 2_46666664_03152011.xls

Joint	Result Case	Force X (kips)	Force Y (kips)	Force Z (kips)	Moment X (kips-ft)	Moment Y (kips-ft)	Moment Z (kips-ft)
1001	DC-Dead Load	13	-50	11176	2854	805	1
2001	DC-Dead Load	-14	62	19391	-15552	-4001	2
3001	DC-Dead Load	51	3	20844	-26560	-770	51
4001	DC-Dead Load	34	-8	20942	-21194	1438	458
5001	DC-Dead Load	-37	12	21095	-17253	-2309	1250
6001	DC-Dead Load	-48	-15	22007	-19337	-888	1148
7001	DC-Dead Load	-10	-40	20186	-11829	3114	0
8001	DC-Dead Load	11	35	10907	-6537	1042	9

EQL

NEW

LARSA Output LCS_FEE EQ 1_46666664_03152011.xls

Joint	Result Case	Force X (kips)	Force Y (kips)	Force Z (kips)	Moment X (kips-ft)	Moment Y (kips-ft)	Moment Z (kips-ft)
1001	EXT Ia - EQ 1 - 1	4850	5267	12241	276696	-90163	565
2001	EXT Ia - EQ 1 - 1	4070	3280	24563	237457	-61230	1963
3001	EXT Ia - EQ 1 - 1	6457	3819	25732	328523	-391120	22433
4001	EXT Ia - EQ 1 - 1	5956	3342	26336	303001	-405888	18229
5001	EXT Ia - EQ 1 - 1	5789	3503	26479	310279	-412852	19176
6001	EXT Ia - EQ 1 - 1	7331	3774	27179	365785	-525709	21252
7001	EXT Ia - EQ 1 - 1	8259	5560	25708	368352	-216107	5603
8001	EXT Ia - EQ 1 - 1	2852	3615	11931	278907	-117011	5370

EQT

NEW

LARSA Output LCS_FEE EQ 2_46666664_03152011.xls

Joint	Result Case	Force X (kips)	Force Y (kips)	Force Z (kips)	Moment X (kips-ft)	Moment Y (kips-ft)	Moment Z (kips-ft)
1001	EXT Ia - EQ 2 - 1	4787	6844	12108	343396	-109646	591
2001	EXT Ia - EQ 2 - 1	3733	4707	24225	351180	-84076	1419
3001	EXT Ia - EQ 2 - 1	2937	6938	25763	566383	-179158	38271
4001	EXT Ia - EQ 2 - 1	2474	7421	25909	613034	-167116	22917
5001	EXT Ia - EQ 2 - 1	2479	6329	26024	570404	-177159	42527
6001	EXT Ia - EQ 2 - 1	3021	6100	27152	578194	-212598	36454
7001	EXT Ia - EQ 2 - 1	5138	8538	25359	572772	-183240	5763
8001	EXT Ia - EQ 2 - 1	3439	5227	11945	382029	-151425	5686

FREQUENCIES USING FOUNDATION SPRINGS ASSOCIATED WITH LONGITUDINAL EARTHQUAKE

Mode Shapes - Frequencies

Mode Shape	Frequency (Hz)	Period (s)	Per Mass X	Per Mass Y	Per Mass Z	Cumulative Per Mass X	Cumulative Per Mass Y	Cumulative Per Mass Z
M1: f = 0.24, t = 4.1471	0.24	4.15	74.98	0.29	0.00	74.98	0.29	0.00
M2: f = 0.38, t = 2.6421	0.38	2.64	0.05	62.68	0.00	75.03	62.97	0.01
M3: f = 0.44, t = 2.2505	0.44	2.25	1.99	0.10	0.00	77.01	63.08	0.01
M4: f = 0.58, t = 1.7182	0.58	1.72	0.85	7.95	0.00	77.86	71.03	0.01
M5: f = 0.62, t = 1.6075	0.62	1.61	4.18	7.10	0.00	82.04	78.13	0.01
M6: f = 0.76, t = 1.3134	0.76	1.31	0.97	0.54	0.00	83.01	78.67	0.01
M7: f = 0.91, t = 1.0970	0.91	1.10	0.00	5.74	0.00	83.02	84.40	0.01
M8: f = 1.02, t = 0.9850	1.02	0.99	0.01	0.00	0.03	83.03	84.40	0.04
M9: f = 1.07, t = 0.9324	1.07	0.93	1.04	0.01	0.02	84.07	84.42	0.05
M10: f = 1.08, t = 0.9233	1.08	0.92	0.36	0.66	0.00	84.43	85.08	0.06
M11: f = 1.11, t = 0.8994	1.11	0.90	0.29	0.01	0.00	84.71	85.08	0.06
M12: f = 1.2, t = 0.8327	1.20	0.83	0.94	0.02	0.01	85.66	85.10	0.06
M13: f = 1.23, t = 0.8150	1.23	0.82	1.64	0.01	0.03	87.29	85.11	0.10
M14: f = 1.33, t = 0.7529	1.33	0.75	0.19	0.00	0.03	87.48	85.11	0.12
M15: f = 1.38, t = 0.7262	1.38	0.73	2.27	0.11	0.01	89.75	85.23	0.13
M16: f = 1.38, t = 0.7229	1.38	0.72	0.01	2.26	0.03	89.76	87.49	0.16
M17: f = 1.45, t = 0.6908	1.45	0.69	0.23	0.02	0.01	89.99	87.51	0.17
M18: f = 1.48, t = 0.6760	1.48	0.68	0.27	0.19	0.01	90.27	87.70	0.18
M19: f = 1.53, t = 0.6526	1.53	0.65	0.13	0.00	0.00	90.40	87.70	0.18
M20: f = 1.6, t = 0.6263	1.60	0.63	0.67	2.14	0.02	91.07	89.85	0.20
M21: f = 1.62, t = 0.6185	1.62	0.62	0.00	0.00	0.76	91.07	89.85	0.96
M22: f = 1.7, t = 0.5869	1.70	0.59	0.03	0.21	0.01	91.10	90.06	0.97
M23: f = 1.87, t = 0.5359	1.87	0.54	0.02	0.54	0.00	91.11	90.60	0.97
M24: f = 1.94, t = 0.5143	1.94	0.51	0.00	0.01	3.84	91.11	90.61	4.81
M25: f = 1.96, t = 0.5106	1.96	0.51	0.00	0.00	5.29	91.11	90.61	10.10
M26: f = 2.25, t = 0.4447	2.25	0.44	0.03	0.17	0.01	91.14	90.78	10.11
M27: f = 2.39, t = 0.4192	2.39	0.42	0.01	0.00	2.46	91.15	90.79	12.57
M28: f = 2.39, t = 0.4185	2.39	0.42	0.02	0.00	17.00	91.17	90.79	29.57
M29: f = 2.53, t = 0.3959	2.53	0.40	1.73	1.42	0.01	92.91	92.21	29.58
M30: f = 2.73, t = 0.3667	2.73	0.37	2.16	0.50	0.04	95.07	92.71	29.63
M31: f = 2.77, t = 0.3604	2.77	0.36	0.40	0.05	0.03	95.47	92.76	29.66
M32: f = 3.0, t = 0.3334	3.00	0.33	0.64	2.70	0.02	96.11	95.47	29.68

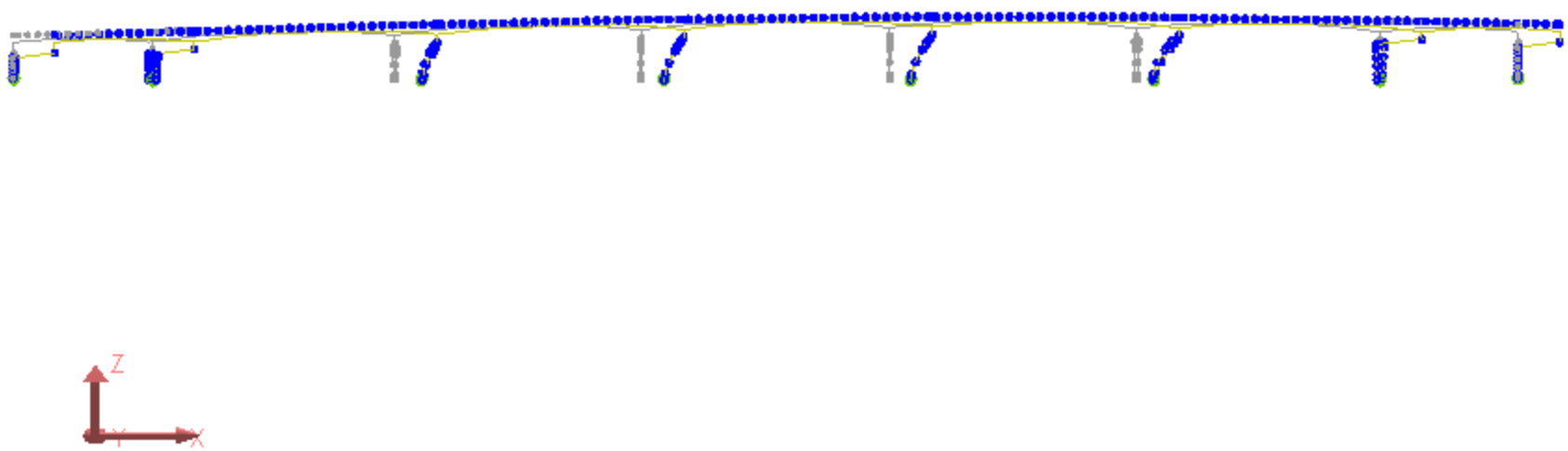
FREQUENCIES USING FOUNDATION SPRINGS ASSOCIATED WITH TRANSVERSE EARTHQUAKE

Mode Shapes - Frequencies

Mode Shape	Frequency (Hz)	Period (s)	Per Mass X	Per Mass Y	Per Mass Z	Cumulative Per Mass X	Cumulative Per Mass Y	Cumulative Per Mass Z
M1: f = 0.27, t = 3.7124	0.27	3.71	72.72	0.30	0.00	72.72	0.30	0.00
M2: f = 0.33, t = 3.0080	0.33	3.01	0.00	60.70	0.01	72.72	61.00	0.01
M3: f = 0.42, t = 2.3990	0.42	2.40	2.66	0.91	0.00	75.38	61.91	0.01
M4: f = 0.57, t = 1.7591	0.57	1.76	0.06	14.09	0.00	75.44	76.00	0.01
M5: f = 0.62, t = 1.6037	0.62	1.60	5.13	2.73	0.00	80.57	78.73	0.01
M6: f = 0.74, t = 1.3456	0.74	1.35	1.00	0.68	0.00	81.57	79.41	0.01
M7: f = 0.9, t = 1.1167	0.90	1.12	0.01	6.04	0.00	81.58	85.45	0.01
M8: f = 1.04, t = 0.9661	1.04	0.97	0.14	0.19	0.03	81.72	85.64	0.04
M9: f = 1.04, t = 0.9624	1.04	0.96	0.29	0.47	0.02	82.01	86.11	0.06
M10: f = 1.2, t = 0.8323	1.20	0.83	0.79	0.00	0.00	82.80	86.11	0.06
M11: f = 1.22, t = 0.8184	1.22	0.82	0.08	0.02	0.00	82.88	86.14	0.06
M12: f = 1.25, t = 0.7984	1.25	0.80	2.73	0.00	0.00	85.61	86.14	0.07
M13: f = 1.29, t = 0.7769	1.29	0.78	0.74	0.34	0.03	86.35	86.48	0.10
M14: f = 1.3, t = 0.7674	1.30	0.77	0.06	1.01	0.04	86.41	87.49	0.13
M15: f = 1.37, t = 0.7285	1.37	0.73	0.46	0.11	0.03	86.87	87.60	0.17
M16: f = 1.38, t = 0.7227	1.38	0.72	2.33	0.11	0.01	89.20	87.71	0.17
M17: f = 1.4, t = 0.7152	1.40	0.72	0.50	0.13	0.00	89.71	87.85	0.17
M18: f = 1.45, t = 0.6874	1.45	0.69	0.03	0.12	0.01	89.73	87.97	0.18
M19: f = 1.49, t = 0.6699	1.49	0.67	0.74	0.00	0.00	90.47	87.97	0.19
M20: f = 1.56, t = 0.6394	1.56	0.64	0.60	2.15	0.03	91.07	90.12	0.21
M21: f = 1.62, t = 0.6179	1.62	0.62	0.00	0.01	0.82	91.07	90.13	1.03
M22: f = 1.67, t = 0.5992	1.67	0.60	0.01	0.17	0.00	91.09	90.31	1.03
M23: f = 1.83, t = 0.5464	1.83	0.55	0.04	0.39	0.00	91.12	90.69	1.04
M24: f = 1.95, t = 0.5131	1.95	0.51	0.00	0.01	4.17	91.12	90.70	5.20
M25: f = 1.96, t = 0.5092	1.96	0.51	0.00	0.00	4.53	91.13	90.70	9.73
M26: f = 2.24, t = 0.4470	2.24	0.45	0.03	0.17	0.01	91.16	90.87	9.74
M27: f = 2.38, t = 0.4199	2.38	0.42	0.03	0.00	0.02	91.19	90.87	9.76
M28: f = 2.4, t = 0.4169	2.40	0.42	0.00	0.00	19.01	91.19	90.87	28.78
M29: f = 2.52, t = 0.3964	2.52	0.40	1.72	1.49	0.01	92.91	92.36	28.79
M30: f = 2.73, t = 0.3660	2.73	0.37	0.90	0.52	0.02	93.81	92.88	28.81
M31: f = 2.79, t = 0.3584	2.79	0.36	1.31	0.43	0.05	95.12	93.31	28.86
M32: f = 2.97, t = 0.3366	2.97	0.34	1.10	2.26	0.04	96.22	95.56	28.89

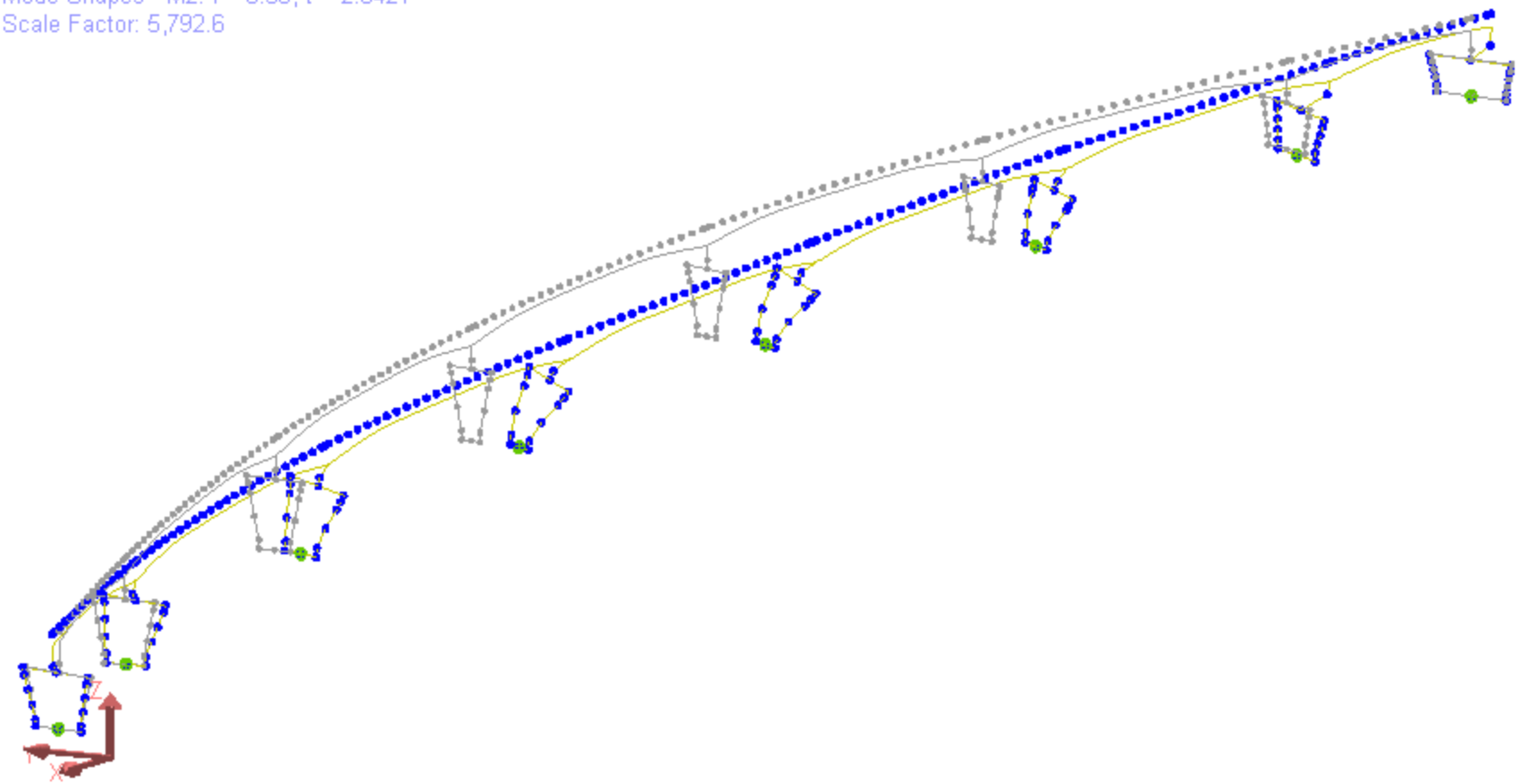
Graphics View 1

Zoom 1.875X
Mode Shapes - M1: f = 0.24, t = 4.1471
Scale Factor: 5,792.6



Graphics View 1

Zoom 3.662X
Mode Shapes - M2: f = 0.38, t = 2.6421
Scale Factor: 5,792.6

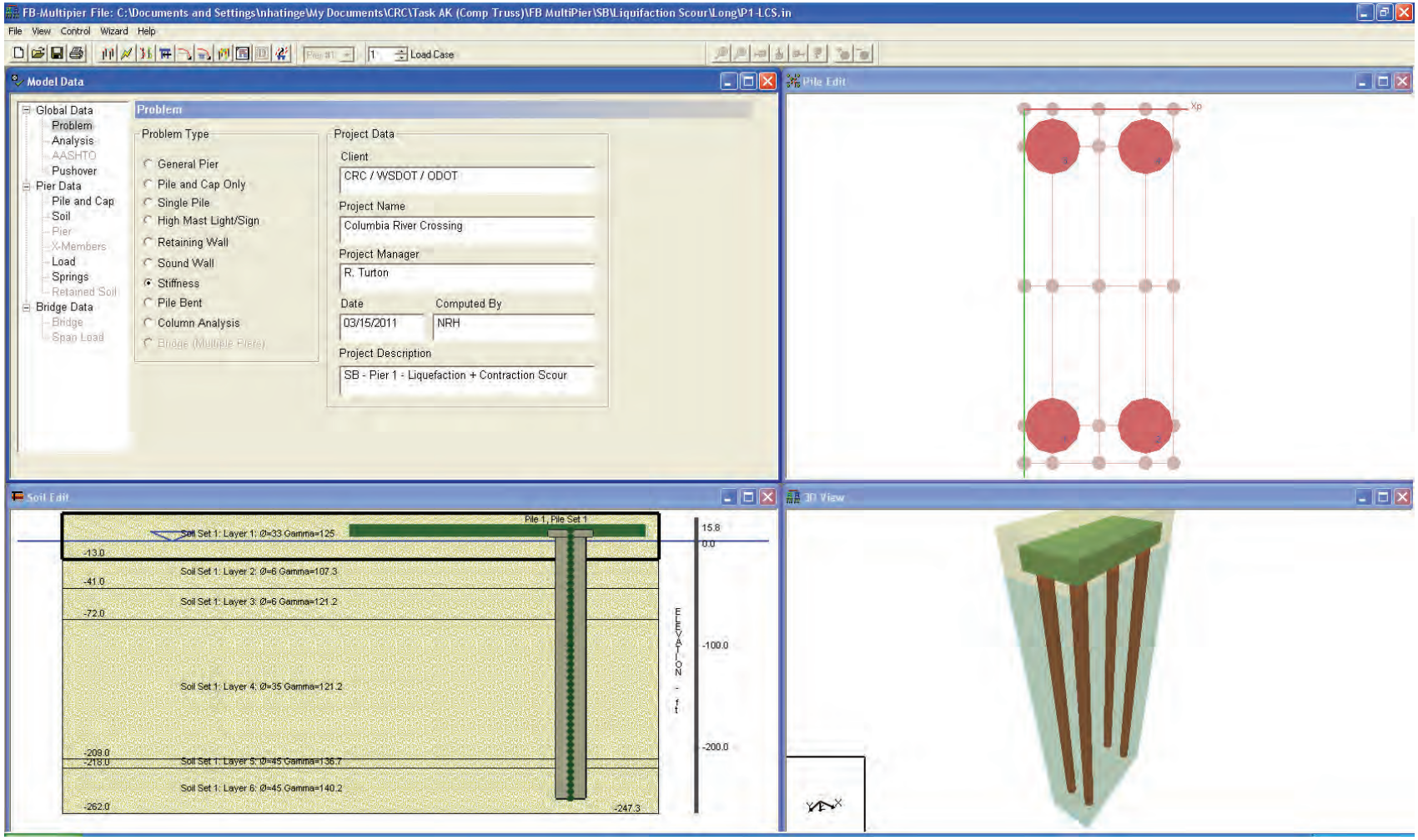


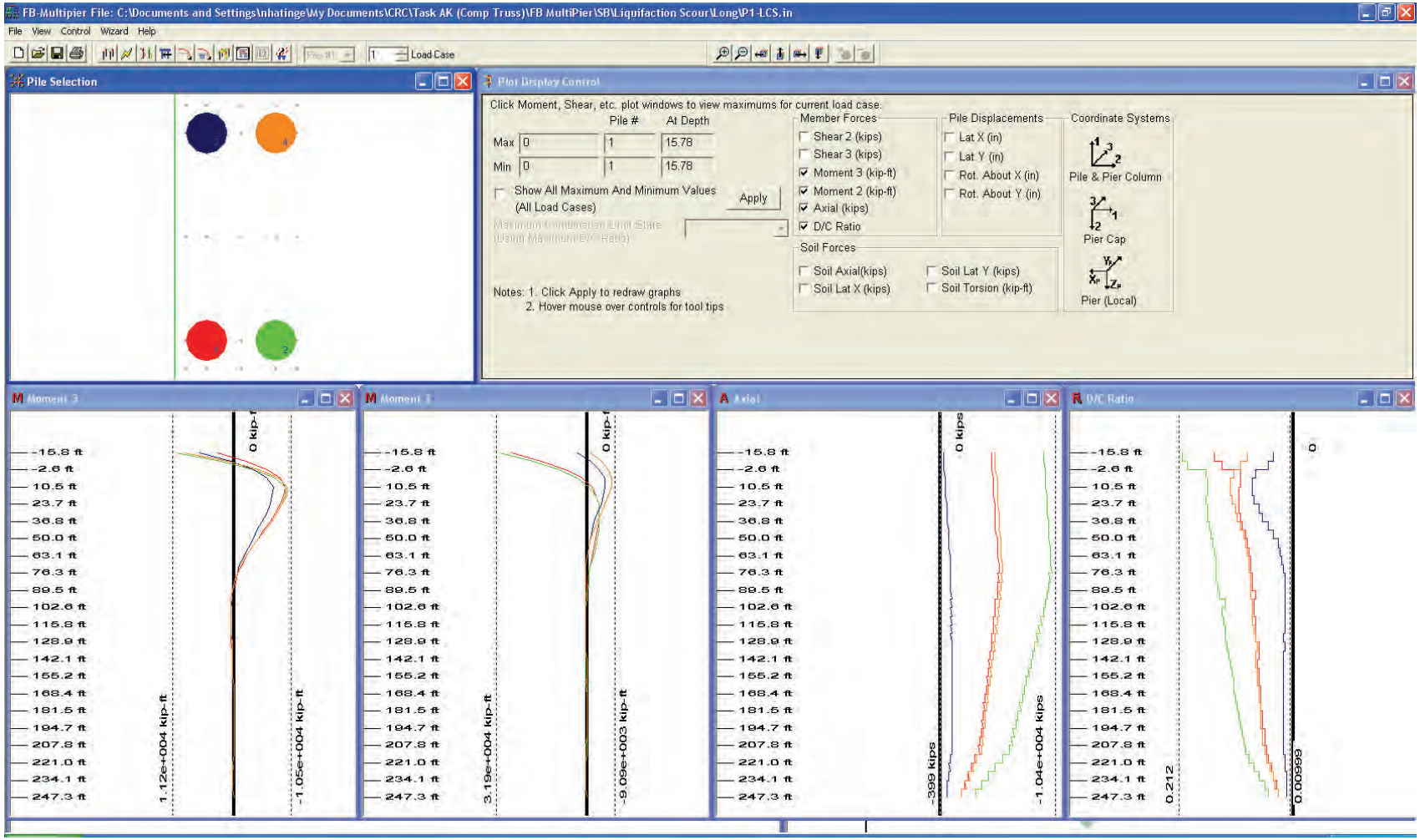
ONE COMPANY
Many Solutions℠

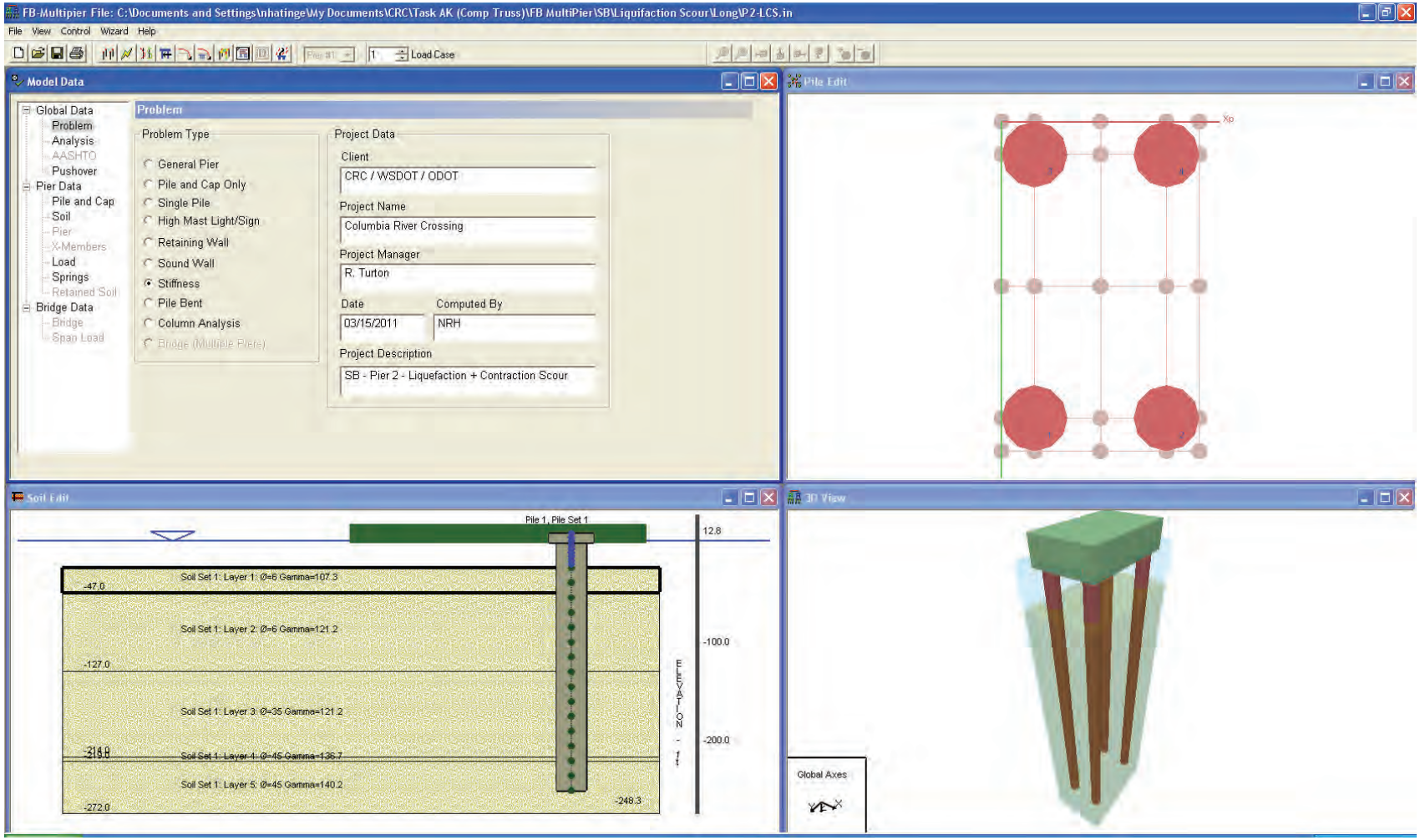
FB-Multipier Foundation Analysis

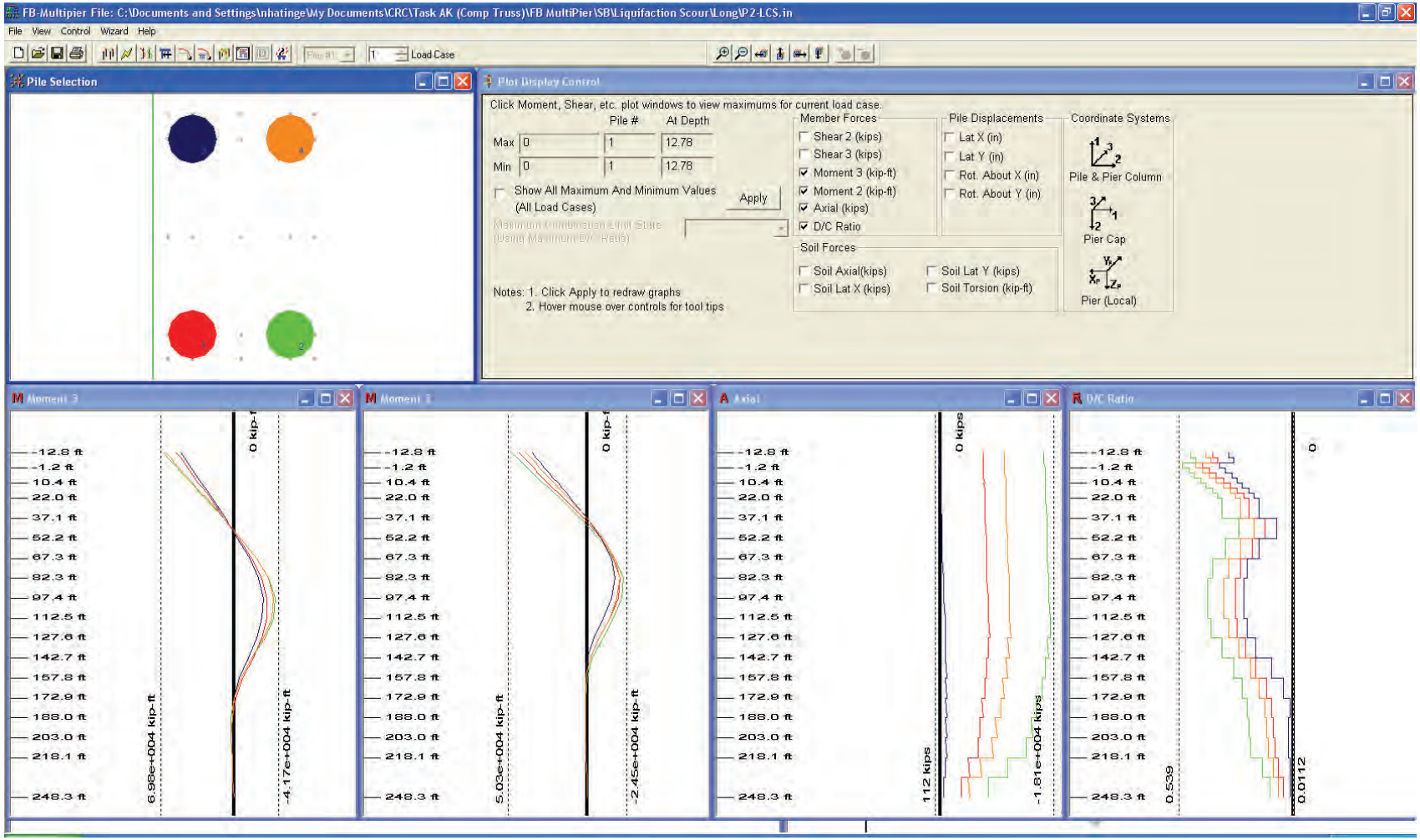
Project:	Columbia River Crossing	Computed:	C. Werts	Date:	03-23-2011
Subject:	River Bridge Preliminary Design	Checked:		Date:	
Task:	Composite Deck Truss Alternative	Sheet:		of	

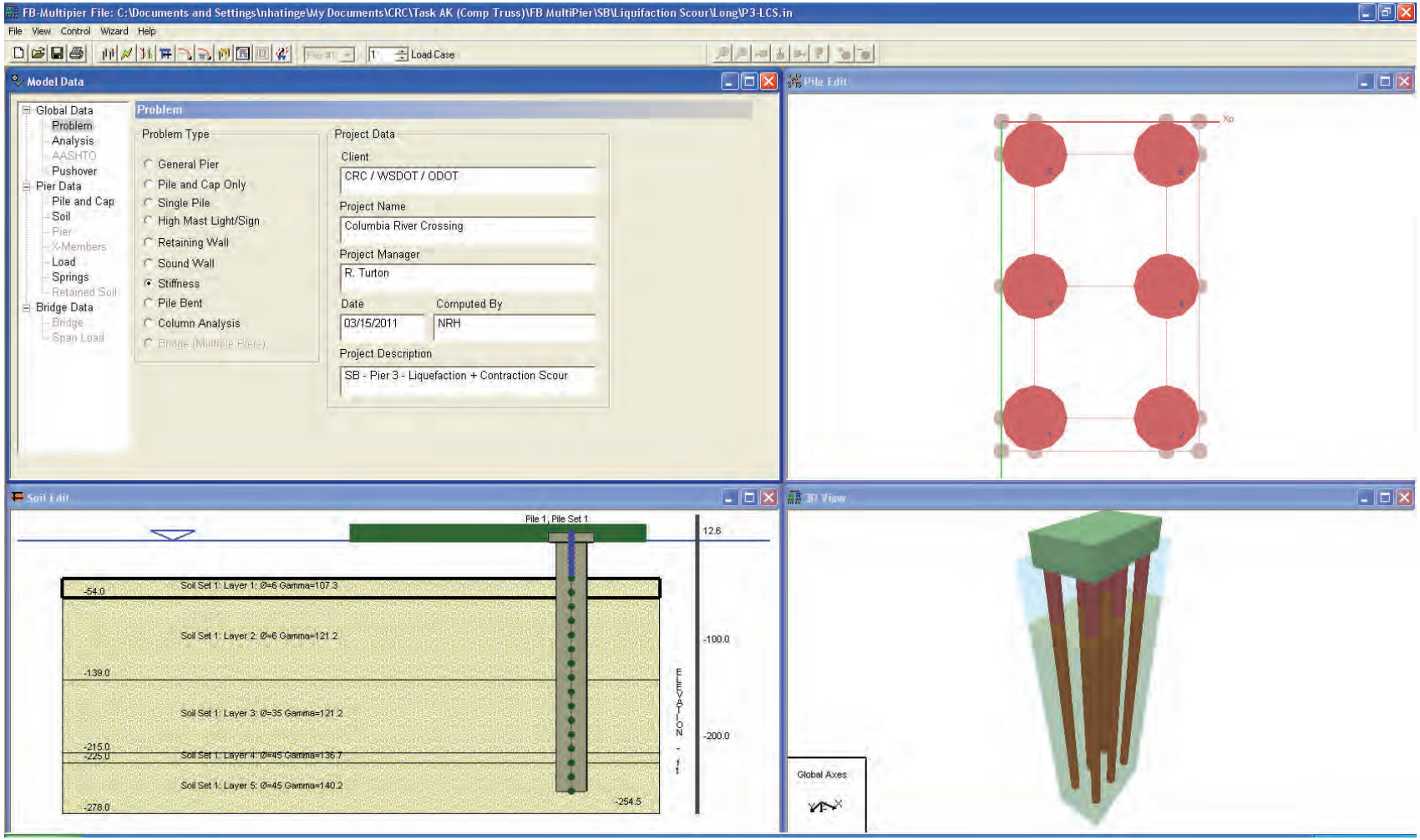
3. FB-Multipier Foundation Analysis

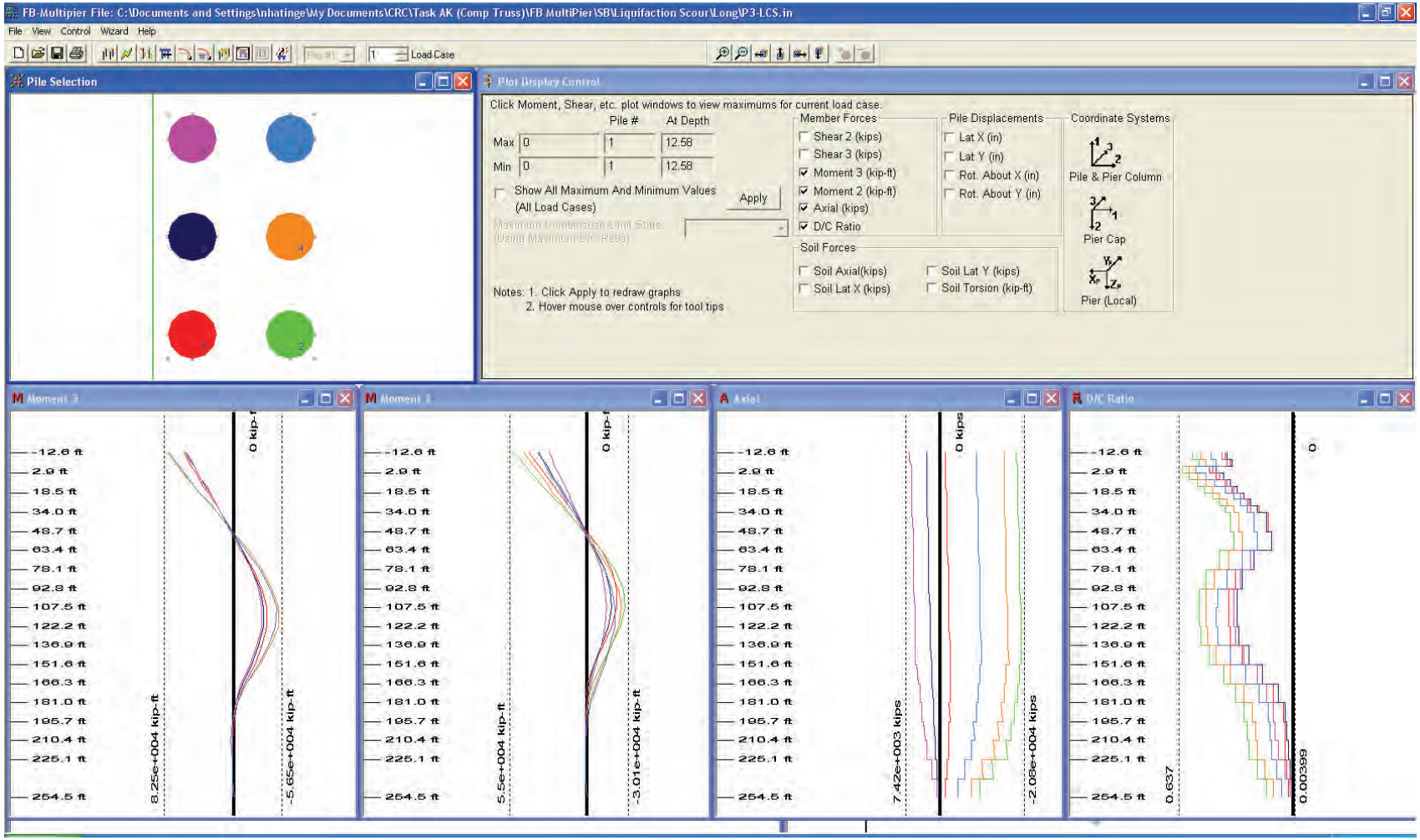

FB-Multipier File: C:\Documents and Settings\nhatinge\My Documents\CRC\Task AK (Comp Truss)\FB MultiPier\SB\Liquifaction Scour\Long\P1-LCS.in
File View Control Wizard Help
Load Case
Model Data
Global Data
Problem
Analysis
AASHTO
Pushover
Pier Data
Pile and Cap
Soil
Pier
X-Members
Load
Springs
Retained Soil
Bridge Data
Bridge
Span Load
Problem
Problem Type
General Pier
Pile and Cap Only
Single Pile
High Mast Light/Sign
Retaining Wall
Sound Wall
Stiffness
Pile Bent
Column Analysis
Bridge (Multiple Piers)
Project Data
Client
CRC / WSDOT / ODOT
Project Name
Columbia River Crossing
Project Manager
R. Turton
Date
03/15/2011
Computed By
NRH
Project Description
SB - Pier 1 - Liquefaction + Contraction Scour
Pile Edit
Xp
Soil Edit
Pile 1, Pile Set 1
Soil Set 1: Layer 1: Ø=33 Gamma=125
Soil Set 1: Layer 2: Ø=6 Gamma=107.3
Soil Set 1: Layer 3: Ø=6 Gamma=121.2
Soil Set 1: Layer 4: Ø=35 Gamma=121.2
Soil Set 1: Layer 5: Ø=45 Gamma=136.7
Soil Set 1: Layer 6: Ø=45 Gamma=140.2
15.8
0.0
-13.0
-41.0
-72.0
-100.0
-200.0
-209.0
-218.0
-262.0
-247.3
ELEVATION - ft
3D View

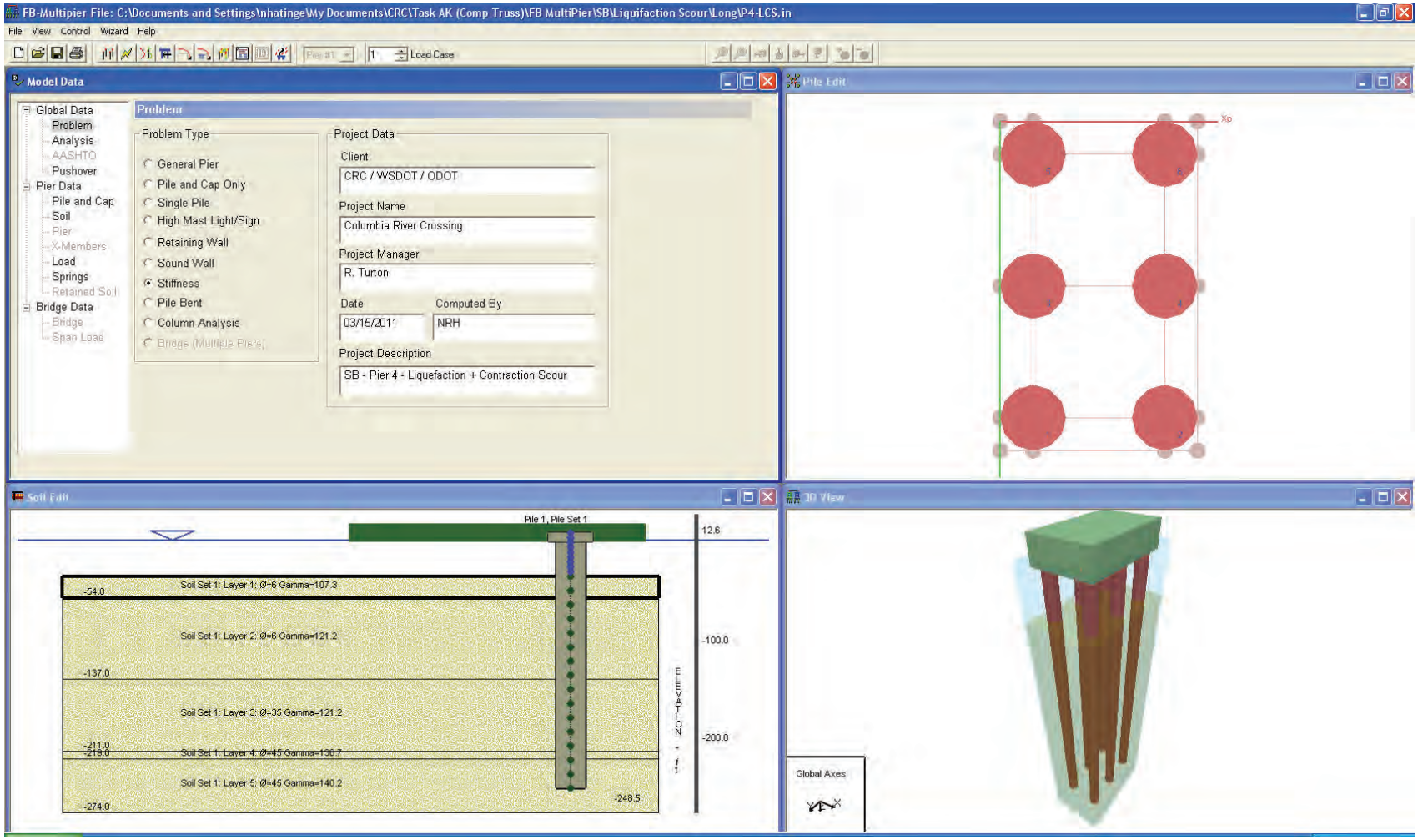

FB-Multipier File: C:\Documents and Settings\nhatinge\My Documents\CRC\Task AK (Comp Truss)\FB MultiPier\SB\Liquifaction Scour\Long\P1-LCS.in
File View Control Wizard Help
Load Case
Pile Selection
Plot Display Control
Click Moment, Shear, etc. plot windows to view maximums for current load case.
Pile # At Depth
Max 0 1 15.78
Min 0 1 15.78
Show All Maximum And Minimum Values (All Load Cases)
Apply
Member Forces
Shear 2 (kips)
Shear 3 (kips)
Moment 3 (kip-ft)
Moment 2 (kip-ft)
Axial (kips)
D/C Ratio
Pile Displacements
Lat X (in)
Lat Y (in)
Rot. About X (in)
Rot. About Y (in)
Coordinate Systems
Pile & Pier Column
Pier Cap
Pier (Local)
Soil Forces
Soil Axial(kips)
Soil Lat X (kips)
Soil Lat Y (kips)
Soil Torsion (kip-ft)
Notes: 1. Click Apply to redraw graphs
2. Hover mouse over controls for tool tips
Moment 3
Axial
D/C Ratio
-15.8 ft
-2.6 ft
10.5 ft
23.7 ft
36.8 ft
50.0 ft
63.1 ft
76.3 ft
89.5 ft
102.6 ft
115.8 ft
128.9 ft
142.1 ft
155.2 ft
168.4 ft
181.5 ft
194.7 ft
207.8 ft
221.0 ft
234.1 ft
247.3 ft
1.12e+004 kip-ft
-1.05e+004 kip-ft
3.19e+004 kip-ft
-9.09e+003 kip-ft
0 kips
-399 kips
-1.04e+004 kips
0.212
0.0999
0

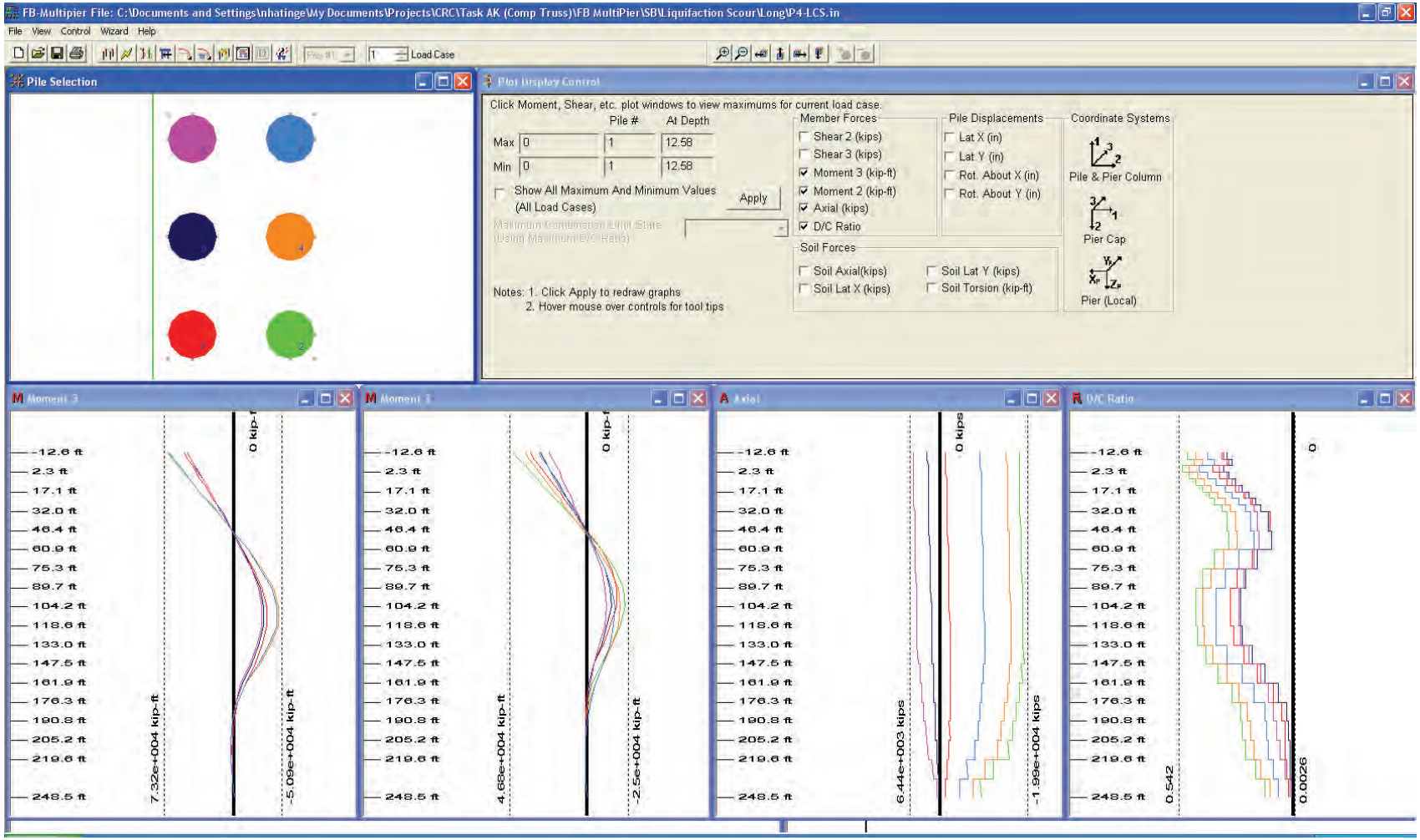

FB-Multipier File: C:\Documents and Settings\nhatinge\My Documents\CRC\Task AK (Comp Truss)\FB MultiPier\SB\Liquifaction Scour\Long\P2-LCS.in
File View Control Wizard Help
Load Case
Model Data
Global Data
Problem
Analysis
AASHTO
Pushover
Pier Data
Pile and Cap
Soil
Pier
X-Members
Load
Springs
Retained Soil
Bridge Data
Bridge
Span Load
Problem
Problem Type
General Pier
Pile and Cap Only
Single Pile
High Mast Light/Sign
Retaining Wall
Sound Wall
Stiffness
Pile Bent
Column Analysis
Bridge (Multiple Piers)
Project Data
Client
CRC / WSDOT / ODOT
Project Name
Columbia River Crossing
Project Manager
R. Turton
Date
03/15/2011
Computed By
NRH
Project Description
SB - Pier 2 - Liquefaction + Contraction Scour
Pile Edit
Xp
Soil Edit
Pile 1, Pile Set 1
12.8
Soil Set 1: Layer 1: Ø=6 Gamma=107.3
-47.0
Soil Set 1: Layer 2: Ø=6 Gamma=121.2
-127.0
Soil Set 1: Layer 3: Ø=35 Gamma=121.2
Soil Set 1: Layer 4: Ø=45 Gamma=136.7
Soil Set 1: Layer 5: Ø=45 Gamma=140.2
-272.0
-248.3
-100.0
-200.0
ELEVATION - ft
3D View
Global Axes

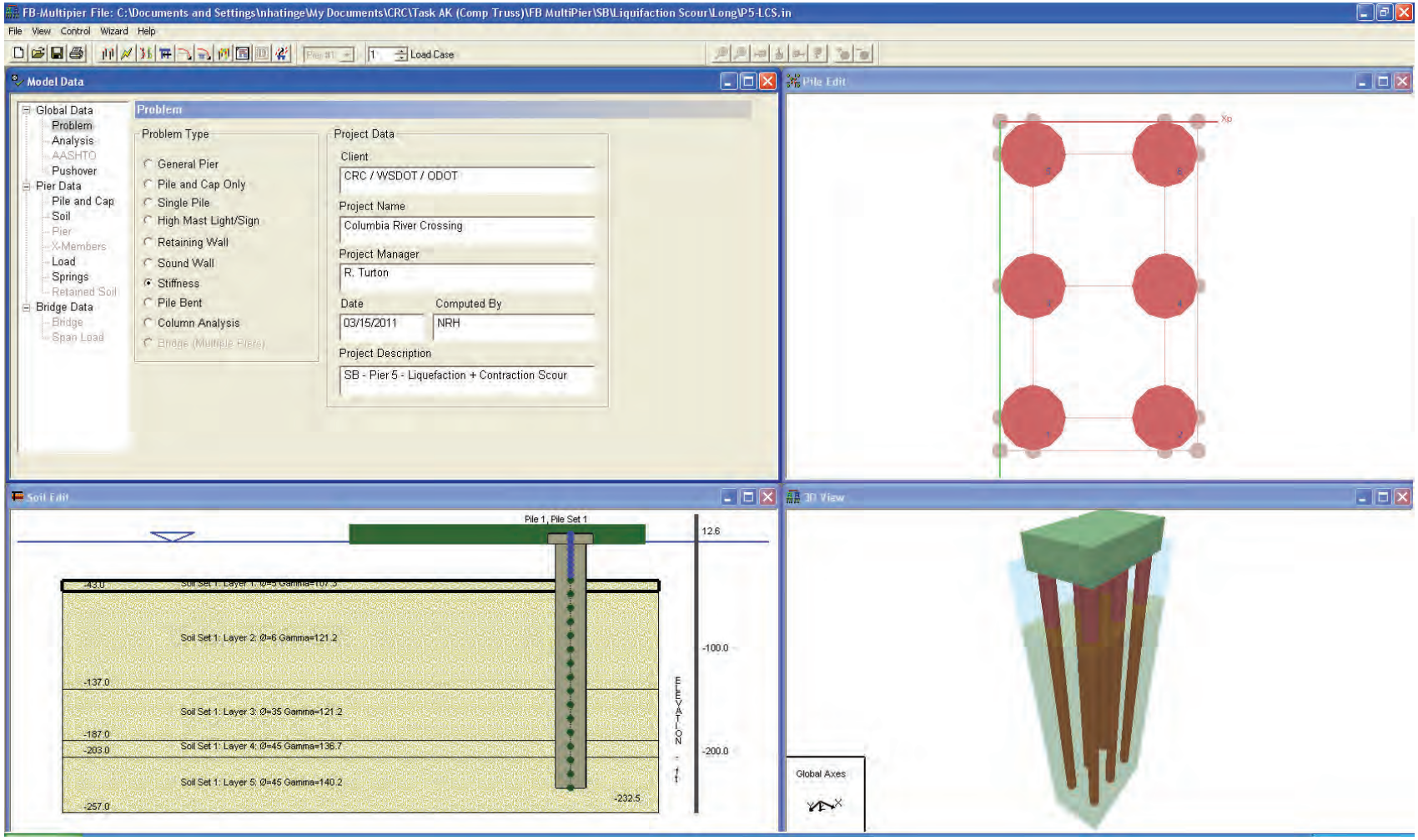

FB-Multipier File: C:\Documents and Settings\nhatinge\My Documents\CRC\Task AK (Comp Truss)\FB MultiPier\SB\Liquifaction Scour\Long\P2-LCS.in
File View Control Wizard Help
Load Case
Pile Selection
Plot Display Control
Click Moment, Shear, etc. plot windows to view maximums for current load case.
Pile # At Depth
Max 0 1 12.78
Min 0 1 12.78
Show All Maximum And Minimum Values (All Load Cases)
Apply
Notes: 1. Click Apply to redraw graphs
2. Hover mouse over controls for tool tips
Member Forces
Shear 2 (kips)
Shear 3 (kips)
Moment 3 (kip-ft)
Moment 2 (kip-ft)
Axial (kips)
D/C Ratio
Pile Displacements
Lat X (in)
Lat Y (in)
Rot. About X (in)
Rot. About Y (in)
Soil Forces
Soil Axial(kips)
Soil Lat X (kips)
Soil Lat Y (kips)
Soil Torsion (kip-ft)
Coordinate Systems
Pile & Pier Column
Pier Cap
Pier (Local)
Moment 3
6.98e+004 kip-ft
0 kip-f
-4.17e+004 kip-ft
Moment 3
5.03e+004 kip-ft
0 kip-f
-2.45e+004 kip-ft
Axial
112 kips
0 kips
-1.81e+004 kips
D/C Ratio
0.539
0
0.0112
-12.8 ft
-1.2 ft
10.4 ft
22.0 ft
37.1 ft
52.2 ft
67.3 ft
82.3 ft
97.4 ft
112.5 ft
127.6 ft
142.7 ft
157.8 ft
172.9 ft
188.0 ft
203.0 ft
218.1 ft
248.3 ft

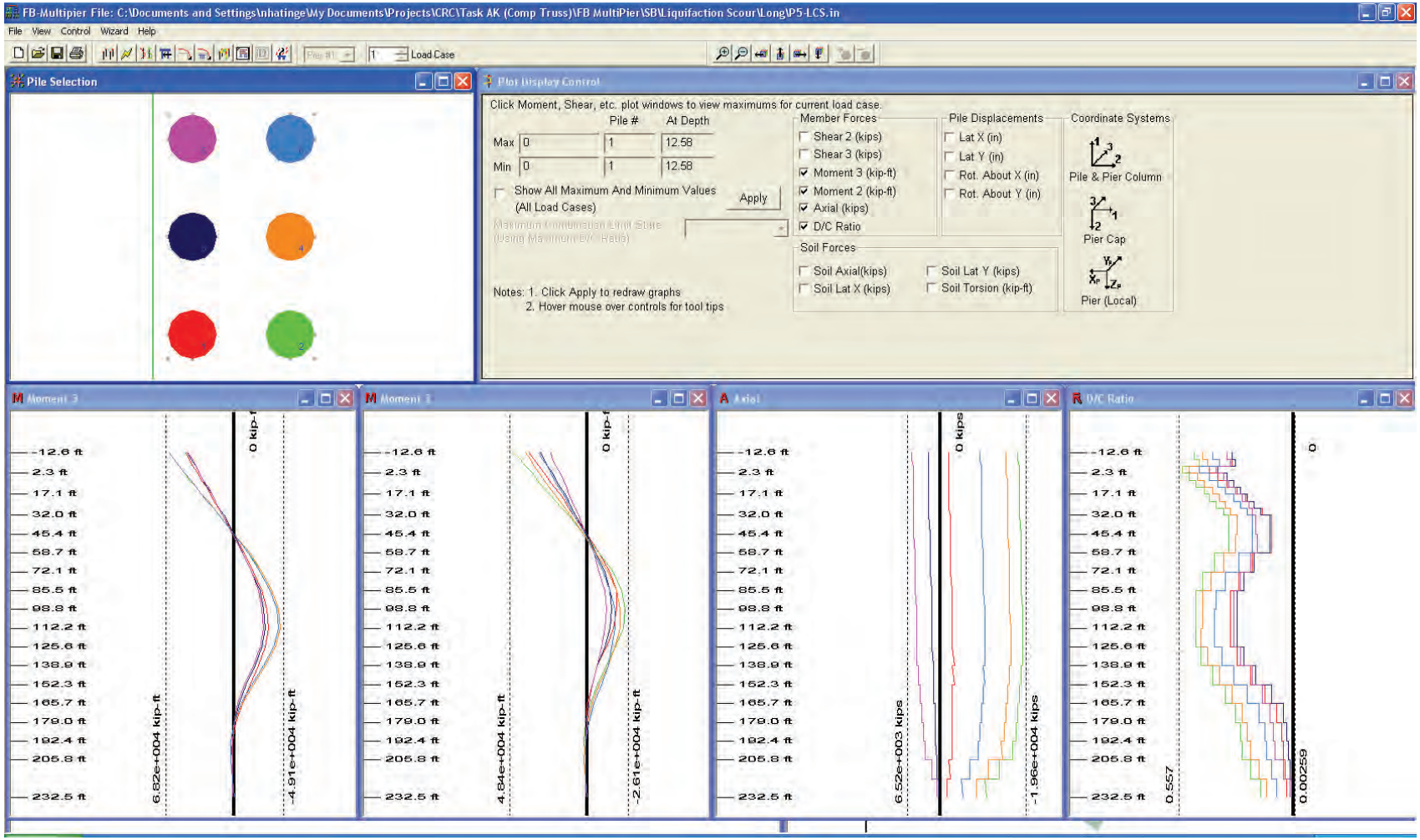

FB-Multipier File: C:\Documents and Settings\nhatinge\My Documents\CRC\Task AK (Comp Truss)\FB MultiPier\SB\Liquifaction Scour\Long\P3-LCS.in
File View Control Wizard Help
Load Case
Model Data
Global Data
Problem
Analysis
AASHTO
Pushover
Pier Data
Pile and Cap
Soil
Pier
X-Members
Load
Springs
Retained Soil
Bridge Data
Bridge
Span Load
Problem
Problem Type
General Pier
Pile and Cap Only
Single Pile
High Mast Light/Sign
Retaining Wall
Sound Wall
Stiffness
Pile Bent
Column Analysis
Bridge (Multiple Piers)
Project Data
Client
CRC / WSDOT / ODOT
Project Name
Columbia River Crossing
Project Manager
R. Turton
Date
03/15/2011
Computed By
NRH
Project Description
SB - Pier 3 - Liquefaction + Contraction Scour
Pile Edit
Xp
Soil Edit
Pile 1, Pile Set 1
12.6
-54.0
Soil Set 1: Layer 1: Ø=6 Gamma=107.3
Soil Set 1: Layer 2: Ø=6 Gamma=121.2
-100.0
-139.0
Soil Set 1: Layer 3: Ø=35 Gamma=121.2
-200.0
-215.0
-225.0
Soil Set 1: Layer 4: Ø=45 Gamma=136.7
Soil Set 1: Layer 5: Ø=45 Gamma=140.2
-278.0
-254.5
ELEVATION - ft
3D View
Global Axes

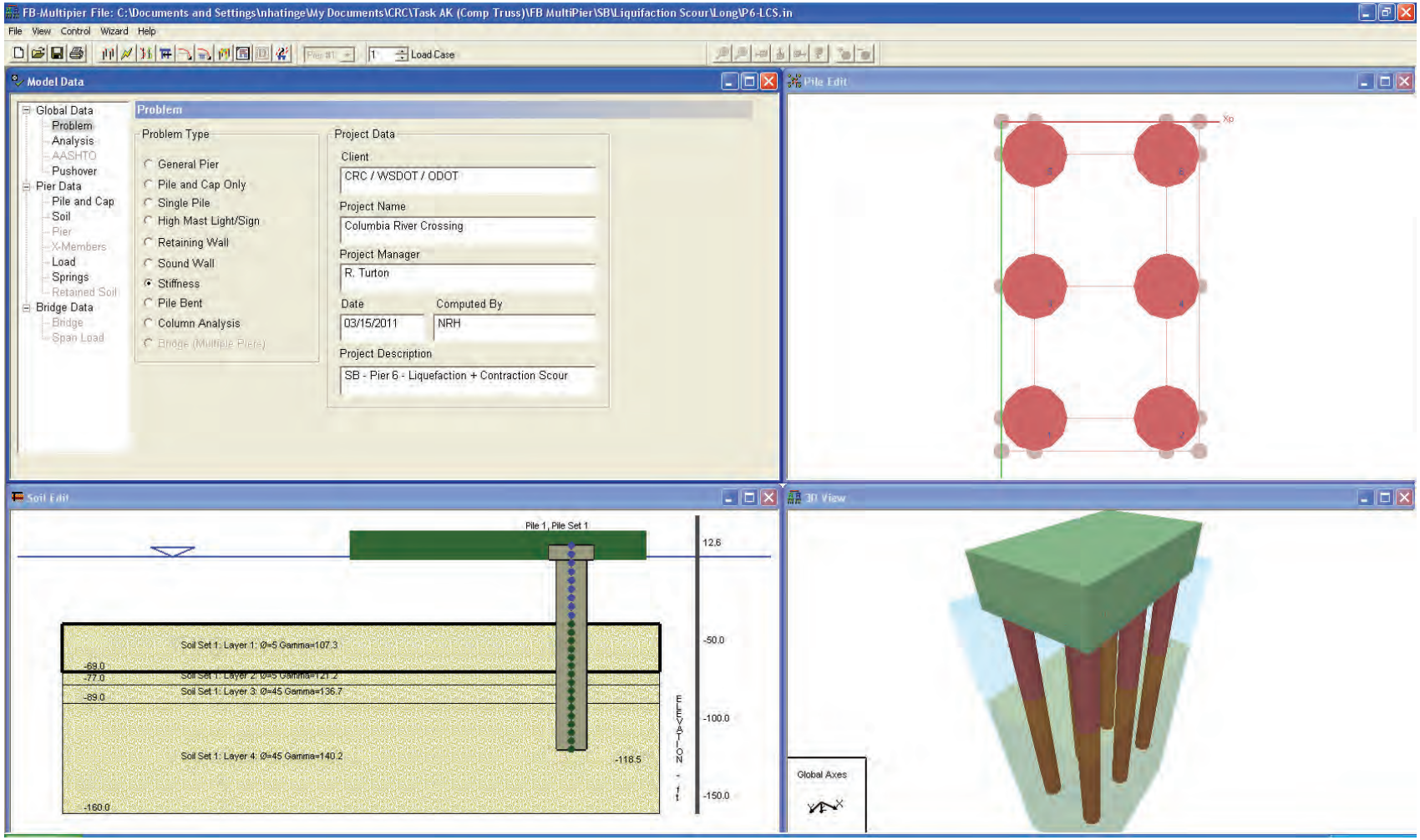

FB-Multipier File: C:\Documents and Settings\nhatinge\My Documents\CRC\Task AK (Comp Truss)\FB MultiPier\SB\Liquifaction Scour\Long\P3-LCS.in
File View Control Wizard Help
Load Case
Pile Selection
Plot Display Control
Click Moment, Shear, etc. plot windows to view maximums for current load case.
Pile # At Depth
Max 0 1 12.58
Min 0 1 12.58
Show All Maximum And Minimum Values (All Load Cases)
Apply
Member Forces
Shear 2 (kips)
Shear 3 (kips)
Moment 3 (kip-ft)
Moment 2 (kip-ft)
Axial (kips)
D/C Ratio
Pile Displacements
Lat X (in)
Lat Y (in)
Rot. About X (in)
Rot. About Y (in)
Coordinate Systems
Pile & Pier Column
Pier Cap
Pier (Local)
Soil Forces
Soil Axial(kips)
Soil Lat X (kips)
Soil Lat Y (kips)
Soil Torsion (kip-ft)
Notes: 1. Click Apply to redraw graphs
2. Hover mouse over controls for tool tips
Moment 3
Moment 3
Axial
D/C Ratio
-12.6 ft
2.9 ft
18.5 ft
34.0 ft
48.7 ft
63.4 ft
78.1 ft
92.8 ft
107.5 ft
122.2 ft
136.9 ft
151.6 ft
166.3 ft
181.0 ft
195.7 ft
210.4 ft
225.1 ft
254.5 ft
8.25e+004 kip-ft
-5.65e+004 kip-ft
5.5e+004 kip-ft
-3.01e+004 kip-ft
7.42e+003 kips
-2.06e+004 kips
0 kips
0.637
0.00399
0

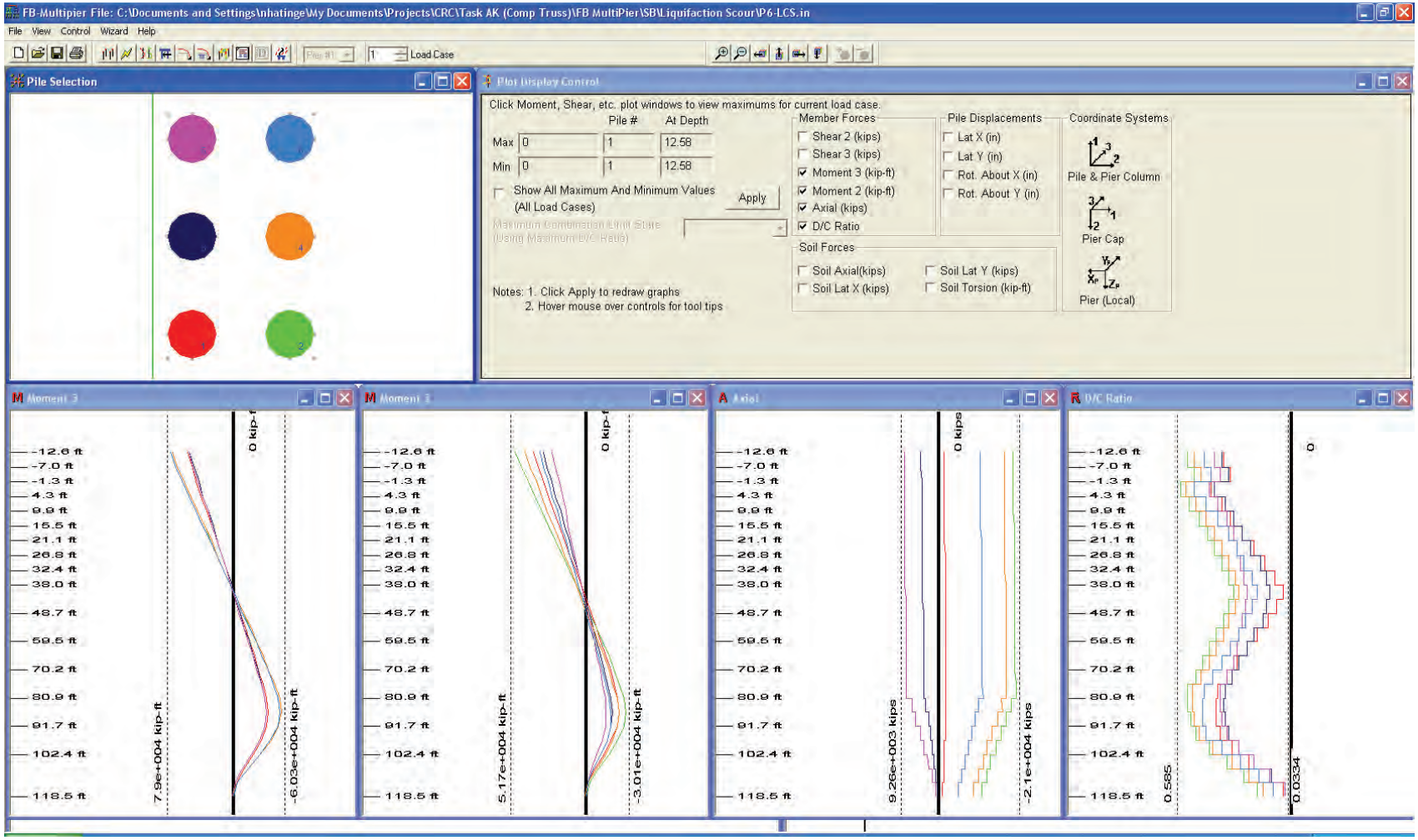

FB-Multipier File: C:\Documents and Settings\nhatinge\My Documents\CRC\Task AK (Comp Truss)\FB MultiPier\SB\Liquifaction Scour\Long\P4-LCS.in
File View Control Wizard Help
Load Case
Model Data
Global Data
Problem
Analysis
AASHTO
Pushover
Pier Data
Pile and Cap
Soil
Pier
X-Members
Load
Springs
Retained Soil
Bridge Data
Bridge
Span Load
Problem
Problem Type
General Pier
Pile and Cap Only
Single Pile
High Mast Light/Sign
Retaining Wall
Sound Wall
Stiffness
Pile Bent
Column Analysis
Bridge (Multiple Piers)
Project Data
Client
CRC / WSDOT / ODOT
Project Name
Columbia River Crossing
Project Manager
R. Turton
Date
03/15/2011
Computed By
NRH
Project Description
SB - Pier 4 - Liquefaction + Contraction Scour
Pile Edit
Xp
Soil Edit
Pile 1, Pile Set 1
12.6
-54.0
Soil Set 1: Layer 1: Ø=6 Gamma=107.3
Soil Set 1: Layer 2: Ø=6 Gamma=121.2
-100.0
-137.0
Soil Set 1: Layer 3: Ø=35 Gamma=121.2
-200.0
-211.0
-219.0
Soil Set 1: Layer 4: Ø=45 Gamma=138.7
Soil Set 1: Layer 5: Ø=45 Gamma=140.2
-248.5
-274.0
ELEVATION - ft
3D View
Global Axes

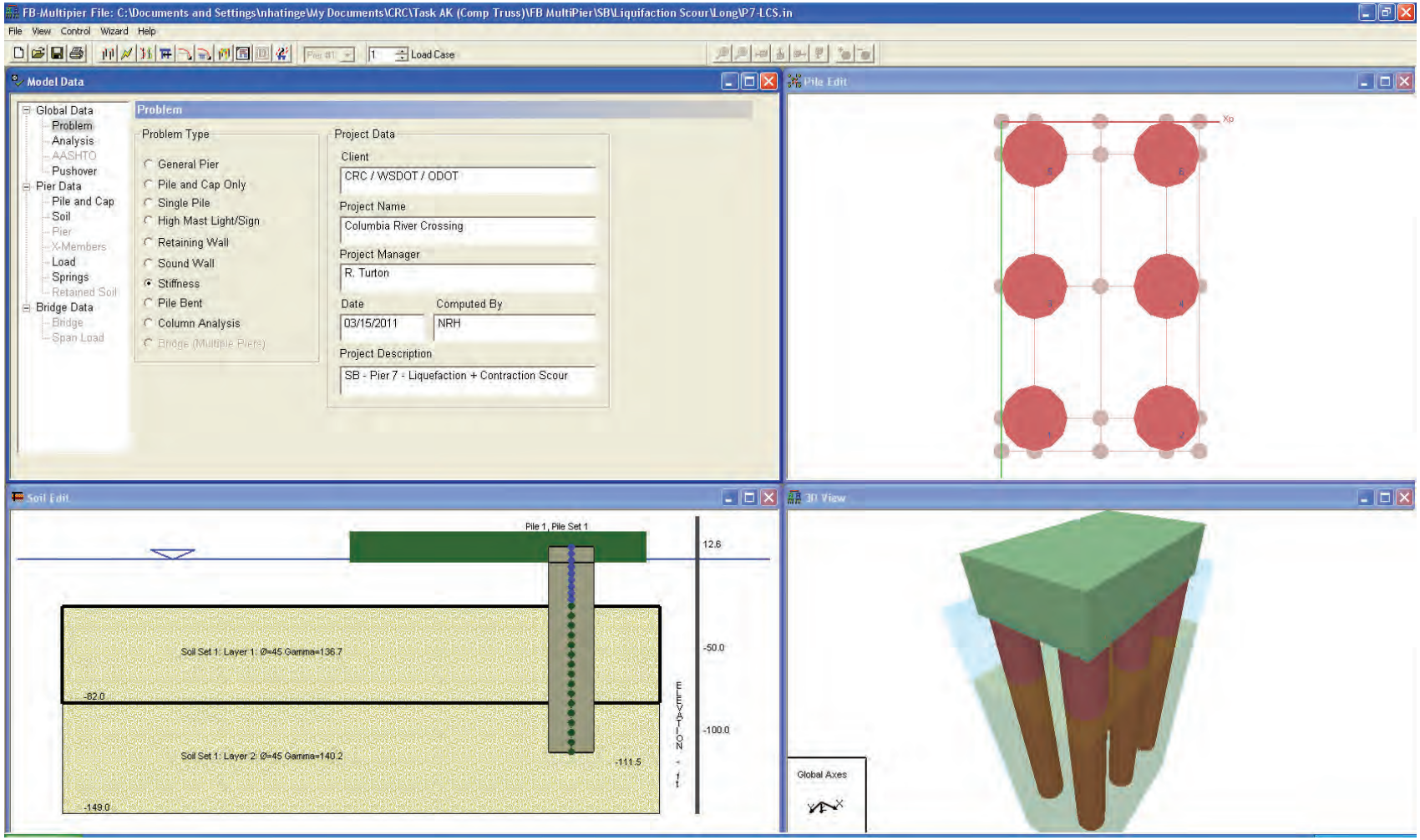

FB-Multipier File: C:\Documents and Settings\nhatinge\My Documents\Projects\CRC\Task AK (Comp Truss)\FB MultiPier\SB\Liquifaction Scour\Long\P4-LCS.in
File View Control Wizard Help
Load Case
Pile Selection
Plot Display Control
Click Moment, Shear, etc. plot windows to view maximums for current load case.
Pile # At Depth
Max 0 1 12.58
Min 0 1 12.58
Show All Maximum And Minimum Values (All Load Cases)
Apply
Member Forces
Shear 2 (kips)
Shear 3 (kips)
Moment 3 (kip-ft)
Moment 2 (kip-ft)
Axial (kips)
D/C Ratio
Pile Displacements
Lat X (in)
Lat Y (in)
Rot. About X (in)
Rot. About Y (in)
Coordinate Systems
Pile & Pier Column
Pier Cap
Pier (Local)
Soil Forces
Soil Axial(kips)
Soil Lat X (kips)
Soil Lat Y (kips)
Soil Torsion (kip-ft)
Notes: 1. Click Apply to redraw graphs
2. Hover mouse over controls for tool tips
Moment 3
Axial
D/C Ratio
-12.6 ft
2.3 ft
17.1 ft
32.0 ft
46.4 ft
60.9 ft
75.3 ft
89.7 ft
104.2 ft
118.6 ft
133.0 ft
147.5 ft
161.9 ft
176.3 ft
190.8 ft
205.2 ft
219.6 ft
248.5 ft
7.32e+004 kip-ft
-5.09e+004 kip-ft
4.68e+004 kip-ft
-2.5e+004 kip-ft
6.44e+003 kips
-1.99e+004 kips
0 kips
0.542
0.0026

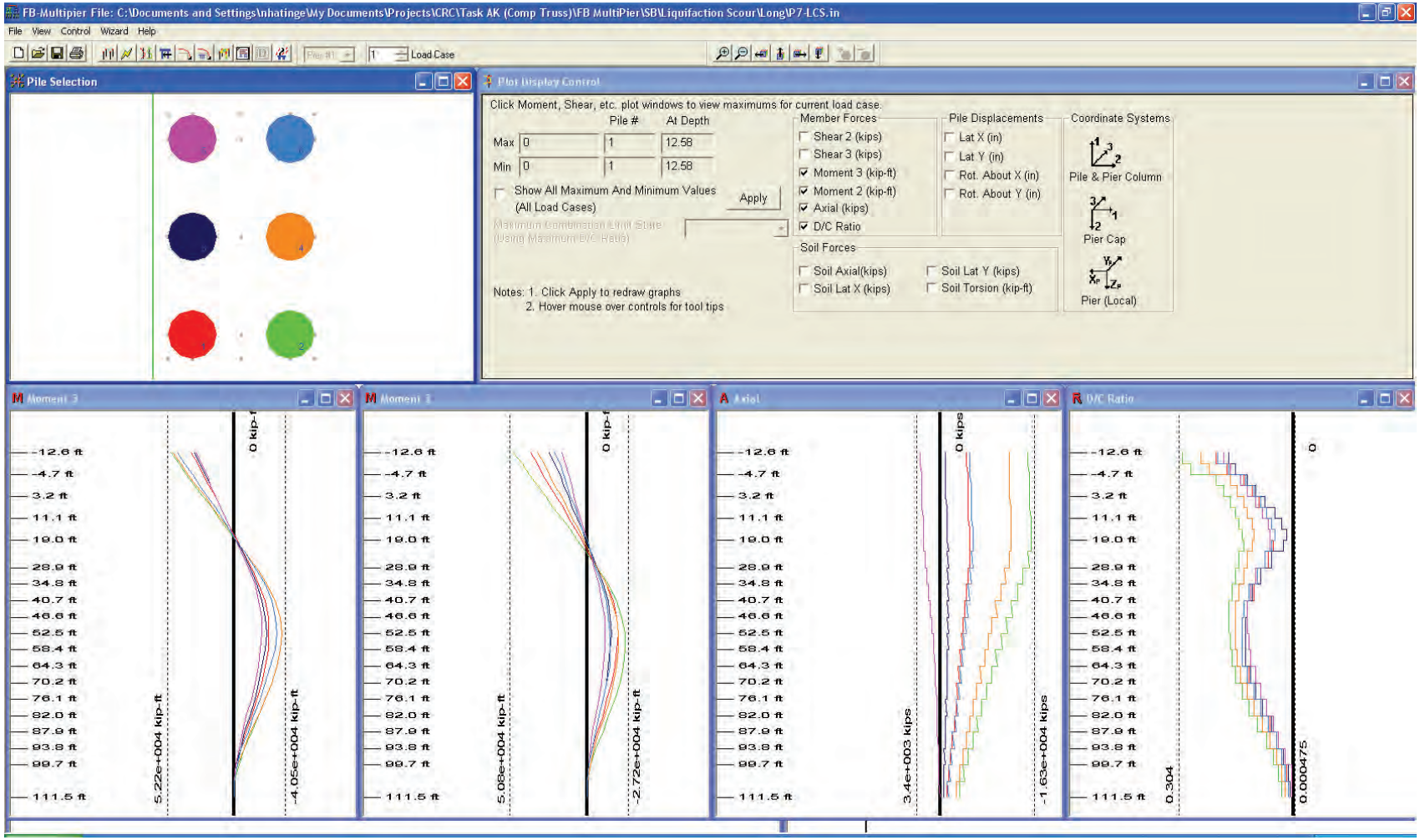

FB-Multipier File: C:\Documents and Settings\nhatinge\My Documents\CRC\Task AK (Comp Truss)\FB MultiPier\SB\Liquifaction Scour\Long\P5-LCS.in
File View Control Wizard Help
Load Case
Model Data
Global Data
Problem
Analysis
AASHTO
Pushover
Pier Data
Pile and Cap
Soil
Pier
X-Members
Load
Springs
Retained Soil
Bridge Data
Bridge
Span Load
Problem
Problem Type
General Pier
Pile and Cap Only
Single Pile
High Mast Light/Sign
Retaining Wall
Sound Wall
Stiffness
Pile Bent
Column Analysis
Bridge (Multiple Piers)
Project Data
Client
CRC / WSDOT / ODOT
Project Name
Columbia River Crossing
Project Manager
R. Turton
Date
03/15/2011
Computed By
NRH
Project Description
SB - Pier 5 - Liquefaction + Contraction Scour
Pile Edit
Xp
Soil Edit
Pile 1, Pile Set 1
12.6
-43.0
Soil Set 1: Layer 2: Ø=6 Gamma=121.2
-100.0
-137.0
Soil Set 1: Layer 3: Ø=35 Gamma=121.2
-187.0
-203.0
Soil Set 1: Layer 4: Ø=45 Gamma=136.7
-200.0
Soil Set 1: Layer 5: Ø=45 Gamma=140.2
-257.0
-232.5
ELEVATION - ft
3D View
Global Axes

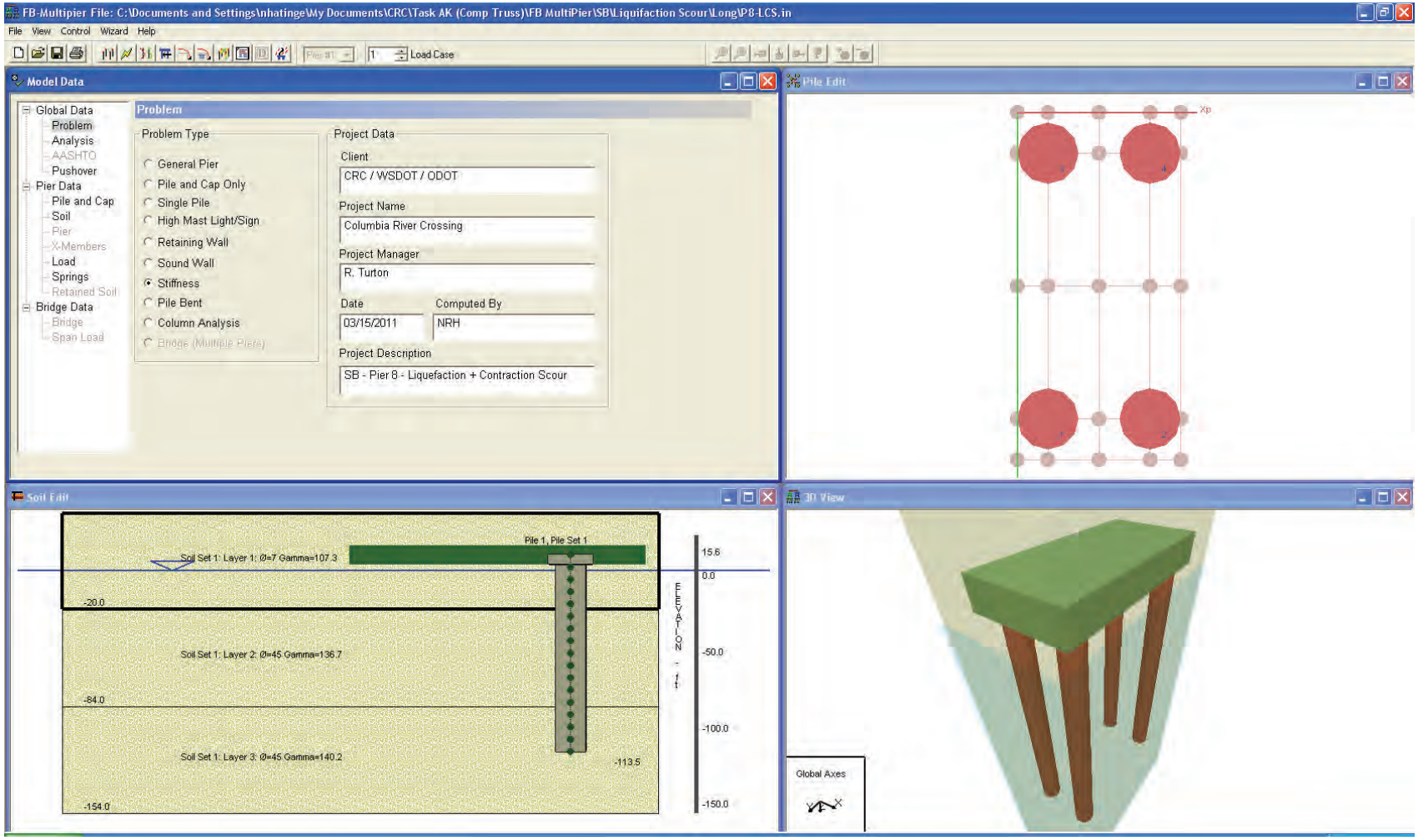

FB-Multipier File: C:\Documents and Settings\nhatinge\My Documents\Projects\CRC\Task AK (Comp Truss)\FB MultiPier\SB\Liquifaction Scour\Long\P5-LCS.in
File View Control Wizard Help
Load Case
Pile Selection
Plot Display Control
Click Moment, Shear, etc. plot windows to view maximums for current load case.
Pile # At Depth
Max 0 1 12.58
Min 0 1 12.58
Show All Maximum And Minimum Values (All Load Cases)
Apply
Member Forces
Shear 2 (kips)
Shear 3 (kips)
Moment 3 (kip-ft)
Moment 2 (kip-ft)
Axial (kips)
D/C Ratio
Pile Displacements
Lat X (in)
Lat Y (in)
Rot. About X (in)
Rot. About Y (in)
Coordinate Systems
Pile & Pier Column
Pier Cap
Pier (Local)
Soil Forces
Soil Axial(kips)
Soil Lat X (kips)
Soil Lat Y (kips)
Soil Torsion (kip-ft)
Notes: 1. Click Apply to redraw graphs
2. Hover mouse over controls for tool tips
Moment 3
6.82e+004 kip-ft
-4.91e+004 kip-ft
Moment 3
4.84e+004 kip-ft
-2.61e+004 kip-ft
Axial
6.52e+003 kips
-1.96e+004 kips
D/C Ratio
0.557
0.00259
-12.6 ft
2.3 ft
17.1 ft
32.0 ft
45.4 ft
58.7 ft
72.1 ft
85.5 ft
98.8 ft
112.2 ft
125.6 ft
138.9 ft
152.3 ft
165.7 ft
179.0 ft
192.4 ft
205.8 ft
232.5 ft

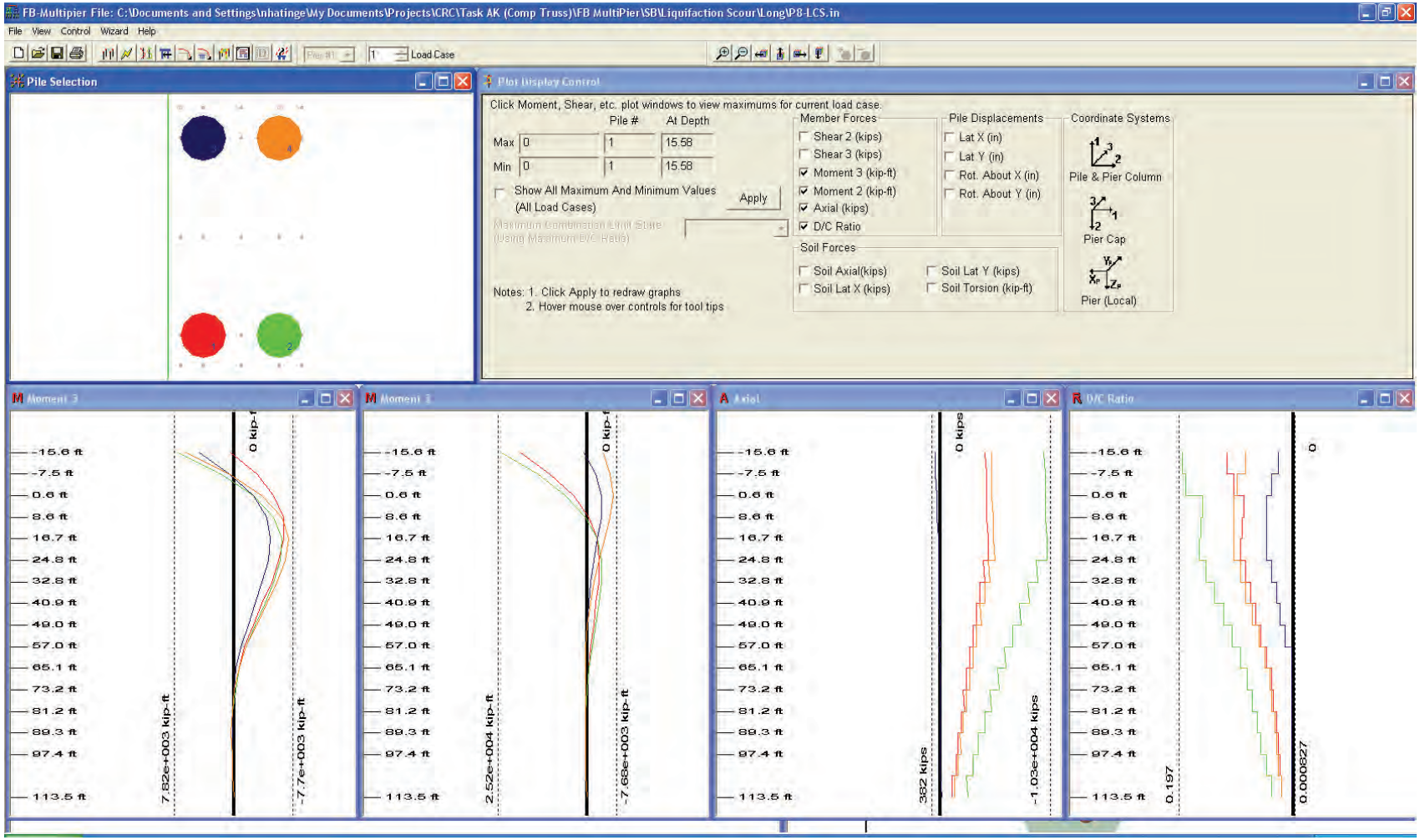

FB-Multipier File: C:\Documents and Settings\nhatinge\My Documents\CRC\Task AK (Comp Truss)\FB MultiPier\SB\Liquifaction Scour\Long\P6-LCS.in
File View Control Wizard Help
Load Case
Model Data
Global Data
Problem
Analysis
AASHTO
Pushover
Pier Data
Pile and Cap
Soil
Pier
X-Members
Load
Springs
Retained Soil
Bridge Data
Bridge
Span Load
Problem
Problem Type
General Pier
Pile and Cap Only
Single Pile
High Mast Light/Sign
Retaining Wall
Sound Wall
Stiffness
Pile Bent
Column Analysis
Bridge (Multiple Piers)
Project Data
Client
CRC / WSDOT / ODOT
Project Name
Columbia River Crossing
Project Manager
R. Turton
Date
03/15/2011
Computed By
NRH
Project Description
SB - Pier 6 - Liquefaction + Contraction Scour
Pile Edit
Xp
Soil Edit
Pile 1, Pile Set 1
12.6
-50.0
-100.0
-150.0
ELEVATION - ft
Soil Set 1: Layer 1; Ø=5 Gamma=107.3
-69.0
-77.0
Soil Set 1: Layer 2; Ø=5 Gamma=121.2
-89.0
Soil Set 1: Layer 3; Ø=45 Gamma=136.7
Soil Set 1: Layer 4; Ø=45 Gamma=140.2
-118.5
-160.0
3D View
Global Axes

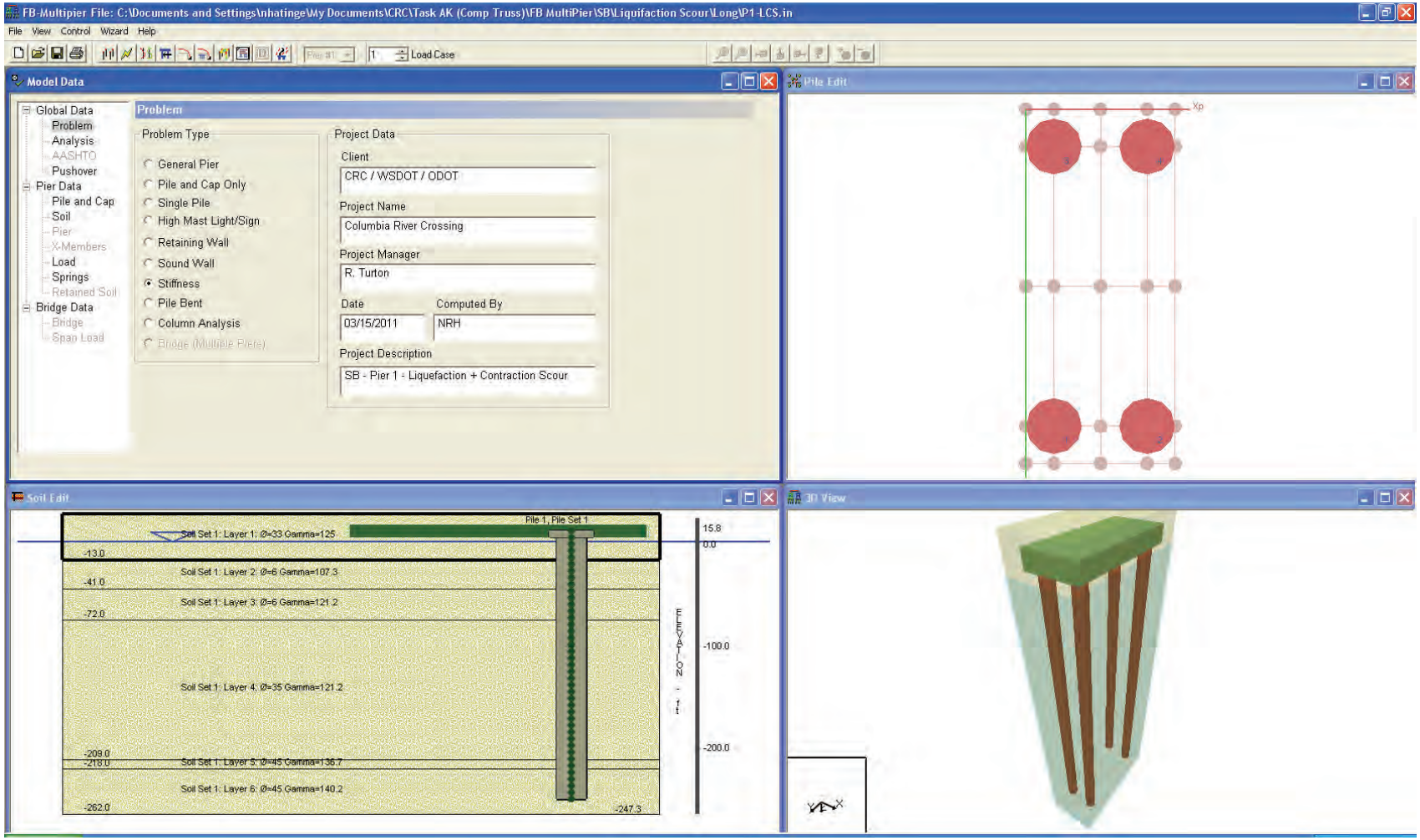

FB-Multipier File: C:\Documents and Settings\nhatinge\My Documents\Projects\CRC\Task AK (Comp Truss)\FB MultiPier\SB\Liquifaction Scour\P6-LCS.in
File View Control Wizard Help
Load Case
Pile Selection
Plot Display Control
Click Moment, Shear, etc. plot windows to view maximums for current load case.
Pile # At Depth
Max 0 1 12.58
Min 0 1 12.58
Show All Maximum And Minimum Values (All Load Cases)
Apply
Maximum Combination Limit State (Using Maximum D/C Ratio)
Member Forces
Shear 2 (kips)
Shear 3 (kips)
Moment 3 (kip-ft)
Moment 2 (kip-ft)
Axial (kips)
D/C Ratio
Pile Displacements
Lat X (in)
Lat Y (in)
Rot. About X (in)
Rot. About Y (in)
Coordinate Systems
Pile & Pier Column
Pier Cap
Pier (Local)
Soil Forces
Soil Axial(kips)
Soil Lat X (kips)
Soil Lat Y (kips)
Soil Torsion (kip-ft)
Notes: 1. Click Apply to redraw graphs
2. Hover mouse over controls for tool tips
Moment 3
7.9e+004 kip-ft
0 kip-f
-6.03e+004 kip-ft
Moment 3
5.17e+004 kip-ft
0 kip-f
-3.01e+004 kip-ft
Axial
9.26e+003 kips
0 kips
-2.1e+004 kips
D/C Ratio
0.585
0
0.0334
-12.6 ft
-7.0 ft
-1.3 ft
4.3 ft
9.9 ft
15.5 ft
21.1 ft
26.8 ft
32.4 ft
38.0 ft
48.7 ft
59.5 ft
70.2 ft
80.9 ft
91.7 ft
102.4 ft
118.5 ft

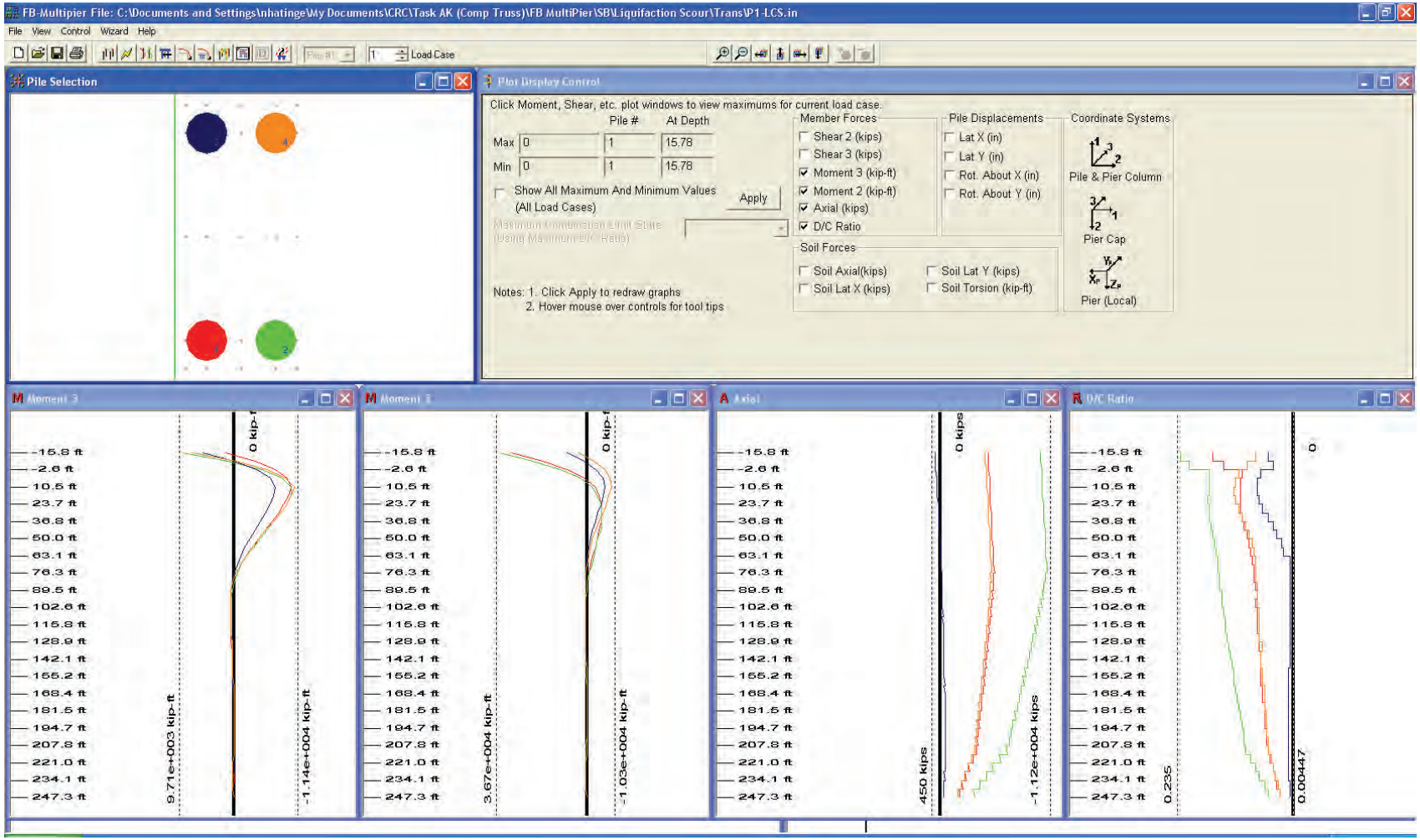

FB-Multipier File: C:\Documents and Settings\nhatinge\My Documents\CRC\Task AK (Comp Truss)\FB MultiPier\SB\Liquifaction Scour\Long\P7-LCS.in
File View Control Wizard Help
Load Case
Model Data
Global Data
Problem
Analysis
AASHTO
Pushover
Pier Data
Pile and Cap
Soil
Pier
X-Members
Load
Springs
Retained Soil
Bridge Data
Bridge
Span Load
Problem
Problem Type
General Pier
Pile and Cap Only
Single Pile
High Mast Light/Sign
Retaining Wall
Sound Wall
Stiffness
Pile Bent
Column Analysis
Bridge (Multiple Piers)
Project Data
Client
CRC / WSDOT / ODOT
Project Name
Columbia River Crossing
Project Manager
R. Turton
Date
03/15/2011
Computed By
NRH
Project Description
SB - Pier 7 - Liquefaction + Contraction Scour
Pile Edit
Xp
Soil Edit
Pile 1, Pile Set 1
12.6
-50.0
-100.0
ELEVATION - ft
Soil Set 1: Layer 1: Ø=45 Gamma=136.7
-82.0
Soil Set 1: Layer 2: Ø=45 Gamma=140.2
-111.5
-149.0
3D View
Global Axes

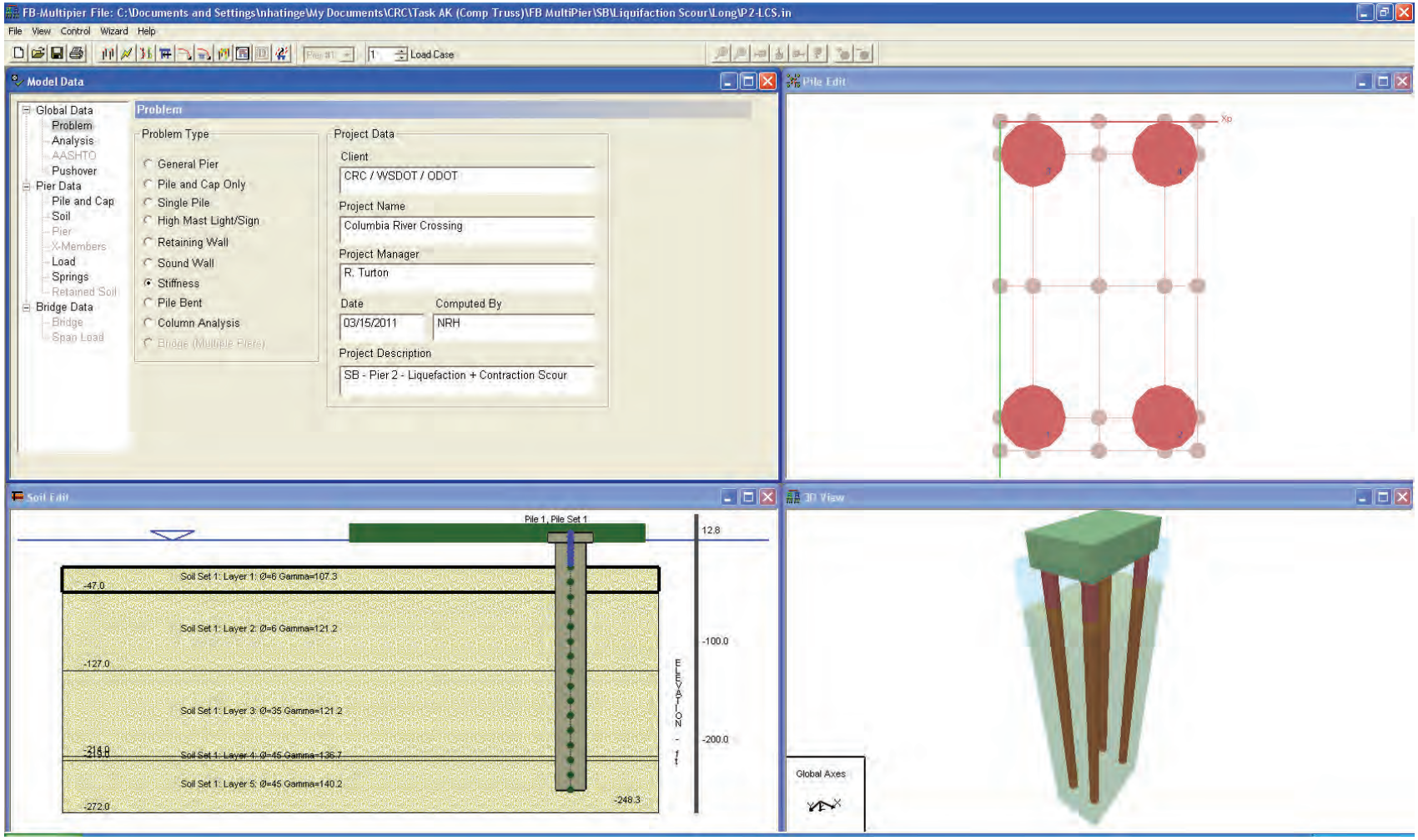

FB-Multipier File: C:\Documents and Settings\nhatinge\My Documents\Projects\CRC\Task AK (Comp Truss)\FB MultiPier\SB\Liquifaction Scour\Long\P7-LCS.in
File View Control Wizard Help
Load Case
Pile Selection
Plot Display Control
Click Moment, Shear, etc. plot windows to view maximums for current load case.
Pile # At Depth
Max 0 1 12.58
Min 0 1 12.58
Show All Maximum And Minimum Values (All Load Cases)
Apply
Maximum Combination Limit State (Using Maximum D/C Ratio)
Member Forces
Shear 2 (kips)
Shear 3 (kips)
Moment 3 (kip-ft)
Moment 2 (kip-ft)
Axial (kips)
D/C Ratio
Pile Displacements
Lat X (in)
Lat Y (in)
Rot. About X (in)
Rot. About Y (in)
Coordinate Systems
Pile & Pier Column
Pier Cap
Pier (Local)
Soil Forces
Soil Axial(kips)
Soil Lat X (kips)
Soil Lat Y (kips)
Soil Torsion (kip-ft)
Notes: 1. Click Apply to redraw graphs
2. Hover mouse over controls for tool tips
Moment 3
Moment 3
Axial
D/C Ratio
-12.6 ft
-4.7 ft
3.2 ft
11.1 ft
19.0 ft
28.9 ft
34.8 ft
40.7 ft
46.6 ft
52.5 ft
58.4 ft
64.3 ft
70.2 ft
76.1 ft
82.0 ft
87.9 ft
93.8 ft
99.7 ft
111.5 ft
5.22e+004 kip-ft
0 kip-f
-4.05e+004 kip-ft
5.08e+004 kip-ft
0 kip-f
-2.72e+004 kip-ft
3.4e+003 kips
0 kips
-1.63e+004 kips
0.304
0
0.000475

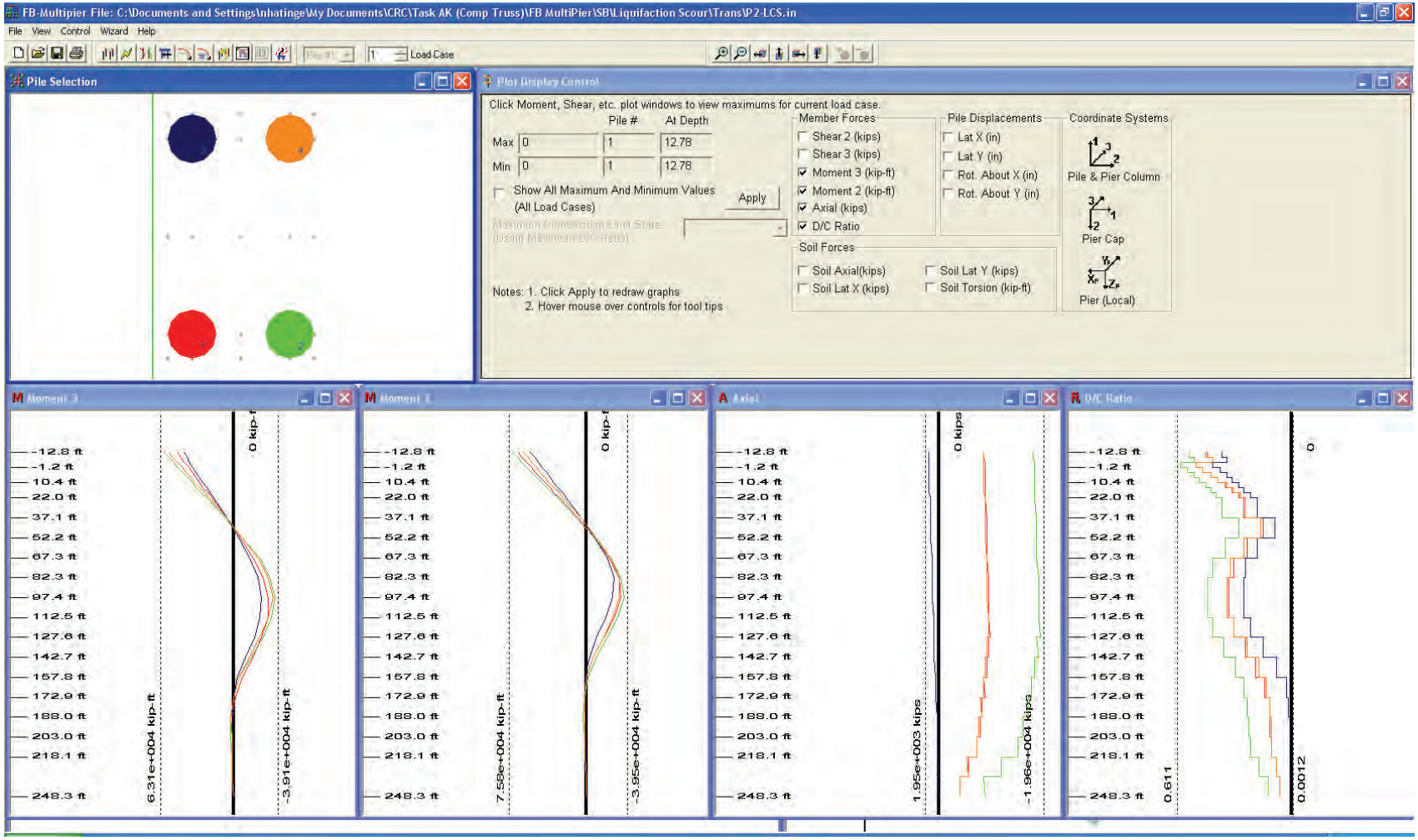

FB-Multipier File: C:\Documents and Settings\nhatinge\My Documents\CRC\Task AK (Comp Truss)\FB MultiPier\SB\Liquifaction Scour\Long\P8-LCS.in
File View Control Wizard Help
Load Case
Model Data
Global Data
Problem
Analysis
AASHTO
Pushover
Pier Data
Pile and Cap
Soil
Pier
X-Members
Load
Springs
Retained Soil
Bridge Data
Bridge
Span Load
Problem
Problem Type
General Pier
Pile and Cap Only
Single Pile
High Mast Light/Sign
Retaining Wall
Sound Wall
Stiffness
Pile Bent
Column Analysis
Bridge (Multiple Piers)
Project Data
Client
CRC / WSDOT / ODOT
Project Name
Columbia River Crossing
Project Manager
R. Turton
Date
03/15/2011
Computed By
NRH
Project Description
SB - Pier 8 - Liquefaction + Contraction Scour
Pile Edit
Xp
Soil Edit
Pile 1, Pile Set 1
Soil Set 1: Layer 1: Ø=7 Gamma=107.3
Soil Set 1: Layer 2: Ø=45 Gamma=136.7
Soil Set 1: Layer 3: Ø=45 Gamma=140.2
15.6
0.0
-20.0
-50.0
-84.0
-100.0
-113.5
-150.0
-154.0
ELEVATION - ft
3D View
Global Axes

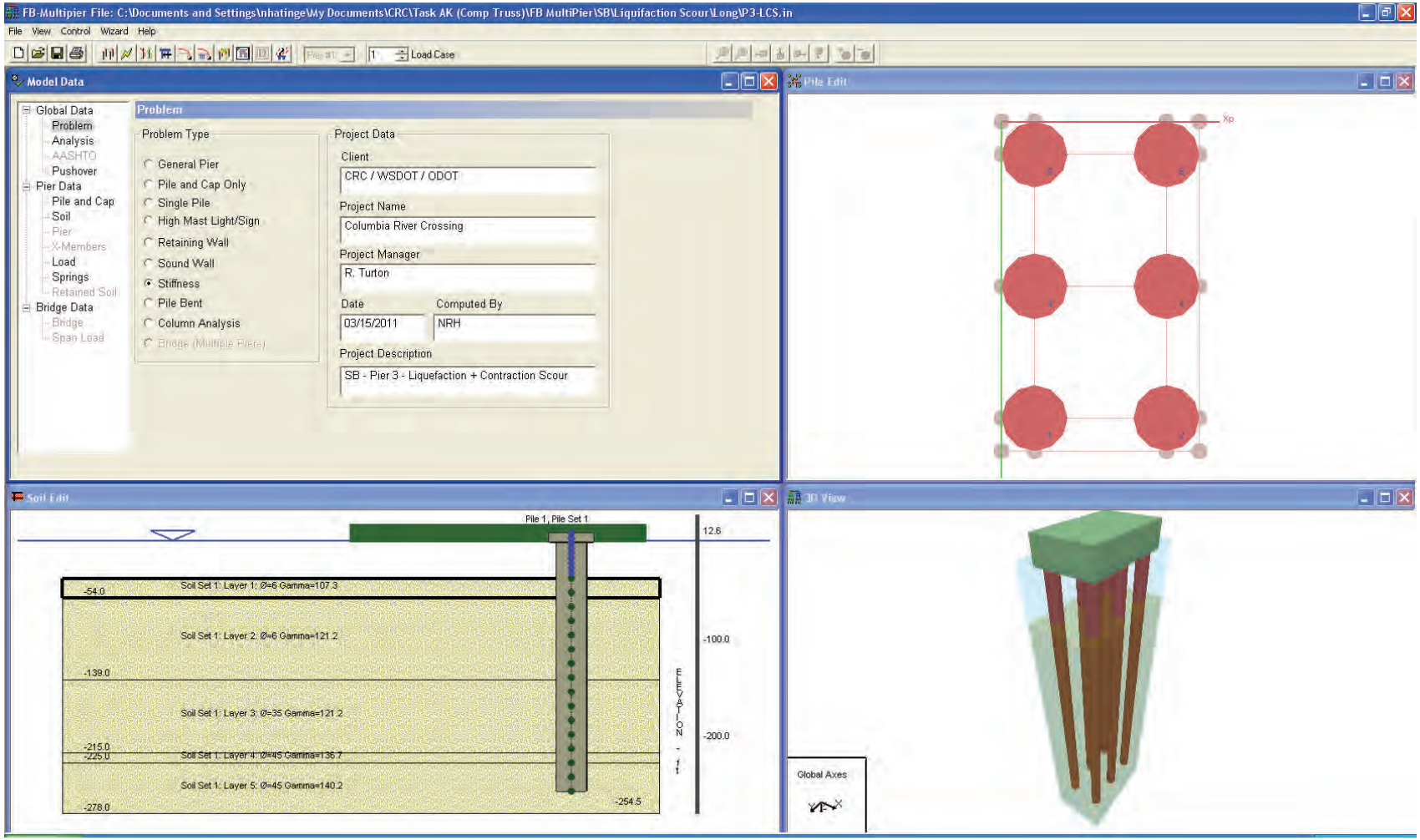

FB-Multipier File: C:\Documents and Settings\nhatinge\My Documents\Projects\CRC\Task AK (Comp Truss)\FB MultiPier\SB\Liquifaction Scour\Long\P8-LCS.in
File View Control Wizard Help
Load Case
Pile Selection
Plot Display Control
Click Moment, Shear, etc. plot windows to view maximums for current load case.
Pile # At Depth
Max 0 1 15.58
Min 0 1 15.58
Show All Maximum And Minimum Values (All Load Cases)
Apply
Maximum Combination Limit State (Using Maximum D/C Ratio)
Member Forces
Shear 2 (kips)
Shear 3 (kips)
Moment 3 (kip-ft)
Moment 2 (kip-ft)
Axial (kips)
D/C Ratio
Pile Displacements
Lat X (in)
Lat Y (in)
Rot. About X (in)
Rot. About Y (in)
Coordinate Systems
Pile & Pier Column
Pier Cap
Pier (Local)
Soil Forces
Soil Axial(kips)
Soil Lat X (kips)
Soil Lat Y (kips)
Soil Torsion (kip-ft)
Notes: 1. Click Apply to redraw graphs
2. Hover mouse over controls for tool tips
Moment 3
Moment 3
Axial
D/C Ratio
-15.6 ft
-7.5 ft
0.6 ft
8.6 ft
16.7 ft
24.8 ft
32.8 ft
40.9 ft
49.0 ft
57.0 ft
65.1 ft
73.2 ft
81.2 ft
89.3 ft
97.4 ft
113.5 ft
7.82e+003 kip-ft
0 kip-f
-7.7e+003 kip-ft
2.52e+004 kip-ft
-7.68e+003 kip-ft
362 kips
0 kips
-1.03e+004 kips
0.197
0
0.000827

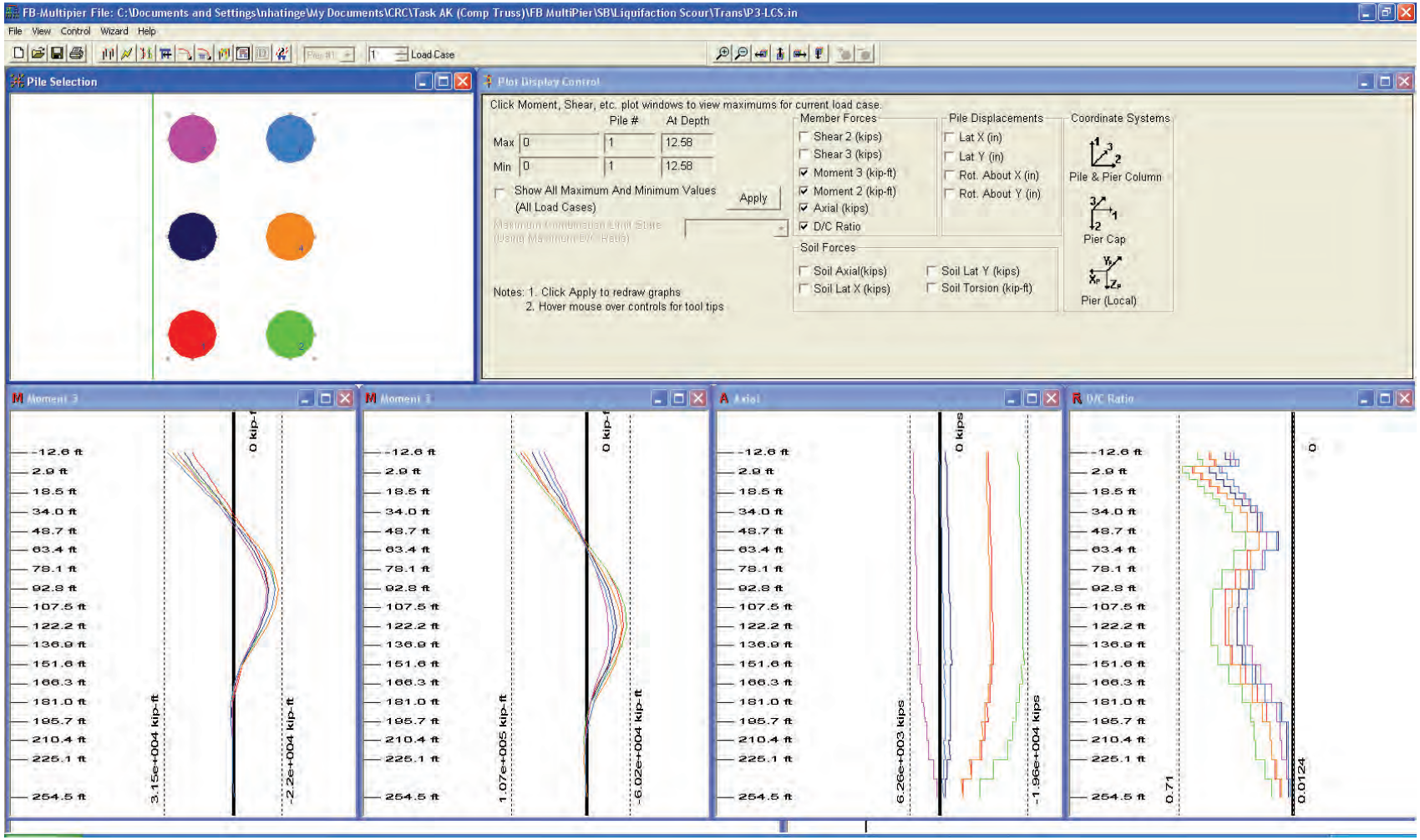

FB-Multipier File: C:\Documents and Settings\nhatinge\My Documents\CRC\Task AK (Comp Truss)\FB MultiPier\SB\Liquifaction Scour\Long\P1-LCS.in
File View Control Wizard Help
Load Case
Model Data
Global Data
Problem
Analysis
AASHTO
Pushover
Pier Data
Pile and Cap
Soil
Pier
X-Members
Load
Springs
Retained Soil
Bridge Data
Bridge
Span Load
Problem
Problem Type
General Pier
Pile and Cap Only
Single Pile
High Mast Light/Sign
Retaining Wall
Sound Wall
Stiffness
Pile Bent
Column Analysis
Bridge (Multiple Piers)
Project Data
Client
CRC / WSDOT / ODOT
Project Name
Columbia River Crossing
Project Manager
R. Turton
Date
03/15/2011
Computed By
NRH
Project Description
SB - Pier 1 - Liquefaction + Contraction Scour
Pile Edit
Xp
Soil Edit
Pile 1, Pile Set 1
Soil Set 1: Layer 1: Ø=33 Gamma=125
Soil Set 1: Layer 2: Ø=6 Gamma=107.3
Soil Set 1: Layer 3: Ø=6 Gamma=121.2
Soil Set 1: Layer 4: Ø=35 Gamma=121.2
Soil Set 1: Layer 5: Ø=45 Gamma=136.7
Soil Set 1: Layer 6: Ø=45 Gamma=140.2
15.8
0.0
-13.0
-41.0
-72.0
-100.0
-200.0
-209.0
-218.0
-262.0
-247.3
ELEVATION - ft
3D View

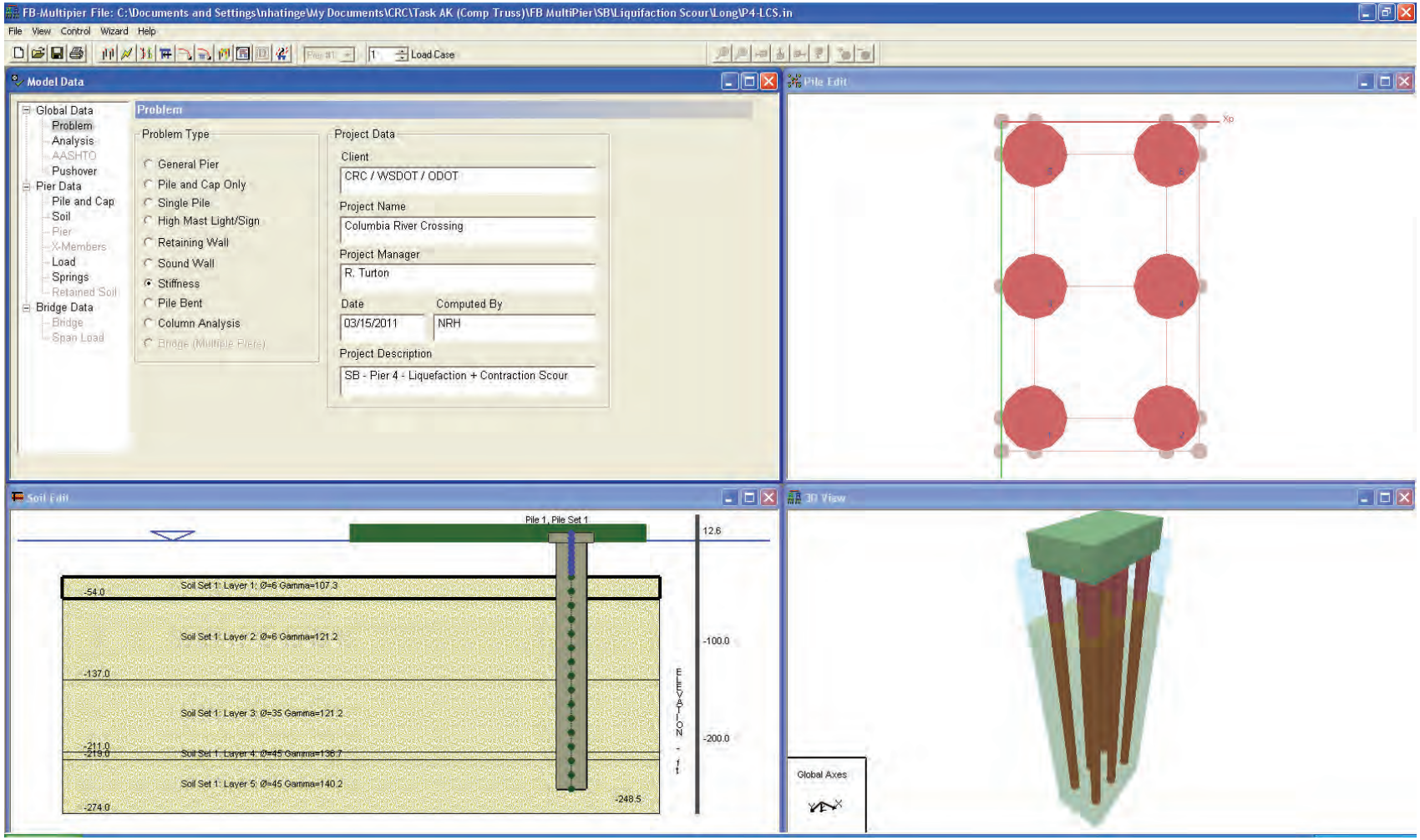

FB-Multipier File: C:\Documents and Settings\nhatinge\My Documents\CRC\Task AK (Comp Truss)\FB MultiPier\SB\Liquifaction Scour\Trans\P1-LCS.in
File View Control Wizard Help
Load Case
Pile Selection
Plot Display Control
Click Moment, Shear, etc. plot windows to view maximums for current load case.
Pile # At Depth
Max 0 1 15.78
Min 0 1 15.78
Show All Maximum And Minimum Values (All Load Cases)
Apply
Member Forces
Shear 2 (kips)
Shear 3 (kips)
Moment 3 (kip-ft)
Moment 2 (kip-ft)
Axial (kips)
D/C Ratio
Pile Displacements
Lat X (in)
Lat Y (in)
Rot. About X (in)
Rot. About Y (in)
Coordinate Systems
Pile & Pier Column
Pier Cap
Pier (Local)
Soil Forces
Soil Axial(kips)
Soil Lat X (kips)
Soil Lat Y (kips)
Soil Torsion (kip-ft)
Notes: 1. Click Apply to redraw graphs
2. Hover mouse over controls for tool tips
Moment 3
Axial
D/C Ratio
-15.8 ft
-2.6 ft
10.5 ft
23.7 ft
36.8 ft
50.0 ft
63.1 ft
76.3 ft
89.5 ft
102.6 ft
115.8 ft
128.9 ft
142.1 ft
155.2 ft
168.4 ft
181.5 ft
194.7 ft
207.8 ft
221.0 ft
234.1 ft
247.3 ft
9.71e+003 kip-ft
-1.14e+004 kip-ft
3.67e+004 kip-ft
-1.03e+004 kip-ft
450 kips
-1.12e+004 kips
0.235
0.00447

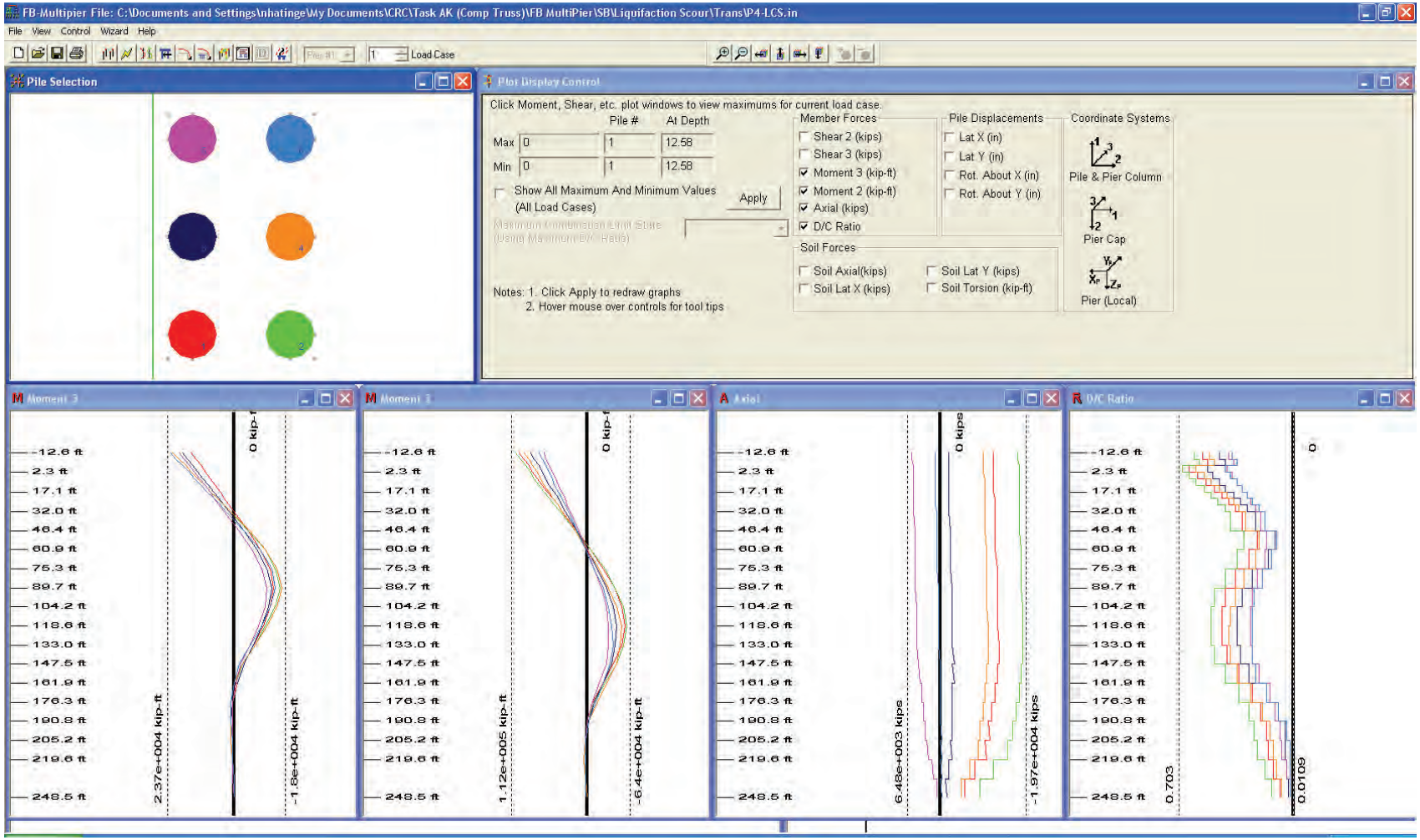

FB-Multipier File: C:\Documents and Settings\nhatinge\My Documents\CRC\Task AK (Comp Truss)\FB MultiPier\SB\Liquifaction Scour\Long\P2-LCS.in
File View Control Wizard Help
Load Case
Model Data
Global Data
Problem
Analysis
AASHTO
Pushover
Pier Data
Pile and Cap
Soil
Pier
X-Members
Load
Springs
Retained Soil
Bridge Data
Bridge
Span Load
Problem
Problem Type
General Pier
Pile and Cap Only
Single Pile
High Mast Light/Sign
Retaining Wall
Sound Wall
Stiffness
Pile Bent
Column Analysis
Bridge (Multiple Piers)
Project Data
Client
CRC / WSDOT / ODOT
Project Name
Columbia River Crossing
Project Manager
R. Turton
Date
03/15/2011
Computed By
NRH
Project Description
SB - Pier 2 - Liquefaction + Contraction Scour
Pile Edit
Xp
Soil Edit
Pile 1, Pile Set 1
12.8
Soil Set 1: Layer 1: Ø=6 Gamma=107.3
-47.0
Soil Set 1: Layer 2: Ø=6 Gamma=121.2
-127.0
Soil Set 1: Layer 3: Ø=35 Gamma=121.2
Soil Set 1: Layer 4: Ø=45 Gamma=136.7
Soil Set 1: Layer 5: Ø=45 Gamma=140.2
-272.0
-248.3
-100.0
-200.0
ELEVATION - ft
3D View
Global Axes

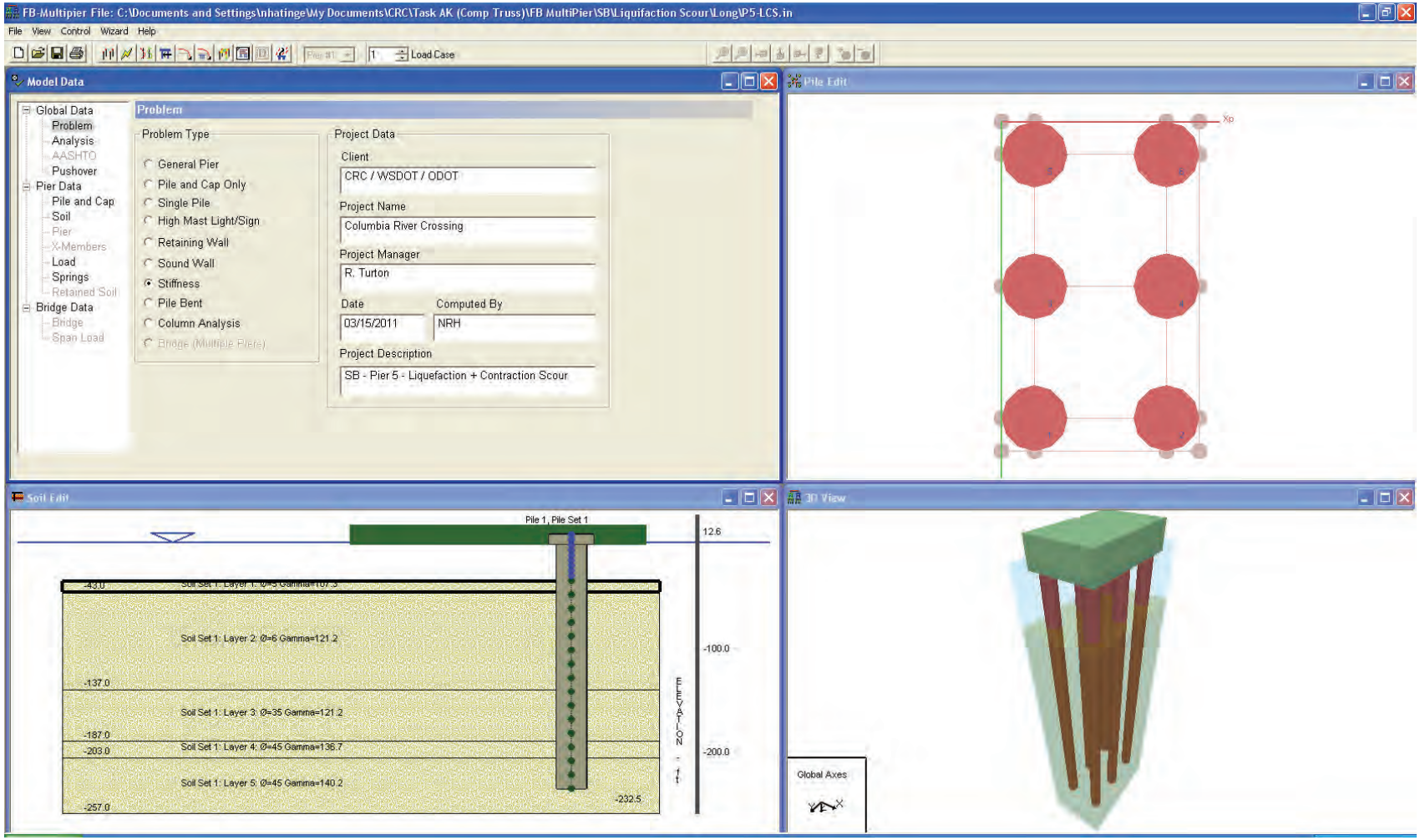

FB-Multipier File: C:\Documents and Settings\nhatinge\My Documents\CRC\Task AK (Comp Truss)\FB MultiPier\SB\Liquifaction Scour\Trans\P2-LCS.in
File View Control Wizard Help
Load Case
Pile Selection
Plot Display Control
Click Moment, Shear, etc. plot windows to view maximums for current load case.
Pile # At Depth
Max 0 1 12.78
Min 0 1 12.78
Show All Maximum And Minimum Values (All Load Cases)
Apply
Notes: 1. Click Apply to redraw graphs
2. Hover mouse over controls for tool tips
Member Forces
Shear 2 (kips)
Shear 3 (kips)
Moment 3 (kip-ft)
Moment 2 (kip-ft)
Axial (kips)
D/C Ratio
Pile Displacements
Lat X (in)
Lat Y (in)
Rot. About X (in)
Rot. About Y (in)
Soil Forces
Soil Axial(kips)
Soil Lat X (kips)
Soil Lat Y (kips)
Soil Torsion (kip-ft)
Coordinate Systems
Pile & Pier Column
Pier Cap
Pier (Local)
Moment 3
Axial
D/C Ratio
-12.8 ft
-1.2 ft
10.4 ft
22.0 ft
37.1 ft
52.2 ft
67.3 ft
82.3 ft
97.4 ft
112.5 ft
127.6 ft
142.7 ft
157.8 ft
172.9 ft
188.0 ft
203.0 ft
218.1 ft
248.3 ft
6.31e+004 kip-ft
-3.91e+004 kip-ft
7.58e+004 kip-ft
-3.95e+004 kip-ft
1.95e+003 kips
-1.96e+004 kips
0 kips
0.611
0.0012

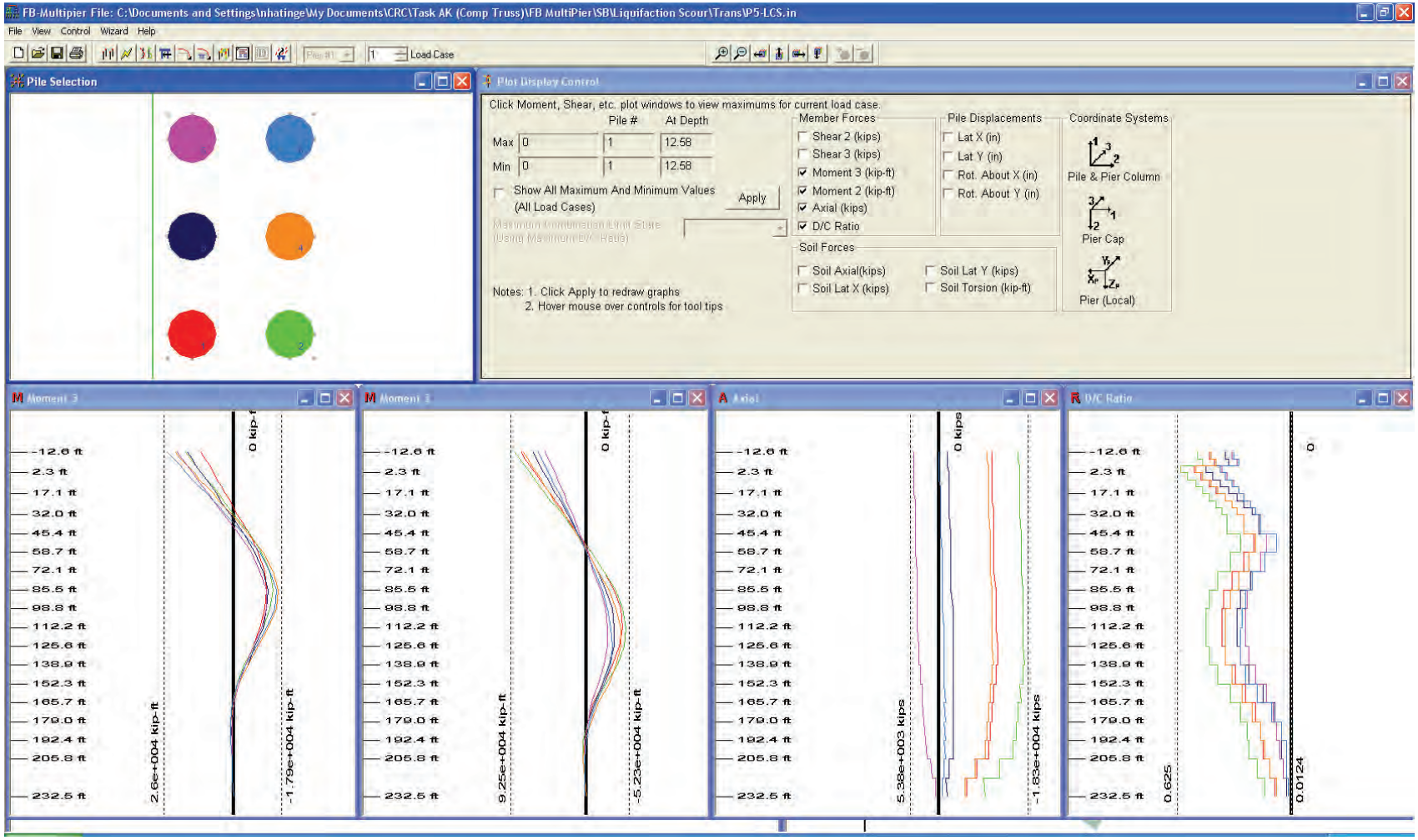

FB-Multipier File: C:\Documents and Settings\nhatinge\My Documents\CRC\Task AK (Comp Truss)\FB MultiPier\SB\Liquifaction Scour\Long\P3-LCS.in
File View Control Wizard Help
Load Case
Model Data
Global Data
Problem
Analysis
AASHTO
Pushover
Pier Data
Pile and Cap
Soil
Pier
X-Members
Load
Springs
Retained Soil
Bridge Data
Bridge
Span Load
Problem
Problem Type
General Pier
Pile and Cap Only
Single Pile
High Mast Light/Sign
Retaining Wall
Sound Wall
Stiffness
Pile Bent
Column Analysis
Bridge (Multiple Piers)
Project Data
Client
CRC / WSDOT / ODOT
Project Name
Columbia River Crossing
Project Manager
R. Turton
Date
03/15/2011
Computed By
NRH
Project Description
SB - Pier 3 - Liquefaction + Contraction Scour
Pile Edit
Xp
Soil Edit
Pile 1, Pile Set 1
12.6
-54.0
Soil Set 1: Layer 1: Ø=6 Gamma=107.3
Soil Set 1: Layer 2: Ø=6 Gamma=121.2
-100.0
-139.0
Soil Set 1: Layer 3: Ø=35 Gamma=121.2
-200.0
-215.0
-225.0
Soil Set 1: Layer 4: Ø=45 Gamma=136.7
Soil Set 1: Layer 5: Ø=45 Gamma=140.2
-278.0
-254.5
ELEVATION - ft
3D View
Global Axes

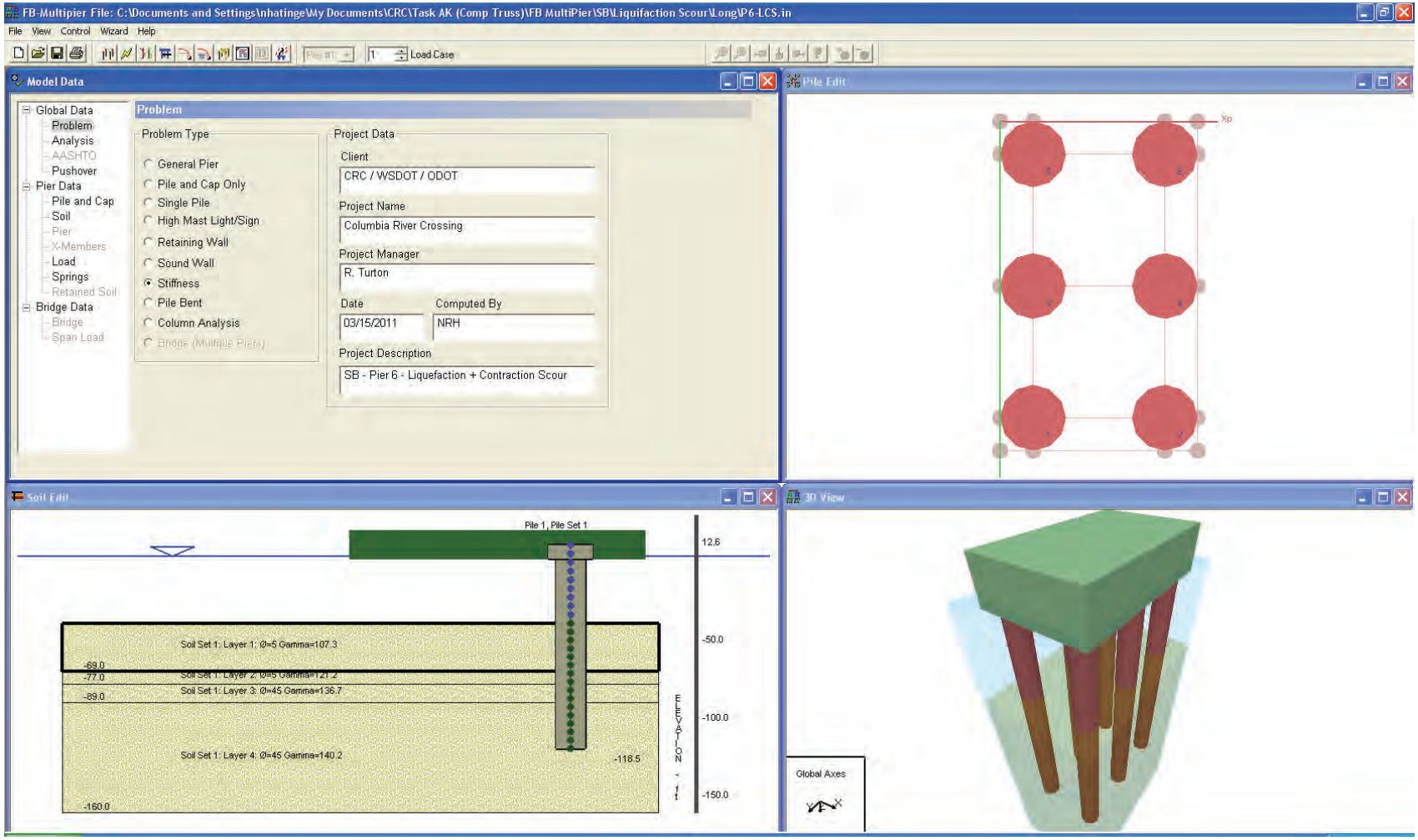

FB-Multipier File: C:\Documents and Settings\nhatinge\My Documents\CRC\Task AK (Comp Truss)\FB MultiPier\SB\Liquifaction Scour\Trans\P3-LCS.in
File View Control Wizard Help
Load Case
Pile Selection
Plot Display Control
Click Moment, Shear, etc. plot windows to view maximums for current load case.
Pile # At Depth
Max 0 1 12.58
Min 0 1 12.58
Show All Maximum And Minimum Values (All Load Cases)
Apply
Member Forces
Shear 2 (kips)
Shear 3 (kips)
Moment 3 (kip-ft)
Moment 2 (kip-ft)
Axial (kips)
D/C Ratio
Pile Displacements
Lat X (in)
Lat Y (in)
Rot. About X (in)
Rot. About Y (in)
Coordinate Systems
Pile & Pier Column
Pier Cap
Pier (Local)
Soil Forces
Soil Axial(kips)
Soil Lat X (kips)
Soil Lat Y (kips)
Soil Torsion (kip-ft)
Notes: 1. Click Apply to redraw graphs
2. Hover mouse over controls for tool tips
Moment 3
Moment 3
Axial
D/C Ratio
-12.6 ft
2.9 ft
18.5 ft
34.0 ft
48.7 ft
63.4 ft
78.1 ft
92.8 ft
107.5 ft
122.2 ft
136.9 ft
151.6 ft
166.3 ft
181.0 ft
195.7 ft
210.4 ft
225.1 ft
254.5 ft
3.15e+004 kip-ft
-2.2e+004 kip-ft
1.07e+005 kip-ft
-6.02e+004 kip-ft
6.26e+003 kips
-1.96e+004 kips
0.71
0.0124

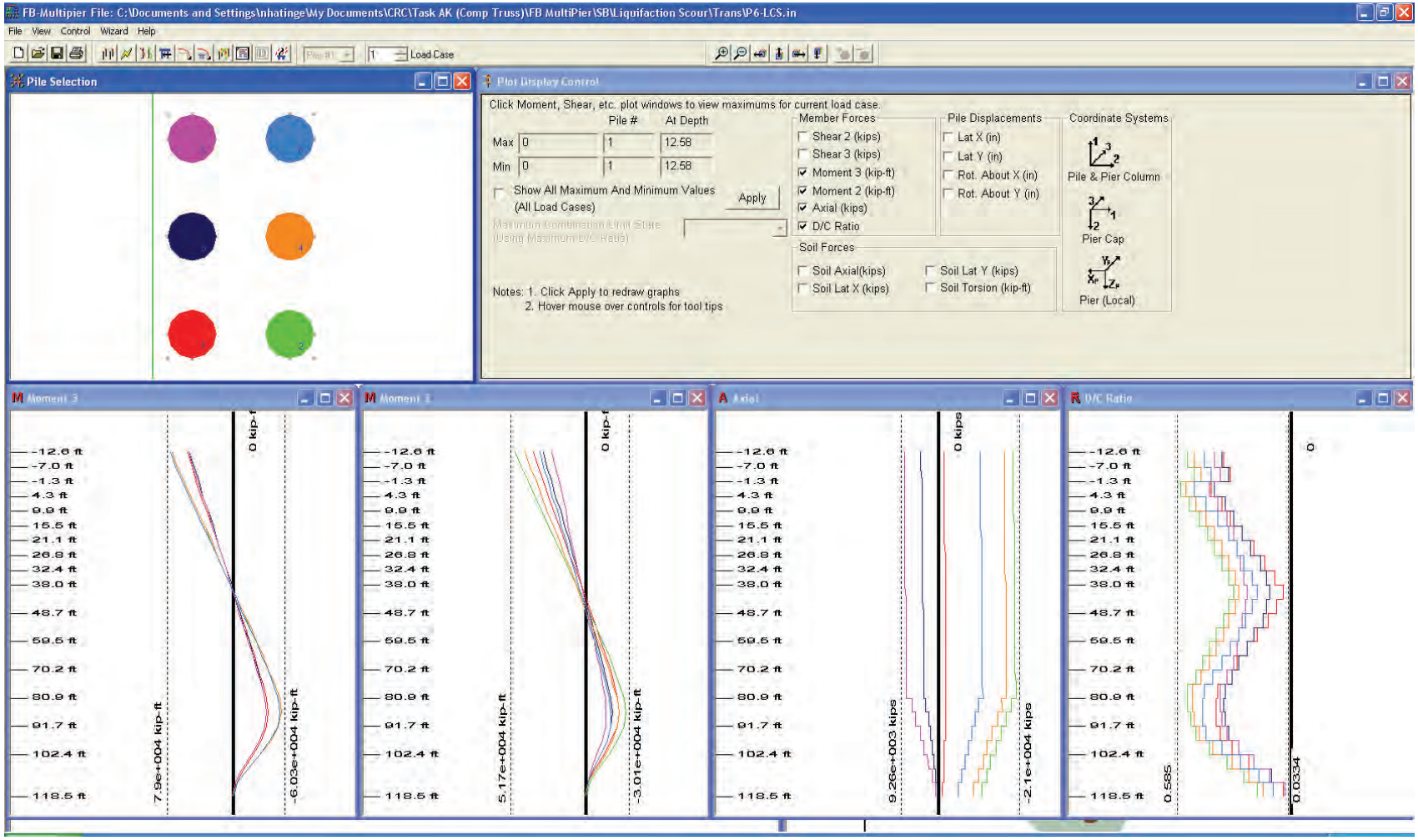

FB-Multipier File: C:\Documents and Settings\nhatinge\My Documents\CRC\Task AK (Comp Truss)\FB MultiPier\SB\Liquifaction Scour\Long\P4-LCS.in
File View Control Wizard Help
Load Case
Model Data
Global Data
Problem
Analysis
AASHTO
Pushover
Pier Data
Pile and Cap
Soil
Pier
X-Members
Load
Springs
Retained Soil
Bridge Data
Bridge
Span Load
Problem
Problem Type
General Pier
Pile and Cap Only
Single Pile
High Mast Light/Sign
Retaining Wall
Sound Wall
Stiffness
Pile Bent
Column Analysis
Bridge (Multiple Piers)
Project Data
Client
CRC / WSDOT / ODOT
Project Name
Columbia River Crossing
Project Manager
R. Turton
Date
03/15/2011
Computed By
NRH
Project Description
SB - Pier 4 - Liquefaction + Contraction Scour
Pile Edit
Xp
Soil Edit
Pile 1, Pile Set 1
12.6
-54.0
Soil Set 1: Layer 1: Ø=6 Gamma=107.3
Soil Set 1: Layer 2: Ø=6 Gamma=121.2
-100.0
-137.0
Soil Set 1: Layer 3: Ø=35 Gamma=121.2
-200.0
-211.0
-219.0
Soil Set 1: Layer 4: Ø=45 Gamma=138.7
Soil Set 1: Layer 5: Ø=45 Gamma=140.2
-248.5
-274.0
ELEVATION - ft
3D View
Global Axes

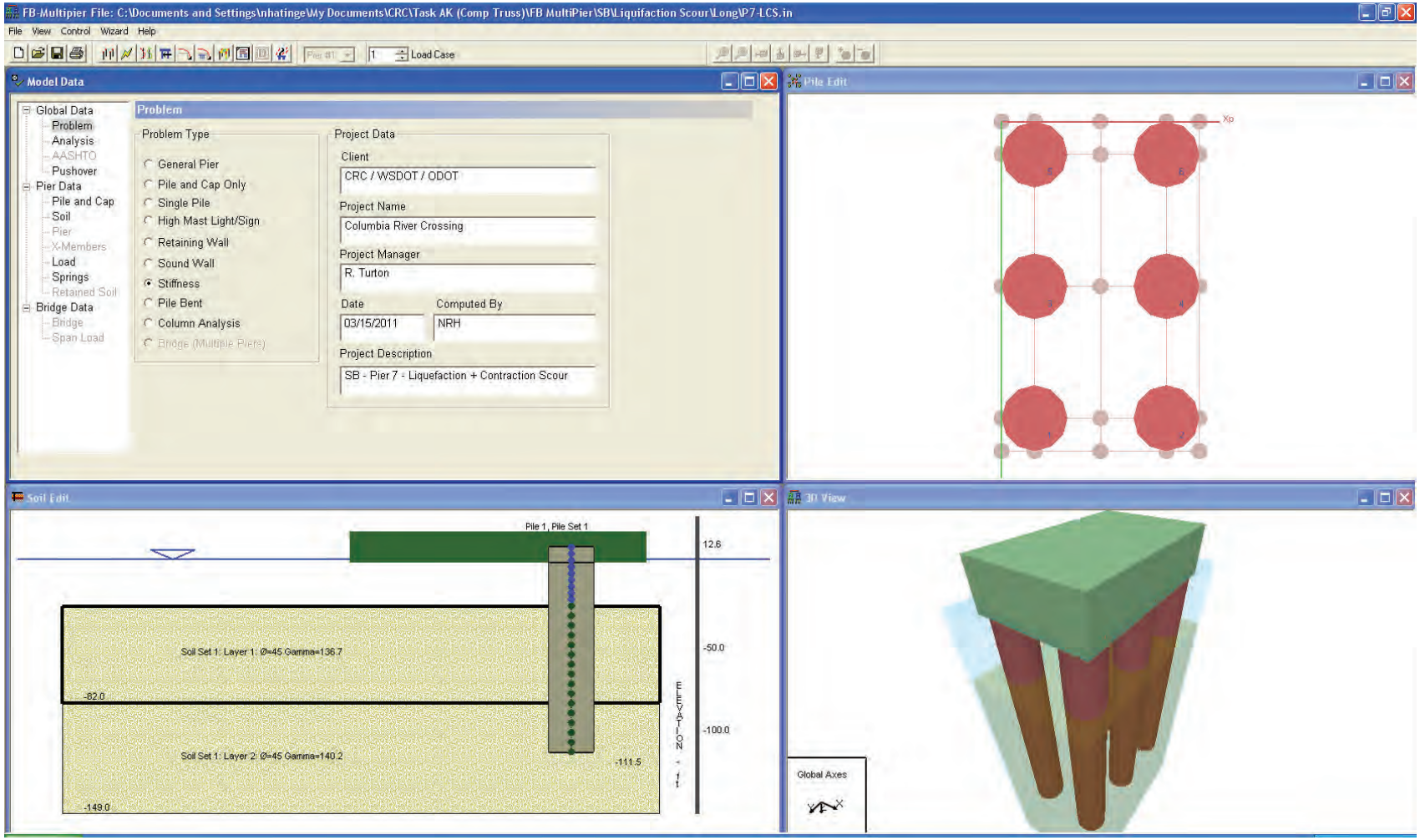

FB-Multipier File: C:\Documents and Settings\nhatinge\My Documents\CRC\Task AK (Comp Truss)\FB MultiPier\SB\Liquifaction Scour\Trans\P4-LCS.in
File View Control Wizard Help
Load Case
Pile Selection
Plot Display Control
Click Moment, Shear, etc. plot windows to view maximums for current load case.
Pile # At Depth
Max 0 1 12.58
Min 0 1 12.58
Show All Maximum And Minimum Values (All Load Cases)
Apply
Member Forces
Shear 2 (kips)
Shear 3 (kips)
Moment 3 (kip-ft)
Moment 2 (kip-ft)
Axial (kips)
D/C Ratio
Pile Displacements
Lat X (in)
Lat Y (in)
Rot. About X (in)
Rot. About Y (in)
Coordinate Systems
Pile & Pier Column
Pier Cap
Pier (Local)
Soil Forces
Soil Axial(kips)
Soil Lat X (kips)
Soil Lat Y (kips)
Soil Torsion (kip-ft)
Notes: 1. Click Apply to redraw graphs
2. Hover mouse over controls for tool tips
Moment 3
2.37e+004 kip-ft
-1.8e+004 kip-ft
Moment 3
1.12e+005 kip-ft
-6.4e+004 kip-ft
Axial
6.48e+003 kips
-1.97e+004 kips
D/C Ratio
0.703
0.0169
-12.6 ft
2.3 ft
17.1 ft
32.0 ft
46.4 ft
60.9 ft
75.3 ft
89.7 ft
104.2 ft
118.6 ft
133.0 ft
147.5 ft
161.9 ft
176.3 ft
190.8 ft
205.2 ft
219.6 ft
248.5 ft

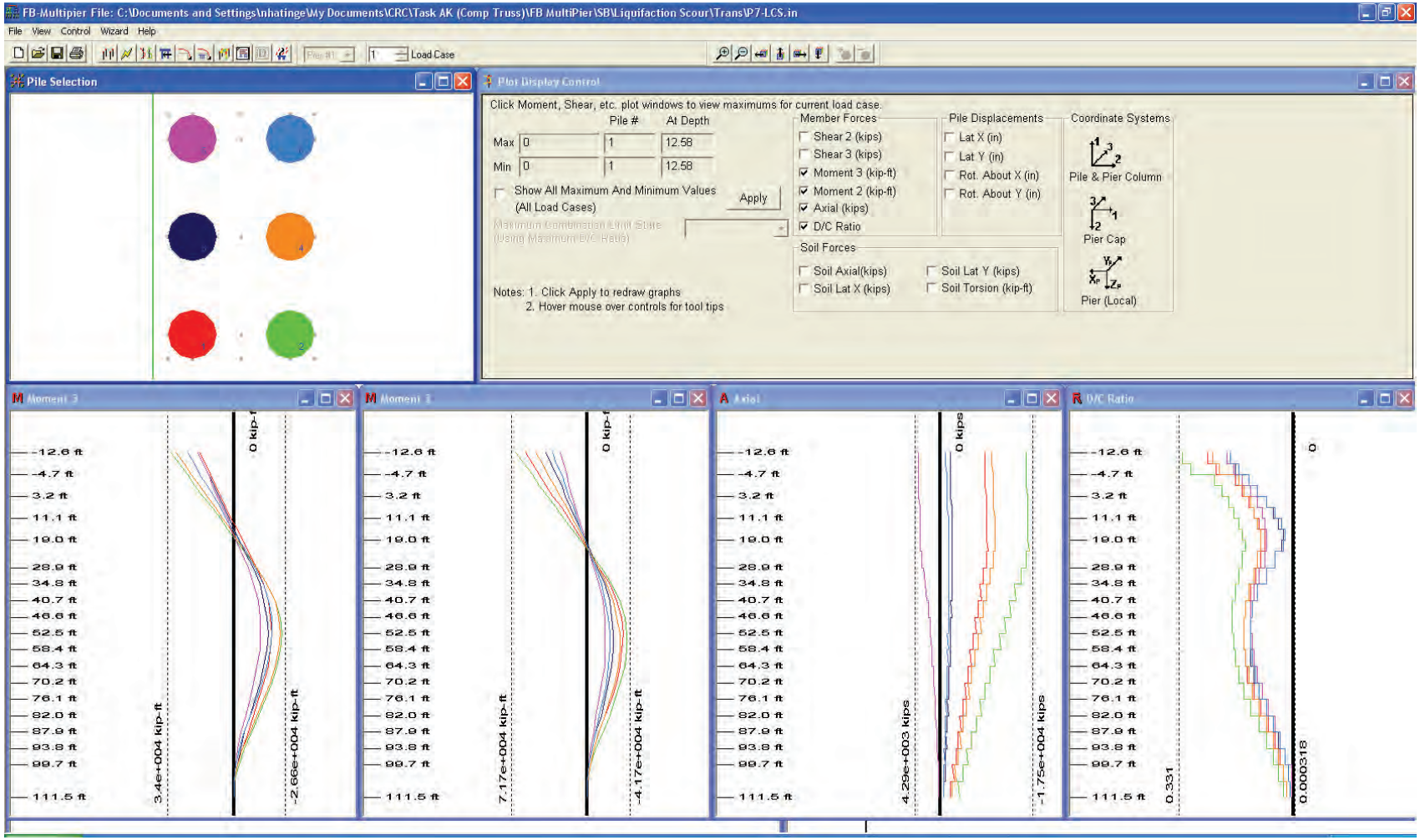

FB-Multipier File: C:\Documents and Settings\nhatinge\My Documents\CRC\Task AK (Comp Truss)\FB MultiPier\SB\Liquifaction Scour\Long\P5-LCS.in
File View Control Wizard Help
Load Case
Model Data
Global Data
Problem
Analysis
AASHTO
Pushover
Pier Data
Pile and Cap
Soil
Pier
X-Members
Load
Springs
Retained Soil
Bridge Data
Bridge
Span Load
Problem
Problem Type
General Pier
Pile and Cap Only
Single Pile
High Mast Light/Sign
Retaining Wall
Sound Wall
Stiffness
Pile Bent
Column Analysis
Bridge (Multiple Piers)
Project Data
Client
CRC / WSDOT / ODOT
Project Name
Columbia River Crossing
Project Manager
R. Turton
Date
03/15/2011
Computed By
NRH
Project Description
SB - Pier 5 - Liquefaction + Contraction Scour
Pile Edit
Xp
Soil Edit
Pile 1, Pile Set 1
12.6
-43.0
Soil Set 1: Layer 2: Ø=6 Gamma=121.2
-100.0
-137.0
Soil Set 1: Layer 3: Ø=35 Gamma=121.2
-187.0
-203.0
Soil Set 1: Layer 4: Ø=45 Gamma=136.7
-200.0
Soil Set 1: Layer 5: Ø=45 Gamma=140.2
-257.0
-232.5
ELEVATION - ft
3D View
Global Axes

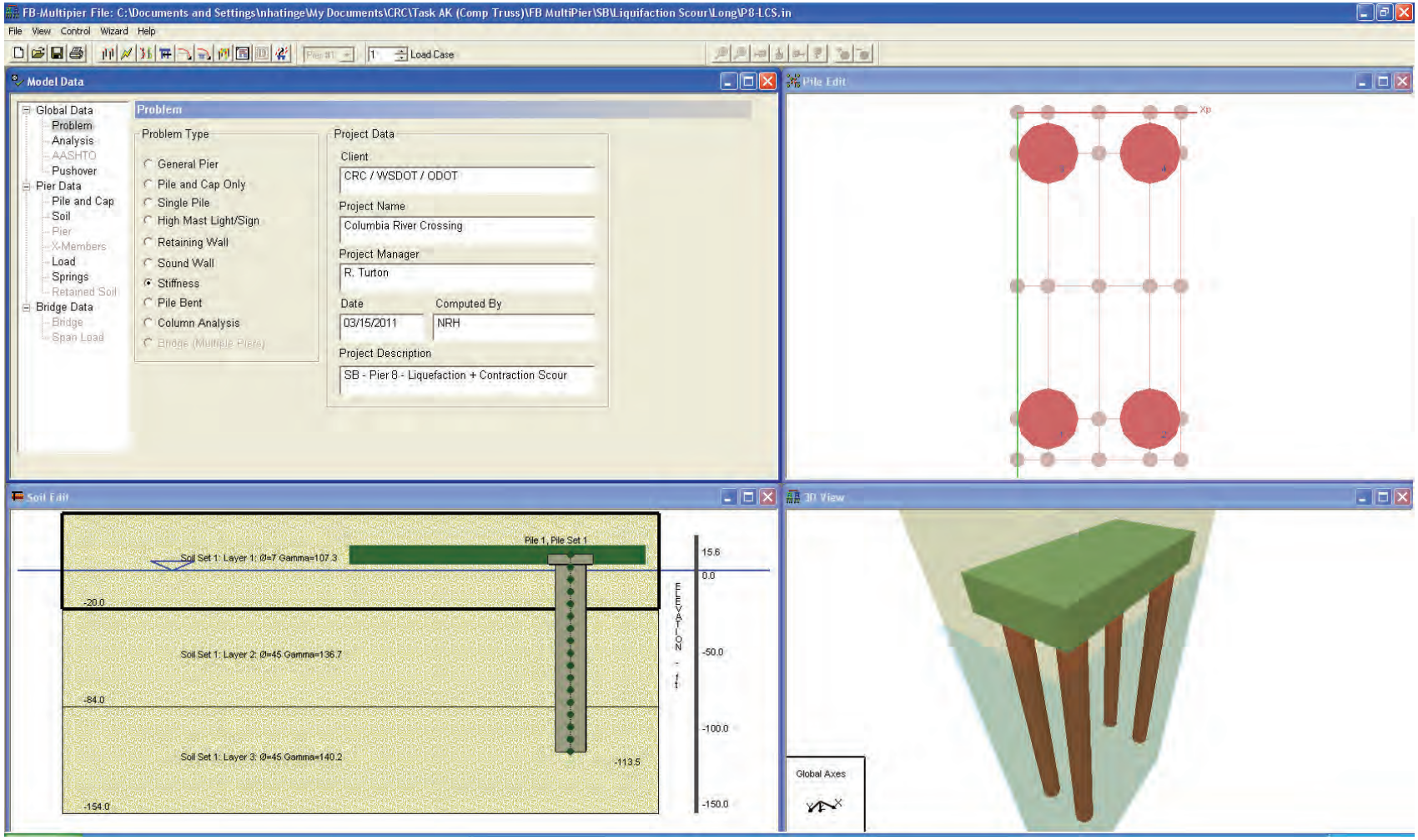

FB-Multipier File: C:\Documents and Settings\nhatinge\My Documents\CRC\Task AK (Comp Truss)\FB MultiPier\SB\Liquifaction Scour\Trans\P5-LCS.in
File View Control Wizard Help
Load Case
Pile Selection
Plot Display Control
Click Moment, Shear, etc. plot windows to view maximums for current load case.
Pile # At Depth
Max 0 1 12.58
Min 0 1 12.58
Show All Maximum And Minimum Values (All Load Cases)
Apply
Member Forces
Shear 2 (kips)
Shear 3 (kips)
Moment 3 (kip-ft)
Moment 2 (kip-ft)
Axial (kips)
D/C Ratio
Pile Displacements
Lat X (in)
Lat Y (in)
Rot. About X (in)
Rot. About Y (in)
Coordinate Systems
Pile & Pier Column
Pier Cap
Pier (Local)
Soil Forces
Soil Axial(kips)
Soil Lat X (kips)
Soil Lat Y (kips)
Soil Torsion (kip-ft)
Notes: 1. Click Apply to redraw graphs
2. Hover mouse over controls for tool tips
Moment 3
Axial
D/C Ratio
-12.6 ft
2.3 ft
17.1 ft
32.0 ft
45.4 ft
58.7 ft
72.1 ft
85.5 ft
98.8 ft
112.2 ft
125.6 ft
138.9 ft
152.3 ft
165.7 ft
179.0 ft
192.4 ft
205.8 ft
232.5 ft
2.6e+004 kip-ft
-1.79e+004 kip-ft
9.25e+004 kip-ft
-5.23e+004 kip-ft
5.38e+003 kips
-1.83e+004 kips
0.625
0.0124

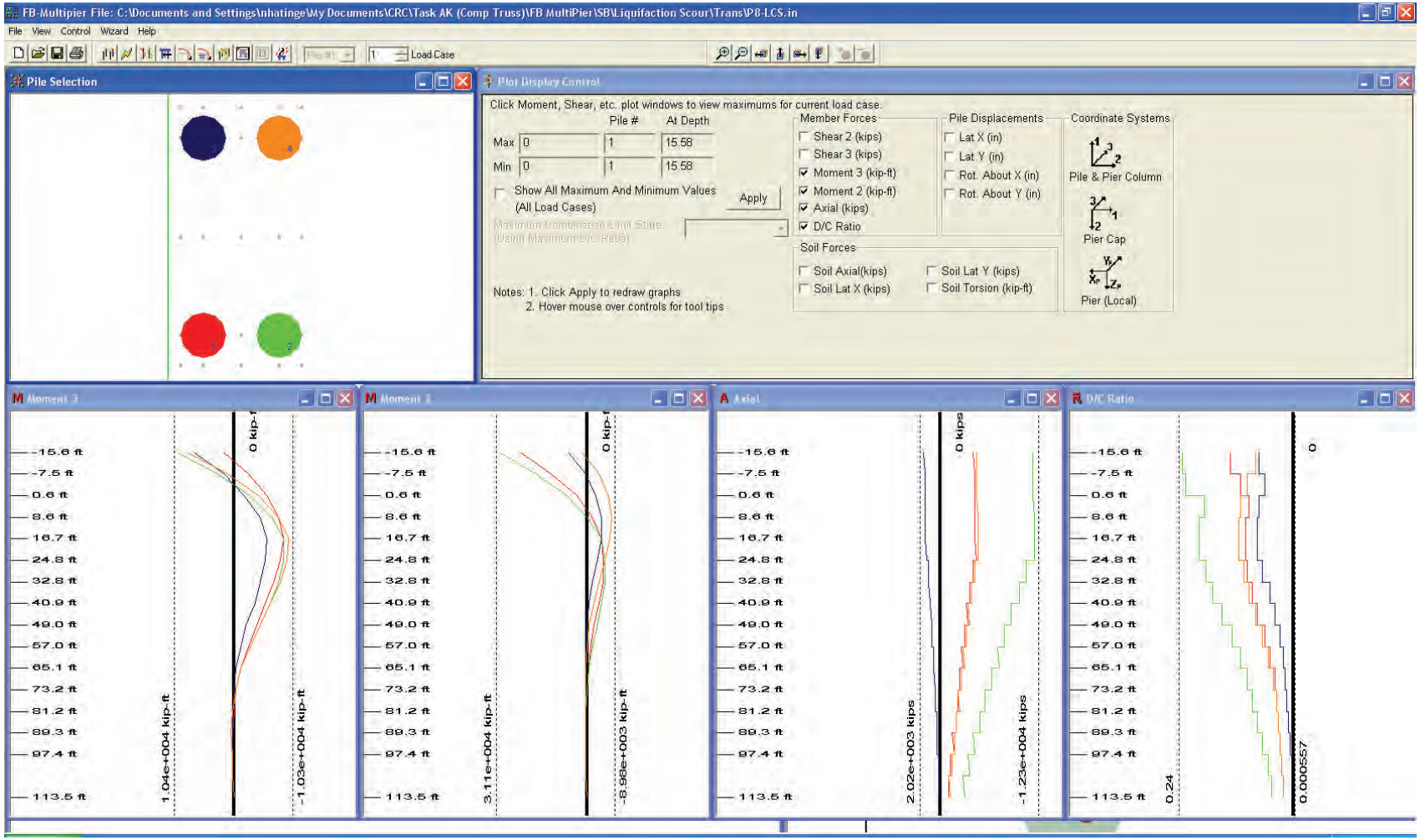

FB-Multipier File: C:\Documents and Settings\nhatinge\My Documents\CRC\Task AK (Comp Truss)\FB MultiPier\SB\Liquifaction Scour\Long\P6-LCS.in
File View Control Wizard Help
Load Case
Model Data
Global Data
Problem
Analysis
AASHTO
Pushover
Pier Data
Pile and Cap
Soil
Pier
X-Members
Load
Springs
Retained Soil
Bridge Data
Bridge
Span Load
Problem
Problem Type
General Pier
Pile and Cap Only
Single Pile
High Mast Light/Sign
Retaining Wall
Sound Wall
Stiffness
Pile Bent
Column Analysis
Bridge (Multiple Piers)
Project Data
Client
CRC / WSDOT / ODOT
Project Name
Columbia River Crossing
Project Manager
R. Turton
Date
03/15/2011
Computed By
NRH
Project Description
SB - Pier 6 - Liquefaction + Contraction Scour
Pile Edit
Xp
Soil Edit
Pile 1, Pile Set 1
12.6
-50.0
-100.0
-150.0
Soil Set 1: Layer 1; Ø=5 Gamma=107.3
-69.0
-77.0
Soil Set 1: Layer 2; Ø=5 Gamma=121.2
-89.0
Soil Set 1: Layer 3; Ø=45 Gamma=136.7
Soil Set 1: Layer 4; Ø=45 Gamma=140.2
-118.5
-160.0
ELEVATION - ft
3D View
Global Axes


FB-Multipier File: C:\Documents and Settings\nhatinge\My Documents\CRC\Task AK (Comp Truss)\FB MultiPier\SB\Liquifaction Scour\Trans\P6-LCS.in
File View Control Wizard Help
Load Case
Pile Selection
Plot Display Control
Click Moment, Shear, etc. plot windows to view maximums for current load case.
Pile # At Depth
Max 0 1 12.58
Min 0 1 12.58
Show All Maximum And Minimum Values (All Load Cases)
Apply
Maximum Combination Limit State (Using Maximum D/C Ratio)
Member Forces
Shear 2 (kips)
Shear 3 (kips)
Moment 3 (kip-ft)
Moment 2 (kip-ft)
Axial (kips)
D/C Ratio
Pile Displacements
Lat X (in)
Lat Y (in)
Rot. About X (in)
Rot. About Y (in)
Coordinate Systems
Pile & Pier Column
Pier Cap
Pier (Local)
Soil Forces
Soil Axial(kips)
Soil Lat X (kips)
Soil Lat Y (kips)
Soil Torsion (kip-ft)
Notes: 1. Click Apply to redraw graphs
2. Hover mouse over controls for tool tips
Moment 3
7.9e+004 kip-ft
0 kip-f
-6.03e+004 kip-ft
Moment 3
5.17e+004 kip-ft
0 kip-f
-3.01e+004 kip-ft
Axial
9.26e+003 kips
0 kips
-2.1e+004 kips
D/C Ratio
0.585
0
0.0334
-12.6 ft
-7.0 ft
-1.3 ft
4.3 ft
9.9 ft
15.5 ft
21.1 ft
26.8 ft
32.4 ft
38.0 ft
48.7 ft
59.5 ft
70.2 ft
80.9 ft
91.7 ft
102.4 ft
118.5 ft


FB-Multipier File: C:\Documents and Settings\nhatinge\My Documents\CRC\Task AK (Comp Truss)\FB MultiPier\SB\Liquifaction Scour\Long\P7-LCS.in
File View Control Wizard Help
Load Case
Model Data
Global Data
Problem
Analysis
AASHTO
Pushover
Pier Data
Pile and Cap
Soil
Pier
X-Members
Load
Springs
Retained Soil
Bridge Data
Bridge
Span Load
Problem
Problem Type
General Pier
Pile and Cap Only
Single Pile
High Mast Light/Sign
Retaining Wall
Sound Wall
Stiffness
Pile Bent
Column Analysis
Bridge (Multiple Piers)
Project Data
Client
CRC / WSDOT / ODOT
Project Name
Columbia River Crossing
Project Manager
R. Turton
Date
03/15/2011
Computed By
NRH
Project Description
SB - Pier 7 - Liquefaction + Contraction Scour
Pile Edit
Xp
Soil Edit
Pile 1, Pile Set 1
12.6
-50.0
-100.0
ELEVATION - ft
Soil Set 1: Layer 1: Ø=45 Gamma=136.7
-82.0
Soil Set 1: Layer 2: Ø=45 Gamma=140.2
-111.5
-149.0
3D View
Global Axes


FB-Multipier File: C:\Documents and Settings\nhatinge\My Documents\CRC\Task AK (Comp Truss)\FB MultiPier\SB\Liquifaction Scour\Trans\P7-LCS.in
File View Control Wizard Help
Load Case
Pile Selection
Plot Display Control
Click Moment, Shear, etc. plot windows to view maximums for current load case.
Pile # At Depth
Max 0 1 12.58
Min 0 1 12.58
Show All Maximum And Minimum Values (All Load Cases)
Apply
Maximum Combination Limit State (Using Maximum D/C Ratio)
Member Forces
Shear 2 (kips)
Shear 3 (kips)
Moment 3 (kip-ft)
Moment 2 (kip-ft)
Axial (kips)
D/C Ratio
Pile Displacements
Lat X (in)
Lat Y (in)
Rot. About X (in)
Rot. About Y (in)
Coordinate Systems
Pile & Pier Column
Pier Cap
Pier (Local)
Soil Forces
Soil Axial(kips)
Soil Lat X (kips)
Soil Lat Y (kips)
Soil Torsion (kip-ft)
Notes: 1. Click Apply to redraw graphs
2. Hover mouse over controls for tool tips
Moment 3
Moment 3
Axial
D/C Ratio
-12.6 ft
-4.7 ft
3.2 ft
11.1 ft
19.0 ft
28.9 ft
34.8 ft
40.7 ft
46.6 ft
52.5 ft
58.4 ft
64.3 ft
70.2 ft
76.1 ft
82.0 ft
87.9 ft
93.8 ft
99.7 ft
111.5 ft
3.4e+004 kip-ft
0 kip-f
-2.66e+004 kip-ft
7.17e+004 kip-ft
0 kip-f
-4.17e+004 kip-ft
4.29e+003 kips
0 kips
-1.75e+004 kips
0.331
0
0.000318


FB-Multipier File: C:\Documents and Settings\nhatinge\My Documents\CRC\Task AK (Comp Truss)\FB MultiPier\SB\Liquifaction Scour\Long\P8-LCS.in
File View Control Wizard Help
Load Case
Model Data
Global Data
Problem
Analysis
AASHTO
Pushover
Pier Data
Pile and Cap
Soil
Pier
X-Members
Load
Springs
Retained Soil
Bridge Data
Bridge
Span Load
Problem
Problem Type
General Pier
Pile and Cap Only
Single Pile
High Mast Light/Sign
Retaining Wall
Sound Wall
Stiffness
Pile Bent
Column Analysis
Bridge (Multiple Piers)
Project Data
Client
CRC / WSDOT / ODOT
Project Name
Columbia River Crossing
Project Manager
R. Turton
Date
03/15/2011
Computed By
NRH
Project Description
SB - Pier 8 - Liquefaction + Contraction Scour
Pile Edit
Xp
Soil Edit
Pile 1, Pile Set 1
Soil Set 1: Layer 1: Ø=7 Gamma=107.3
Soil Set 1: Layer 2: Ø=45 Gamma=136.7
Soil Set 1: Layer 3: Ø=45 Gamma=140.2
15.6
0.0
-20.0
-50.0
-84.0
-100.0
-113.5
-150.0
-154.0
ELEVATION - ft
3D View
Global Axes


FB-Multipier File: C:\Documents and Settings\nhatinge\My Documents\CRC\Task AK (Comp Truss)\FB MultiPier\SB\Liquifaction Scour\Trans\P8-LCS.in
File View Control Wizard Help
Load Case
Pile Selection
Plot Display Control
Click Moment, Shear, etc. plot windows to view maximums for current load case.
Pile # At Depth
Max 0 1 15.58
Min 0 1 15.58
Show All Maximum And Minimum Values (All Load Cases)
Apply
Maximum Combination Limit State (Using Maximum D/C Ratio)
Member Forces
Shear 2 (kips)
Shear 3 (kips)
Moment 3 (kip-ft)
Moment 2 (kip-ft)
Axial (kips)
D/C Ratio
Pile Displacements
Lat X (in)
Lat Y (in)
Rot. About X (in)
Rot. About Y (in)
Coordinate Systems
Pile & Pier Column
Pier Cap
Pier (Local)
Soil Forces
Soil Axial(kips)
Soil Lat X (kips)
Soil Lat Y (kips)
Soil Torsion (kip-ft)
Notes: 1. Click Apply to redraw graphs
2. Hover mouse over controls for tool tips
Moment 3
Moment 3
Axial
D/C Ratio
-15.6 ft
-7.5 ft
0.6 ft
8.6 ft
16.7 ft
24.8 ft
32.8 ft
40.9 ft
49.0 ft
57.0 ft
65.1 ft
73.2 ft
81.2 ft
89.3 ft
97.4 ft
113.5 ft
1.04e+004 kip-ft
-1.03e+004 kip-ft
3.11e+004 kip-ft
-8.98e+003 kip-ft
2.02e+003 kips
-1.23e+004 kips
0.24
0.000557

U.S. Department
of Transportation

**Federal Aviation
Administration**

Northwest Mountain Region
Colorado, Idaho, Montana
Oregon, Utah, Washington,
Wyoming

1601 Lind Avenue, S. W., Ste 315
Renton, Washington 98057

RECEIVED
JUN 23 2008
Columbia River Crossing

June 20, 2008

Ms. Heather Gundersen
CRC Environmental Project Manager
Columbia River Crossing
700 Washington Street, Ste. 300
Vancouver, WA 98660

Dear Ms. Gundersen:

Interstate 5 Columbia River Crossing (CRC) Project
Draft Environmental Impact Statement (EIS)

We have reviewed the May 2008 draft EIS for the CRC project. In accordance with the February 14, 2006, letter (Attachment 1) from the Federal Aviation Administration (FAA), Northwest Mountain Region Administrator, our review was limited to aeronautical-related issues. Specifically, FAA's interest in this project primarily concerns the potential effects of the proposed bridge structure, including temporary construction equipment (cranes), on the navigable airspace and navigational aids, especially those associated with Portland International Airport (PDX) and Vancouver's Pearson Field (VUO).

Previously, we had conducted an aeronautical feasibility study on three conceptual alternatives (see Attachment 2, June 14, 2006, determination letter) and had commented informally on the June 2007 draft Aviation Technical Report (see Attachment 3, partial email correspondence). Those attachments are included again for your convenience.

Our understanding of the alternatives is that none will penetrate the airport imaginary surfaces (14 CFR Part 77) any more than the existing bridge structures, and that the replacement alternatives would actually reduce the amount of penetration by removing existing bridge structures. From an aeronautical standpoint only, we would prefer a bridge option that would prevent or reduce airspace obstruction to the maximum extent practicable. Our specific comments on the draft EIS are as follows:

1. Page 2-17, last para. (also, page 5-27, para. 4) – We understand the trade-off between river- and air-navigation requirements and concur with the statements precluding tall towers and cable-stay or truss-type construction.

2. Page 3-93, para. 3 – As noted above, the replacement alternatives, 2 and 3, reduce airspace obstruction more than any alternatives leaving in place the existing bridge structures, and therefore are preferable for that purpose.

3. Page 3-93, para. 4 (also, page 5-68, para. 4) – The final design should seek to reduce the penetrations of the approaches/ramps (as well as the bridge structure itself) insofar as possible.

4. Page 3-95, para. 5 – Form FAA Form 7460-1, *Notice of Proposed Construction or Alteration*, will have to be filed with FAA for each temporary construction crane, indicating its maximum height and lateral extent of the boom. The form can be filed online; presently, the online filing address is: https://oeaaa.faa.gov/oeaaa/external/portal.jsp.

5. Page 3-96, para. 2 – We concur with the statements regarding obstruction lighting and the prevention of light glare that could affect air navigation.

6. Page 5-68, para. 5 – The aforementioned Form 7460-1 will also have be filed with FAA for the actual construction of the bridge structures. We recommend that it be filed at not later than a 10-percent design stage, or as soon as the footprint and elevation profiles are tentatively established.

If you have any questions, please contact me at (425) 227-2615.

Sincerely,

Don M. Larson

Don M. Larson
Regional Capacity Program Manager

Enclosures

ATTACHMENT 1

U.S. Department
of Transportation
**Federal Aviation
Administration**

Northwest Mountain Region
Colorado, Idaho, Montana, Oregon
Utah, Washington, Wyoming

1601 Lind Avenue, S. W.
Renton, Washington 98055-4056
Tel: (425) 227-2007
Fax: (425) 227-1007

FEB 2 4 2006

Mr. R. F. Krochalis
Regional Administrator
Federal Transit Administration
915 Second Ave., Ste. 3142
Seattle, WA 98174

Dear Mr. Krochalis:

This is in response to your letter of December 14, 2005, regarding the I-5 Columbia River Crossing project. The Federal Aviation Administration (FAA), Northwest Mountain Region, accepts your invitation to serve as a cooperating agency in the National Environmental Policy Act (NEPA) environmental impact statement (EIS). FAA's interest in this project concerns the potential effects of the proposed bridge structure, including temporary construction equipment (cranes), on the navigable airspace and navigational aids, especially those associated with Portland International Airport (PDX) and Vancouver's Pearson Field (VUO). Our review and comments on this study's documents will be limited to aeronautical-related issues, and this should be outlined in a memorandum of understanding (MOU) between our agencies at the outset. Please provide a draft MOU for our review, or let us know if we should prepare it.

The Seattle Airports District Office (ADO) will be the lead for the FAA in this process, and will coordinate involvement of the other operating divisions (Air Traffic, Airway Facilities, Flight Procedures and Flight Standards) as necessary. In fact, we have already begun our advisory participation, as the Columbia River Crossing study team presented a briefing to FAA interdivisional staff here at the Regional Office on December 9, and received our initial feedback and interest in continued participation at that time. Our principal contact person will be Don Larson for airport/airspace planning and notice of proposed construction. Please feel free to contact him directly at (425) 227-2652.

Thank you for the invitation to participate in this project as a cooperating agency.

Sincerely,

for Douglas Murphy
Regional Administrator

ATTACHMENT 2

U.S. Department
of Transportation

**Federal Aviation
Administration**

Seattle Airports District Office
1601 Lind Avenue, S. W., Ste 250
Renton, Washington 98055-4056

June 14, 2006

Ms. Lynn Rust
Columbia River Crossing Project
700 Washington Street
Suite 300
Vancouver, WA 98660

Dear Ms. Rust:

Portland, Oregon – Vancouver, Washington
Airspace Analysis Results for Feasibility Studies
Columbia River Crossing Project

The Federal Aviation Administration (FAA) has completed its review of your request for feasibility studies, per FAA Order 7200-2E, para. 6-1-6, on three conceptual alternatives for a new bridge near Pearson Field (VUO), Vancouver, Washington, and over the Columbia River between Vancouver and Portland, Oregon, as shown on the plans attached to your *Notice*(s) *of Proposed Construction or Alteration* (FAA Form 7460-1) dated May 1, 2006. The findings and comments from these studies are consolidated into one report below.

Aeronautical Study No. 2006-ANM-272-NRA – Downstream mid-level replacement bridge "RC-3"

It has been determined that the critical location of this proposal is Point 309, an existing tower (to be removed with proposed demolition of the existing bridge), which penetrates the Part 77 transitional surface for Runway 8-26 at VUO by 66.6 feet. The future critical location would be Point 304, which would penetrate the VUO horizontal surface by 26.46 feet. The proposal would not penetrate any existing or future Part 77 surface for Portland International Airport (PDX).

Air Traffic Division (AT) states: This lat/long has PART 77 busts: horizontal by 63 feet and transition by 72 feet - a bit more than 27 feet identified; a formal obstruction evaluation (OE) aeronautical study will need to be conducted after this feasibility study. (Robert van Haastert, 907-271-5863)

Airway Facility Division (AF) states: The bridge will penetrate the obstacle clear zone of Pearson's RW 08 visual approach slope indicator (VASI). (Peter Markus, 425-227-1450)

Seattle Flight Procedure Office (SEA-FPO) states: Current VUO RWY 26 instrument flight rules (IFR) departure procedure (DP) climb gradient is 650'/nautical mile (NM); and, is controlled by the existing I5 Bridge. If the existing I5 bridge were not present, the climb gradient would be 269'/NM with the 535' mean sea level (MSL) Columbia River Crossing transmission line tower @453557N/1224312W becoming controlling. Approximate Climb Gradients: 435'/NM for option RC-3 (191.49'MSL @ 2975' from 30' elev threshold height—TH). 460'/NM for option RC-4 (approx 180' MSL @ 2700' from 30' elv TH). 710'/NM for option RC-8 (251' MSL @

2500' from 30' elv TH) Even though RC-3 is higher than RC-4, it results in a lower climb gradient because it is further from VUO's TH. Suggest proponent explore the 180' msl design (ala RC-4) constructed on the West side of the existing I5 bridge. That gradient would be approximately |410'/NM (approx 180' MSL @ approx 2975' from 30' elv TH). (Vic Zembruski, 425-227-2224)

Aeronautical Study No. 2006-ANM-273-NRA – Upstream mid-level replacement bridge "RC-4"

It has been determined that the critical location of this proposal is Point 309, an existing tower (to be removed with proposed demolition of the existing bridge), which penetrates the Part 77 transitional surface for Runway 8-26 at VUO by 66.6 feet. After removal of the existing bridge, no part of the replacement bridge would penetrate any existing or future Part 77 surface for either VUO or PDX.

Air Traffic Division (AT) states: This lat/long and elevation has PART 77 bust: VUO RWY 08 transition by 72 feet - a bit more than identified; a formal OE aeronautical study will need to be conducted after this feasibility study. (Robert van Haastert, 907-271-5863)

Airway Facility Division (AF) states: Tech-Ops has no objection provided the associated traffic lights and freeway signs do not penetrate the obstacle clear zone of Pearson's RW 08 VASI. (Peter Markus, 425-227-1450)

Seattle Flight Procedure Office (SEA-FPO) states: Current VUO RWY 26 IFR DP climb gradient is 650'/NM; and, is controlled by the existing I5 Bridge. If the existing I5 bridge were not present, the climb gradient would be 269'/NM with the 535' MSL Columbia River Crossing transmission line tower @453557N/1224312W becoming controlling. Approximate Climb Gradients: 435'/NM for option RC-3 (191.49' MSL @ 2975' from 30' elv TH). 460'/NM for option RC-4 (approx 180' MSL @ 2700' from 30' elv TH). 710'/NM for option RC-8 (251' MSL @ 2500' from 30' elv TH) Even though RC-3 is higher than RC-4, it results in a lower climb gradient because it is further from VUO's TH. Suggest proponent explore the 180' msl design (ala RC-4) constructed on the West side of the existing I5 bridge. That gradient would be approximately 410'/NM (approx 180' MSL @ approx 2975' from 30' elv TH). (Vic Zembruski, 425-227-2224)

Aeronautical Study No. 2006-ANM-274-NRA – Upstream low-level supplemental bridge "RC-8"

It has been determined that the critical location of this proposal is Point 801, which would penetrate the VUO transitional surface by 72.3 feet. The proposal would not penetrate any existing or future Part 77 surface for PDX.

Air Traffic Division (AT) states: This lat/long has PART 77 busts: horizontal by 69 feet and transition by 72 feet - a bit more than identified; a formal OE aeronautical study will need to be conducted after this feasibility study. (Robert van Haastert, 907-271-5863)

Airway Facility Division (AF) states: When the bridge is open for marine traffic, it will penetrate the obstacle clear zone of Pearson's RW 08 VASI (Peter Markus, 425-227-1450)

Seattle Flight Procedure Office (SEA-FPO) states: Current VUO RWY 26 IFR DP climb gradient is 650'/NM; and, is controlled by the existing I5 Bridge. If the existing I5 bridge were not present, the climb gradient would be 269'/NM with the 535' MSL Columbia River Crossing transmission line tower @453557N/1224312W becoming controlling. Approximate Climb Gradients: 435'/NM for option RC-3 (191.49' MSL @ 2975' from 30' elv TH). 460'/NM for

option RC-4 (approx 180' MSL @ 2700' from 30' elv TH). 710'/NM for option RC-8 (251' MSL @ 2500' from 30' elv TH) Even though RC-3 is higher than RC-4, it results in a lower climb gradient because it is further from VUO's TH. Suggest proponent explore the 180' msl design (ala RC-4) constructed on the West side of the existing I5 bridge. That gradient would be approximately 410'/NM (approx 180' MSL @ approx 2975' from 30' elv TH). (Vic Zembruski, 425-227-2224)

The **Flight Standards Division** stated "no objection" on all three alternatives. If you have any questions on the foregoing comments, please contact the specialists at the numbers listed. Once a final plan has been decided upon for the bridge, a *Notice of Proposed Construction or Alteration* (FAA Form 7460-1) must be submitted to FAA for a formal OE aeronautical study, preferably not later than at a ten-percent design stage. If you have any other questions please contact me at (425) 227-2652.

Sincerely,

ORIGINAL SIGNED BY
DON M. LARSON

Don M. Larson
Airport Planner

ATTACHMENT 3

Steve Karnes/ANM/FAA
ATO, Western System Support Group
04/14/2008 12:49 PM

To Don Larson/ANM/FAA@FAA
cc
bcc
Subject Fw: Columbia River Crossing - 2nd Feasibility Study Request & Draft Aviation Technical Report

Hi Don,

Here is the e:mail trail that Lynn last rec'd from Robert. I had a telephone conversation with her and that was all she needed. She did mention that they planned to have the Draft EIS ready by May 2nd.

Steve Karnes
X 4513

----- Forwarded by Steve Karnes/ANM/FAA on 04/14/2008 12:46 PM -----

"Rust, Lynn" <RustL@columbiarivercrossing.org>
04/14/2008 12:40 PM

To Steve Karnes/ANM/FAA@FAA
cc
Subject RE: FW: Fw: Columbia River Crossing - 2nd Feasibility Study Request & Draft Aviation Technical Report

Lynn Rust
Assistant Deputy Project Director
I-5 Columbia River Crossing Project
360-816-2177

From: robert.van.haastert@faa.gov [mailto:robert.van.haastert@faa.gov]
Sent: Wednesday, January 09, 2008 8:59 AM
To: Rust, Lynn
Cc: Steve.Karnes@faa.gov
Subject: RE: FW: Fw: Columbia River Crossing - 2nd Feasibility Study Request & Draft Aviation Technical Report

Hi Lynn,

Will an email work for you? If so, the FAA has no objections nor comments on the proposed Columbia River Crossing Draft Aviation Technical Report.

FAA point of contact: Steve Karnes, Western Service Area, System Support Group. Telephone: 425-917-6736; email: Steve.Karnes@faa.gov

Steve coordinated with the local FAA facilities and did all of the actual 'grunt' work.

When you have a final product, and if it is available in electronic format (pdf or word document), can you email us a copy or send a CD?

FAA / Western Support Group (AJO2-W2)
Attn: Steve Karnes
1601 Lind Avenue, SW
Renton, WA 98055

Robert van Haastert
Obstacle Evaluation Service, Anchorage
Specialist: AK, AZ, CO, ID, MT, OR, UT, WA, & WY
phone: (907) 271-5863, fax: (907) 271-2850
Sign up for emailannouncement of Public Notices at
https://oeaaa.faa.gov/oeaaa/external/searchAction.jsp?action=showSearchCircularizationForm

"Rust, Lynn"
<RustL@columbiarivercrossing.org>

01/09/2008 07:26 AM

To Robert van Haastert/AAL/FAA@FAA
cc
Subject RE: FW: Fw: Columbia River Crossing - 2nd Feasibility Study Request & Draft Aviation Technical Report

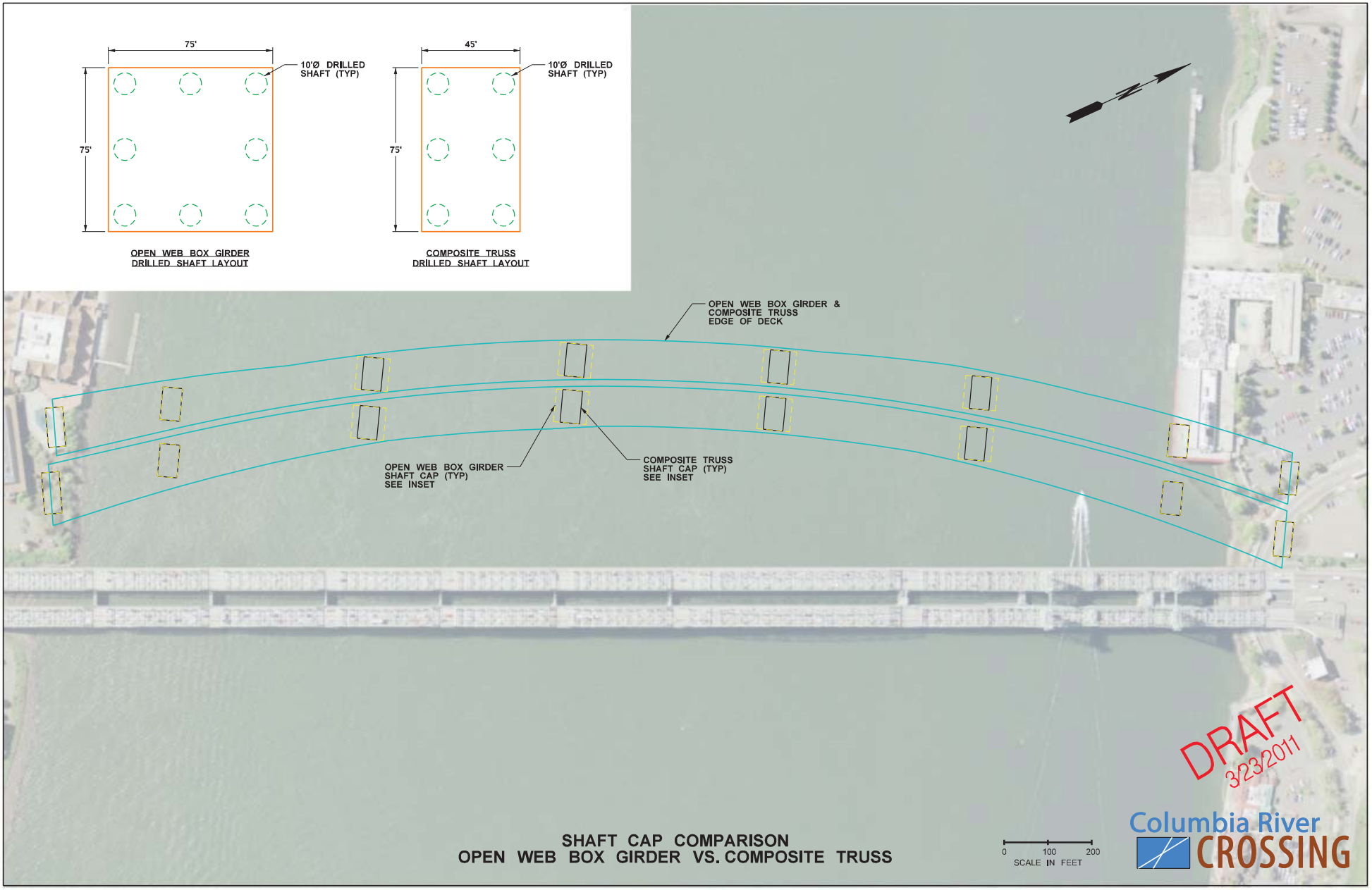
Hello Robert,

I got your voice mail yesterday. Thank you. I like to here no objections. Did you have any comments on the tech report?

Are you or will you send us written correspondence to close the loop on this? Or an email?

Thanks again.

Lynn Rust
Assistant Deputy Project Director
I-5 Columbia River Crossing Project
360-816-2177



SHAFT CAP COMPARISON
OPEN WEB BOX GIRDER VS. COMPOSITE TRUSS

2.3 Components

Components are the building blocks of the alternatives. When combined, the components create the multimodal CRC alternatives intended to address the project's purpose and need. The components of the alternatives include:

- Multimodal river crossing and highway improvements
  - Bridges over the Columbia River carrying transit, highway, and bicycle and pedestrian traffic
  - Bicycle and pedestrian improvements between north Portland and downtown Vancouver
  - Highway and interchange improvements between Marine Drive in north Portland and SR 500 in Vancouver
- High-capacity transit modes
- Transit terminus and alignment options
  - Transit terminus options
  - Transit alignment options
- Transit operations (frequency of train or bus rapid transit service, as well as local buses)
- Bridge tolls
- Transportation System and Demand Management measures

2.3.1 Multimodal River Crossing and Highway Improvements

There are two primary multimodal river crossing options under consideration:

- A replacement multimodal river crossing (included with Alternatives 2 and 3), and
- A supplemental multimodal river crossing (included with Alternatives 4 and 5).

Both river crossings provide improved facilities for highway users, transit users, and bicyclists and pedestrians to enhance the multimodal crossing of the Columbia River and to improve safety, capacity, and mobility on I-5. The replacement and supplemental river crossings differ in the three key elements that comprise this component:

- The bridges over the Columbia River (with dedicated lanes for transit vehicles, cars and trucks, and bicycles and pedestrians),
- Bicycle and pedestrian facilities through Hayden Island, over the Columbia River, and at the Vancouver waterfront, and
- Highway and interchange improvements on I-5 throughout the project area.

Upcoming decisions to define a locally preferred alternative (LPA) will select between a supplemental or replacement crossing (or No Build), but will not decide the specific bridge type or material selection. To narrow the decision further, more analysis is required, and such decisions will be

made after the Draft Environmental Impact Statement (DEIS) and after adoption of an LPA. The decision for this phase of the project regarding the river crossing is only to choose a replacement or a supplemental crossing, or the No-Build Alternative. This process will ensure that the appropriate structural and material selection is evaluated fully before any decision becomes final.

If a replacement crossing is chosen, this will not yet determine the bridge type (for example, three parallel bridges or a stacked transit/highway bridge—see below for information on these design concepts) or bridge material (for example, concrete, steel, or composite). Decisions on bridge type and design would have to be approved by the Federal Highway Administration (FHWA) before a final selection is made. The Federal Transit Administration (FTA) will also take an approval action on the final structure type.

Likewise, if a supplemental crossing is chosen, bridge type or material of the new bridge would be determined during further design and evaluation after adoption of an LPA. Should the supplemental crossing move forward in the National Environmental Policy Act (NEPA) process and become part of the LPA, a bridge type study will be done to determine the bridge type and material, and that information will be submitted to FHWA for approval. FTA will also take approval action on the final structure type.

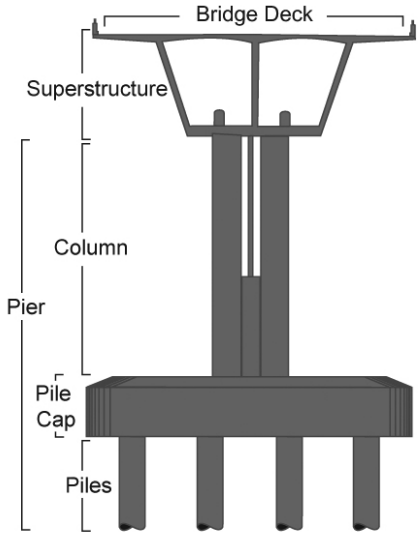
Replacement River Crossing Bridges (Alternatives 2 and 3)

A replacement river crossing (Exhibit 2.3-1) would include removing the existing I-5 bridges and building new bridges west of the existing I-5 bridges. Two new bridges would carry north and southbound interstate traffic, and the third would have a high-capacity transit guideway and an exclusive path for bicycles and pedestrians. North and southbound interstate traffic would each travel on a separate bridge approximately 99 feet wide. A third bridge approximately 52 feet wide would carry transit vehicles, bicyclists, and pedestrians. (Note: there is a possible design that would include placing transit vehicles under one of the highway bridges; see the stacked transit/highway bridge discussion below for this description.)

Bridge design will be determined later in the project, but the basic size and height requirements have been defined. The bridge spans over the river must be tall enough for large barges and tugboats to pass underneath without the need for a lift span (approximately 90 feet vertical clearance), but low enough to minimize interference with aircraft using the nearby Pearson Field or Portland International Airport. The bridges cannot include tall towers, such as those associated with cable-stay or suspension bridges, because these would pose a hazard to aircraft.

TERMS & DEFINITIONS

Bridge Terms



NOTE: The bridge type shown is for display purposes only.

For the Lincoln terminus, construction on northern Vancouver streets would need to be sensitive to the area's active urban environment. Multiple small work zones could focus construction activity and reduce the duration of disturbances to adjacent businesses and residents. Streets would be open to traffic and pedestrians when possible, but would likely need to close during some construction activities (through pedestrian access would always be maintained except for momentary disruptions). The construction sequencing of the new MAX tracks being built in downtown Portland is a good example of how construction could occur in this area, although the bus rapid transit option would be less disruptive and would require slightly less time to construct.

Roadway construction would include restriping or rebuilding the road surface, rebuilding sidewalks in some sections, and constructing station platforms. Streetscape improvements could include removing, replacing, or adding vegetation, curb extensions, new signs and signals, and other measures to improve access to, and use of, the transit stations. Stations, park and rides, and new structures could require pile driving and earthwork for clearing and grading these sites.

The project may include joint development opportunities, such as working with a developer to build transit-oriented development on or near the alignment. No sites or specific plans have been developed, so no specific site impacts can be analyzed at this time.

Transit construction will also require staging areas. Exact locations have not been determined. Where possible, staging activities will take advantage of land that is already in the public right-of-way or in public ownership and that is not being used for other purposes, such as vacant lots. Sites will be significantly smaller than the anticipated construction staging areas for bridge construction. If any sites are used that are close to transit stations, joint developments may be considered to create transit-oriented development on the site after the construction use is completed.

2.5 Alternatives Considered But Not Advanced

This section describes the range of transportation improvements that were initially considered but eliminated during screening and subsequent evaluation due to significant engineering problems, environmental impacts, cost, or failure to meet the project's purpose and need. These transportation improvements include ideas such as a third corridor for crossing the Columbia River (in addition to the current I-5 and I-205 corridors), low-level bridges, tunnels, and multiple transit modes. The process followed to identify and screen alternatives to develop the range of alternatives that are being evaluated in this DEIS complied with US Department of Transportation (USDOT) guidance on linking planning and NEPA requirements.

The following discussion is a chronological description of the transportation improvements evaluated and dropped through the process of developing the range of alternatives evaluated in this DEIS.

2.5.1 Early Studies

Elements of the CRC project have been proposed and studied since the early 1990s, as described in Chapter 1. In 2002, the I-5 Transportation and Trade Partnership produced an evaluation of multiple highway, transit and river crossing improvements in this corridor and other parts of I-5. This process gathered public and stakeholder input on issues and potential solutions for transportation problems in the I-5 corridor. The Partnership then made recommendations for improvements and identified the CRC project as a regional priority in its Final Strategic Plan. This led to the initiation of the CRC Environmental Impact Assessment process. A "Notice of Intent" to prepare an environmental impact statement was issued in September 2005.

2.5.2 Evaluation Criteria and Initial Component Screening

Starting in October 2005, CRC project staff began working closely with the public, stakeholders, and local jurisdictions to develop the project's purpose and need (see Chapter 1). In October 2005, the CRC Task Force adopted a "Vision and Values" document that outlined broad goals and priorities, and served as a basis for developing evaluation criteria to measure and compare performance of different alternatives. Based on this document, the project team worked with local agency sponsors, the CRC Task Force, and state and federal permitting agencies to develop the Evaluation Framework, which outlined a process for generating and evaluating possible alternatives. The statement of purpose and need was finished and approved by FHWA, FTA, and the project's local sponsoring agencies in January 2006.

The project team began the process of developing alternatives by identifying possible transportation components (for example, transit technologies, and river crossing types and locations). Over 70 such components were identified in the 2002 I-5 Transportation and Trade Partnership Final Strategic Plan and through additional public and stakeholder outreach.

Project staff performed two rounds of evaluation and screening to narrow these options. Only transit and crossing components were screened. Other elements that have since been included in the alternatives evaluated in this DEIS, such as pedestrian, bike, and roadway improvements, were advanced without screening. The initial screening in April 2006 eliminated river crossing types and transit modes that did not meet the project's purpose and need[4], including:

- A replacement tunnel, which would fail to serve most of the current vehicle trips
- High-level bridges that would encroach on protected airspace for Pearson Airfield
- Transit Modes that do not effectively serve the specific needs of this region, such as high-speed rail, ferry service, monorail, magnetic levitation railway, commuter rail in freight rail corridor, and heavy rail

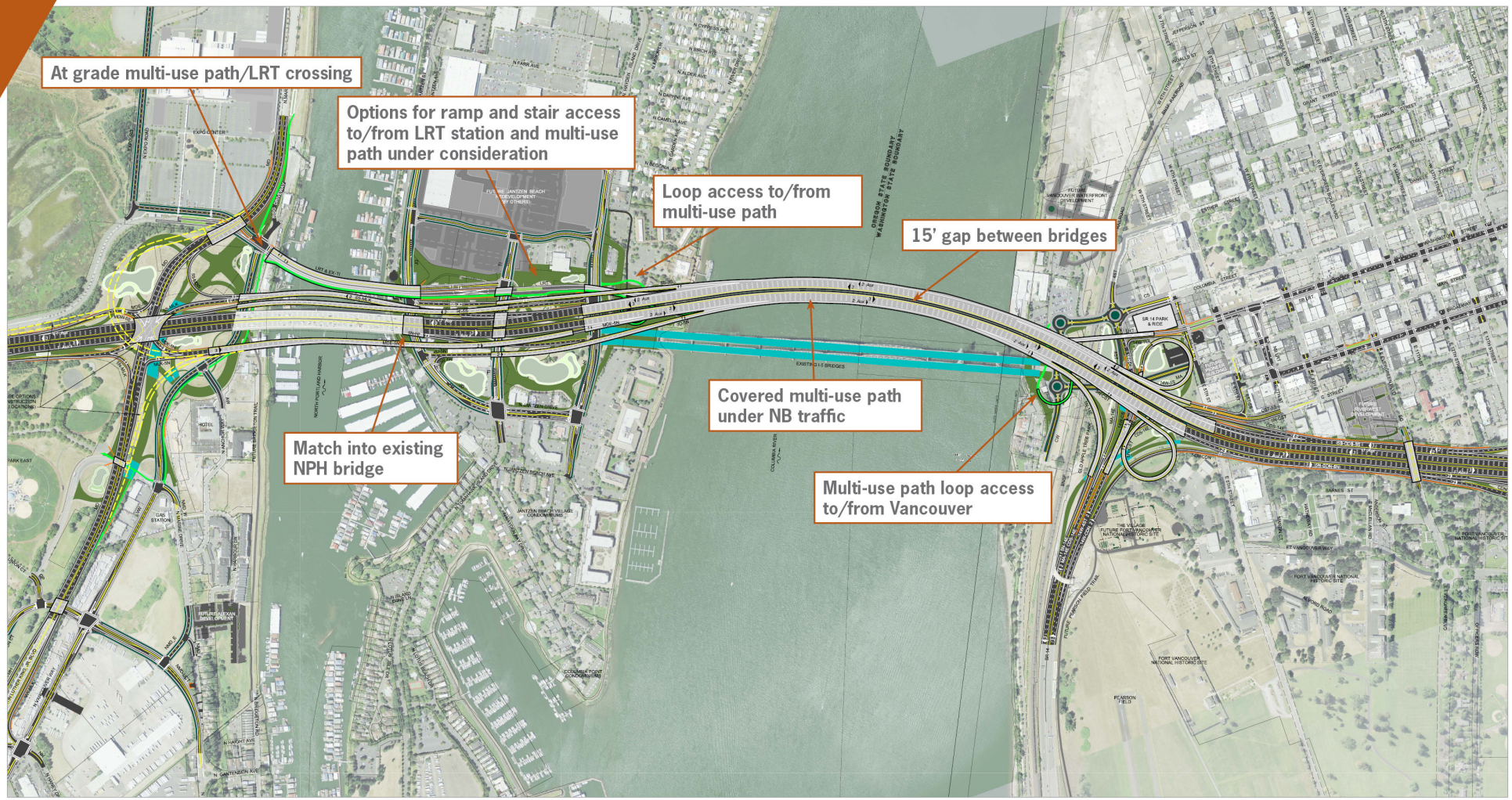
CRC Task Force

The 39-member CRC Task Force is composed of leaders representing a broad cross section of Washington and Oregon communities. Public agencies, businesses, civic organizations, neighborhoods, and freight, commuter, and environmental groups are represented on the Task Force. This group meets regularly to advise the CRC project team and provide guidance and recommendations at key decision points. The Public Involvement Appendix of this DEIS lists task force members.

[4] Step A Screening Report, CRC, 2006.

Columbia River CROSSING

LPA Option A - March 2011



PROJECT PARTNERS

Washington State Department of Transportation

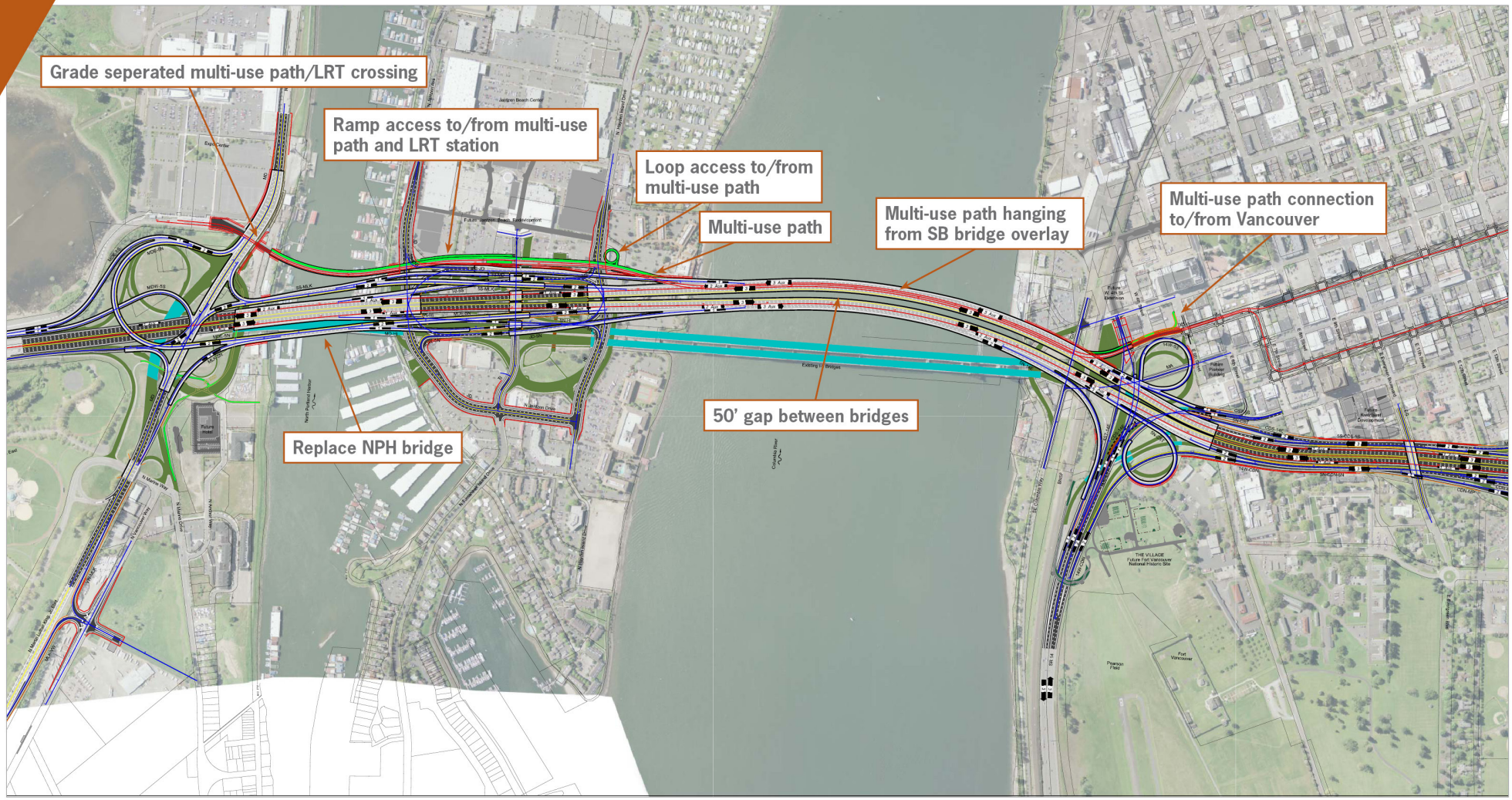
Oregon Department of Transportation

Federal Transit Administration • Federal Highway Administration
City of Vancouver • City of Portland • SW Washington Regional Transportation • Council Metro • C-TRAN • TriMet

DRAFT 04/01/11

Columbia River CROSSING

2 Bridge Alternative - August 2008



PROJECT PARTNERS

Washington State Department of Transportation

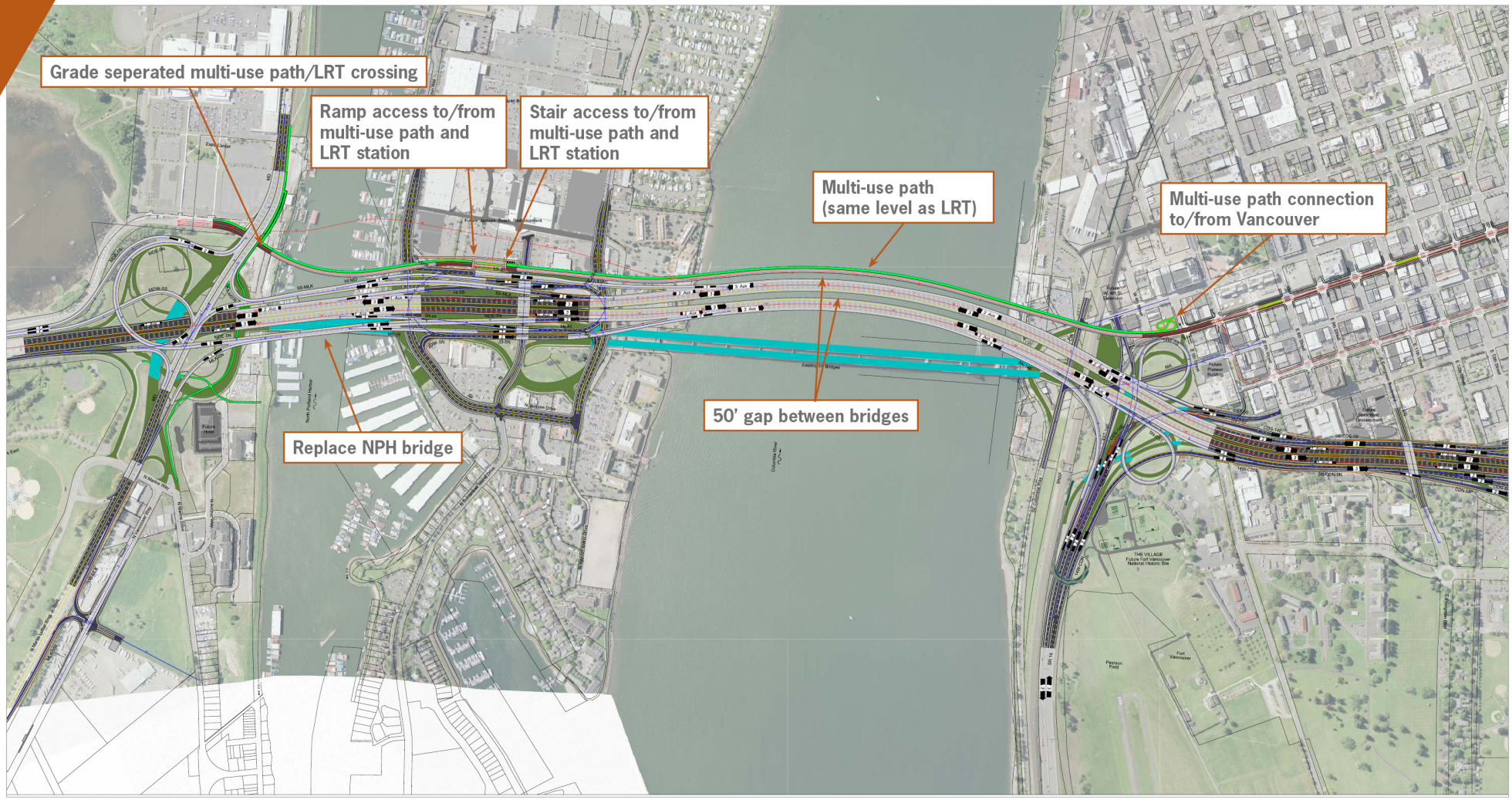
Oregon Department of Transportation

Federal Transit Administration • Federal Highway Administration
City of Vancouver • City of Portland • SW Washington Regional Transportation • Council Metro • C-TRAN • TriMet

DRAFT 04/01/11

Columbia River CROSSING

3 Bridge Alternative - May 2008



PROJECT PARTNERS

Washington State Department of Transportation

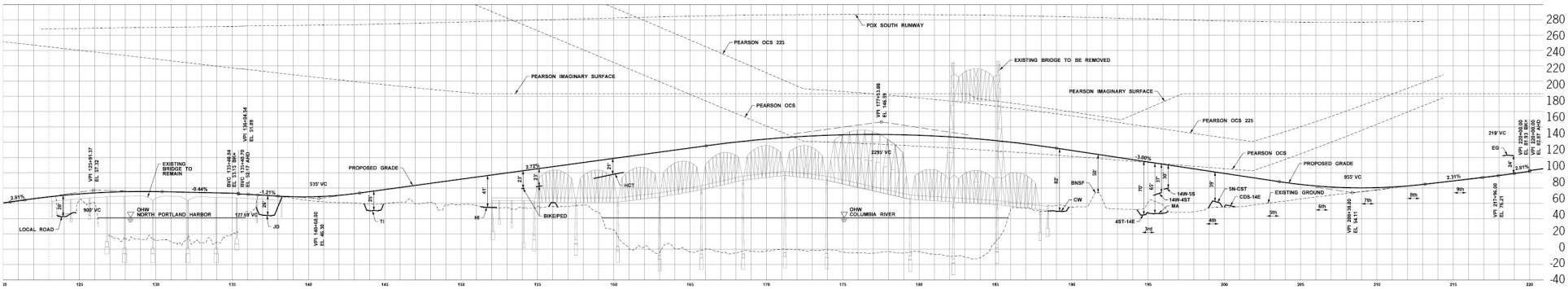
Oregon Department of Transportation

Federal Transit Administration • Federal Highway Administration
City of Vancouver • City of Portland • SW Washington Regional Transportation • Council Metro • C-TRAN • TriMet

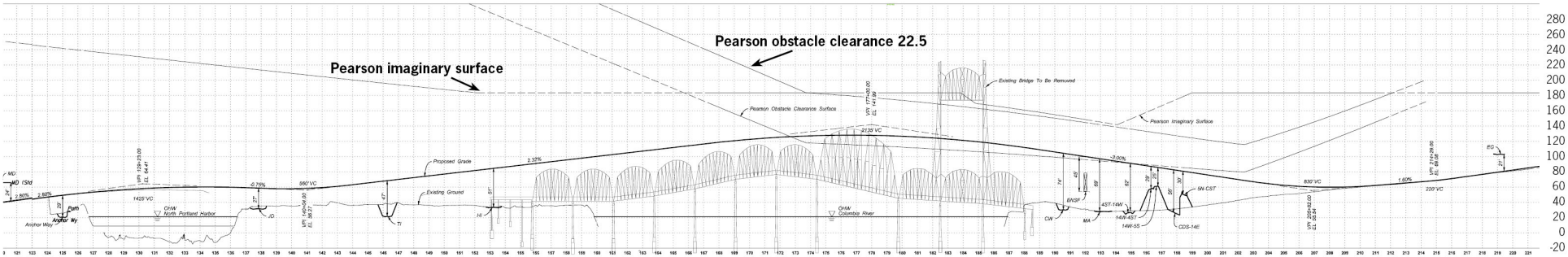
DRAFT 04/01/11

Columbia River CROSSING

Profiles 2008-2011



LPA Profile - March 2011

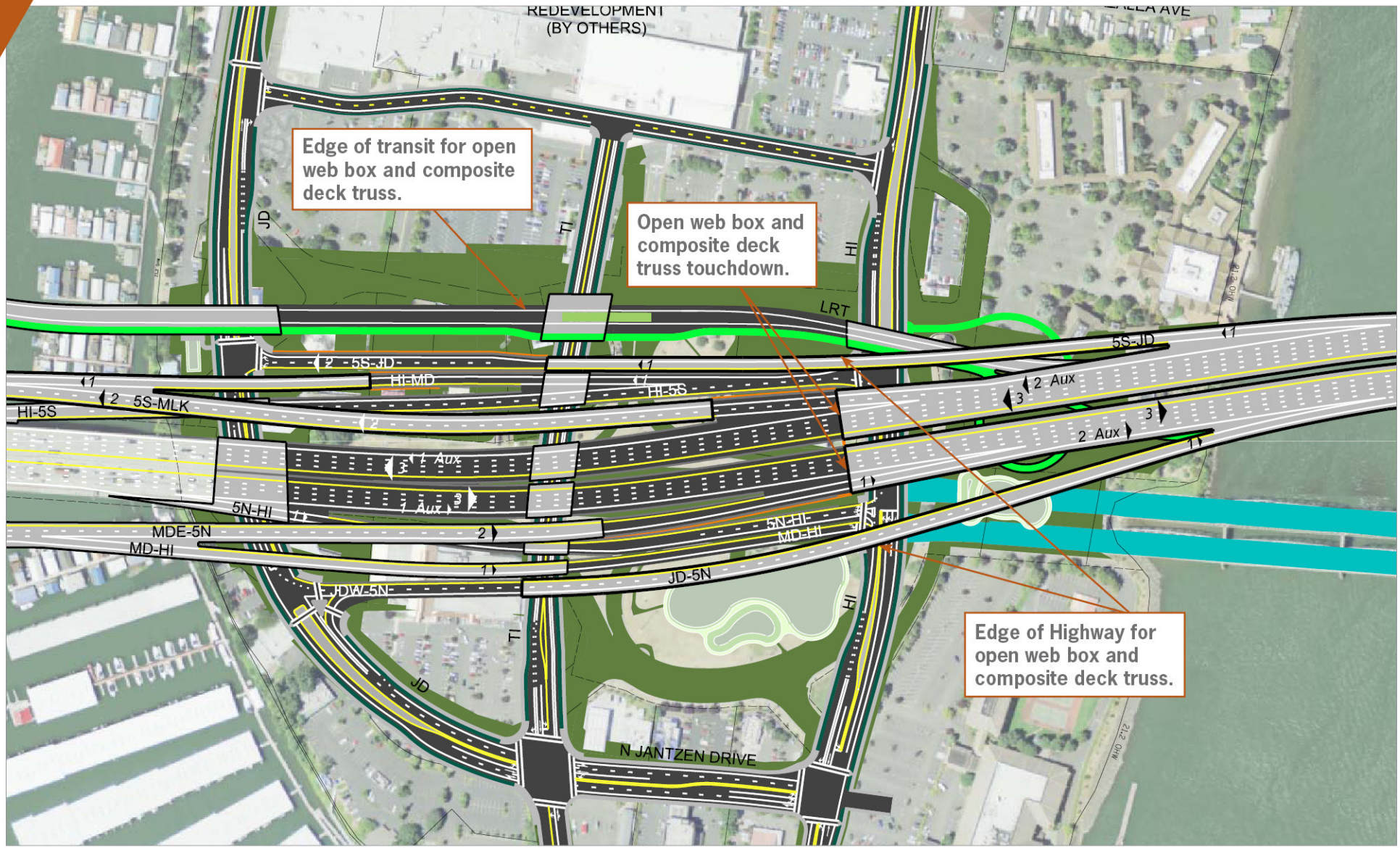


2 and 3 Bridge Alternative Profile - 2008

Columbia River CROSSING

Oregon Touchdown Comparison

EXHIBIT 2 Open Web Box Versus Composite Deck Truss



PROJECT PARTNERS Washington State Department of Transportation • Oregon Department of Transportation

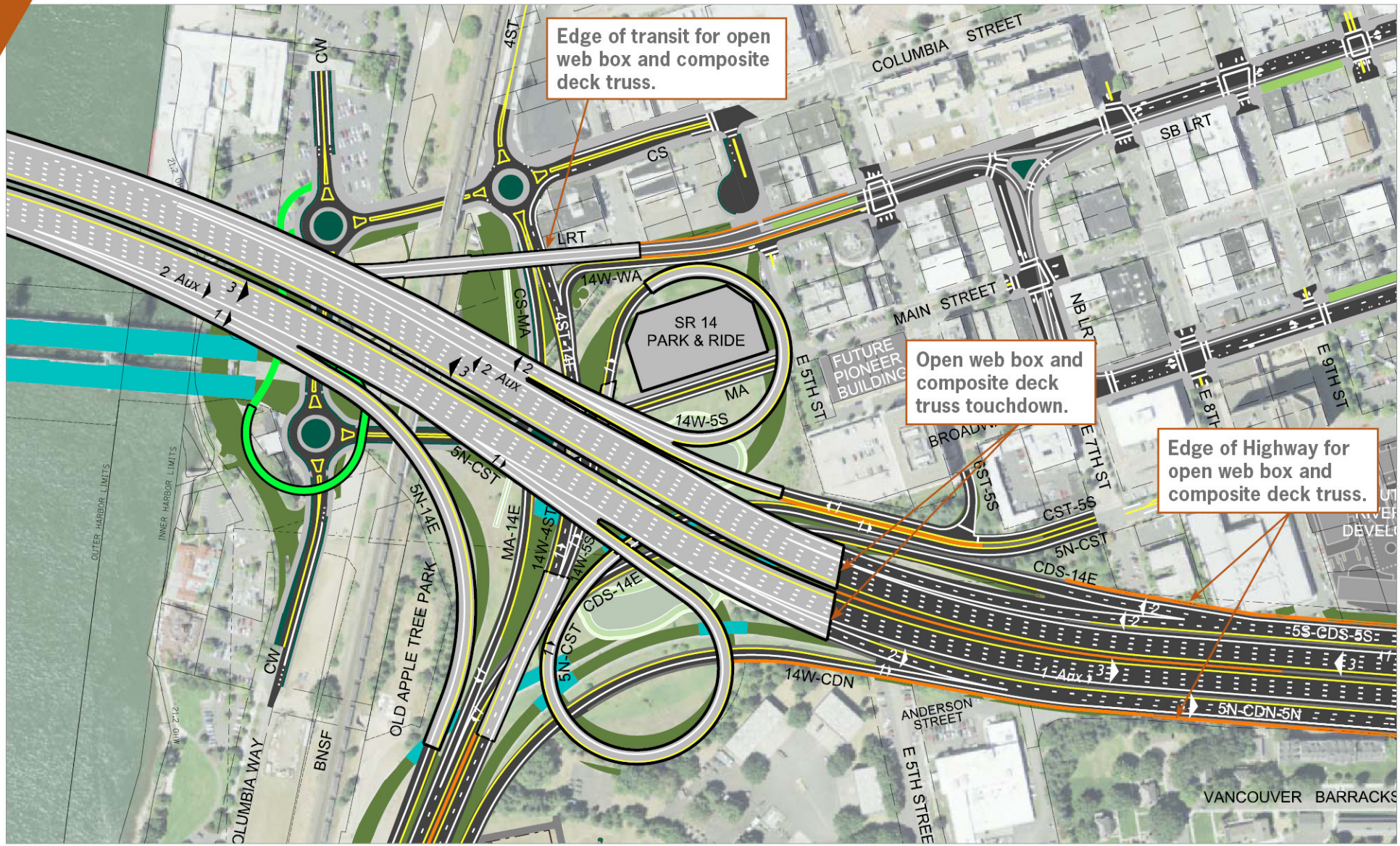
Federal Transit Administration • Federal Highway Administration
City of Vancouver • City of Portland • SW Washington Regional Transportation • Council Metro • C-TRAN • TriMet

DRAFT 03/28/11

Columbia River CROSSING

Washington Touchdown Comparison

EXHIBIT 1 Open Web Box Versus Composite Deck Truss



PROJECT PARTNERS Washington State Department of Transportation | Oregon Department of Transportation

Federal Transit Administration • Federal Highway Administration
City of Vancouver • City of Portland • SW Washington Regional Transportation • Council Metro • C-TRAN • TriMet

DRAFT 03/28/11

ATTACHMENT

Environmental
NEPA Re-evaluation
and appendices

May 2011

U.S. DEPARTMENT OF TRANSPORTATION

Federal Highway Administration

Oregon Division Office
530 Center Street,
Suite 420
Salem, Oregon 97301
503-399-5749

Washington Division Office
711 S. Capitol Way
Suite 501
Olympia, WA 98501
360-753-9889

Federal Transit Administration
Region 10
915 Second Avenue
Room 3142
Seattle, Washington 98174-1002
206-220-7954

June 2, 2011

Ms. Nancy Boyd
Project Director
I-5 Columbia River Crossing
700 Washington Street, Suite 300
Vancouver, WA 98660

RE: Environmental Revaluation, I-5 Columbia River Crossing Project (CRC)

Dear Ms. Boyd:

The Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA) reviewed an Environmental Re-Evaluation Consultation and its supporting documentation which the CRC Project team submitted on May 5, 2011, and attached to this letter. The re-evaluation assessed how environmental impacts for the current Locally Preferred Alternative (LPA) differ from the impacts evaluated in the CRC Draft Environmental Impact Statement (DEIS) submitted in May 2008. The design changes and refinements considered in the re-evaluation are located at various points along the length of the project. The re-evaluation does not address design changes or refinements which were re-evaluated previously, such as the 17th Street transit alignment (March 2010) or the Composite Truss bridge type (March 2011). The impacts from the 17th Street alignment change and the bridge type change were determined not to require additional documentation and were incorporated into the project design. Therefore, they are part of the project that forms the baseline project of the May 2011 re-evaluation. You have offered this information seeking FHWA's and FTA's determination whether the design changes and refinements described in the submittal will require a Supplemental Draft Environmental Impact Statement (SDEIS) under the National Environmental Policy Act (NEPA).

The main design change and refinement covered in the re-evaluation pertains to the decision to retain the existing I-5 bridges over the North Portland Harbor rather than replacing them as shown in the DEIS. This change occurred as a result of the Cost Reduction/Savings Measures that the project identified in 2009.

The re-evaluation also addresses design changes and refinements for the following items:

- Marine Drive interchange,
- State Route 14 interchange,
- Other minor refinements at the other highway interchanges,

- Number of lanes on the main river crossing,
- Number of bridges over the Columbia River,
- Light rail alignments across Hayden Island and in downtown Vancouver,
- Size and location of park and ride facilities,
- Size and location of transit station platforms,
- Community Connector in Vancouver,
- Multi-use path in Portland and Vancouver,
- Construction buffer necessary to build the new supplemental structures (ramps, transit) over the North Portland Harbor.

Impacts associated with the above design changes and refinements have been considered during consultation under the Endangered Species Act and the Marine Mammal Protection Act. The above changes and refinements were also included in the project's Area of Potential Effect (APE) for Section 106 of the National Historic Preservation Act, and no additional use of Section 4(f) (Department of Transportation Act of 1966) resources has been identified.

In our review of this re-evaluation, we considered whether the changes and design refinements present significant environmental impacts which were not reviewed in the DEIS (23CFR771.129). Based upon the information you provided, FHWA and FTA agree that the design changes and refinements incorporated in the project since our approval of the DEIS do not create new environmental impacts that require a Supplemental DEIS.

Please note that we offer this determination solely on the limited question of whether the changes summarized in the May 5, 2011, Environmental Re-Evaluation Consultation require a Supplemental DEIS. Any future changes or design refinements prior to the publication of the FEIS require additional evaluation.

Sincerely,

Phillip A. Ditzler
Division Administrator – Oregon
Federal Highway Administration

R.F. Krochalis
Regional Administrator – Region 10
Federal Transit Administration

Daniel Mathis
Division Administrator – Washington
Federal Highway Administration

Attachment: May 5, 2011 Environmental Re-Evaluation Consultation

ENVIRONMENTAL RE-EVALUATION CONSULTATION

Note: The purpose of this worksheet is to assist sponsoring agencies in gathering and organizing materials for re-evaluations required under the National Environmental Policy Act (NEPA). Submission of the worksheet by itself does not meet NEPA requirements. FTA & FHWA must concur in writing with its determination and/or the sponsoring agency's NEPA recommendation. Contact the FTA Region 10 office at (206) 220-7954 or FHWA CRC Project Manager at (360) 619-7591 if you have any questions regarding this worksheet. We strongly encourage you to contact us to discuss your project changes before you fill out this worksheet.

For Agency Use *Date Received:*	
Recommendation by FTA Planner or Engineer: ☐ *Accept* ☐ *Return for Revisions* ☐ *Not Eligible* *Recommendation by FHWA Planner or Engineer:* ☐ *Accept* ☐ *Return for Revisions* ☐ *Not Eligible*	*Reviewed By:* *Date:* *Reviewed By:* *Date:*
Comments:	
Concurrence by FTA Counsel: ☐ *Accept Recommendation* ☐ *Return with Comments* *Concurrence by FHWA Counsel:* ☐ *Accept Recommendation* ☐ *Return with Comments*	*Reviewed By:* *Date:* *Reviewed By:* *Date:*
Comments:	
Concurrence by Approving Officials: *FTA:* *FHWA:*	*Reviewed By:* *Date:* *Reviewed By:* *Date:*

Please answer the following questions, fill out the impact chart and attach project area and site maps. Using a site map from the previously approved NEPA document, show project changes using a different color. Include additional site maps to help reviewer understand project changes.

PROJECT TITLE
Columbia River Crossing—changes in impacts from DEIS to current LPA

LIST CURRENT, APPROVED ENVIRONMENTAL DOCUMENTS (e.g. EIS/ROD, EA/FONSI, BA, RE-EVALUATION, etc.) If Re-evaluation, briefly describe.
Title: DEIS Date: May 2008 Type and Date of Last Federal Action
Title: Biological Assessment Date: June 2010 Type and Date of Last Federal Action: Received Biological Opinion in January 2011
Title: Biological Opinion Date: January 2011 Type and Date of Last Federal Action

HAS THE MOST CURRENT AND OTHER PERTINENT APPROVED ENVIRONMENTAL DOCUMENTS BEEN *RE-READ* TO COMPARE PROPOSED PROJECT CHANGES?

☐ **NO (STOP! The most current approved environmental document MUST be re-read prior to completing a re-evaluation.)**

☒ **YES NAME: Seth English-Young, Jeff Heilman DATE: April 10, 2011**

IS THE PROJECT CURRENTLY UNDER ☒ DESIGN OR ☐ CONSTRUCTION?

REASON FOR RE-EVALUATION

The purpose of this re-evaluation is to assess how environmental impacts for the current LPA are different from the impacts evaluated in the DEIS. This re-evaluation does not specifically address changes that were covered in previous re-evaluations, such as the 17th Street transit alignment (March 2010) and the Composite Truss bridge type (March 2011). However, where this re-evaluation discusses total impacts from the LPA, those totals include all changes that have been incorporated since the DEIS.

The DEIS assessed the impacts from No-Build (Alternative 1) and four build alternatives (Alternatives 2-5). No preliminary LPA was identified in the DEIS. There were a series of components that comprised the Alternatives:

Components	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Multimodal River Crossing and Highway	Existing	Replacement	Replacement	Supplemental	Supplemental
HCT Mode	None	Bus Rapid Transit	Light Rail	Bus Rapid Transit	Light Rail
HCT Terminus	N/A	(A) Kiggins Bowl, (B) Lincoln, (C) Clark College MOS, or (D) Mill Plain MOS	(A) Kiggins Bowl, (B) Lincoln, (C) Clark College MOS, or (D) Mill Plain MOS	(A) Kiggins Bowl, (B) Lincoln, (C) Clark College MOS, or (D) Mill Plain MOS	(A) Kiggins Bowl, (B) Lincoln, (C) Clark College MOS, or (D) Mill Plain MOS
TDM/TSM	Current Programs	Expanded TDM/TSM programs			
I-5 Bridge Toll	None	Standard rate	Standard rate	Higher rate	Higher rate
Transit Operations	Existing	Efficient	Efficient	Increased	Increased

Because of the different components included in each alternative, the DEIS reported a range of impacts. This re-evaluation compares the LPA to the range of impacts evaluated in the DEIS.

Since publication of the DEIS the LPA has been defined and refined. The LPA was adopted in July 2008 as follows:

- A replacement bridge as the preferred river crossing
- Light rail transit as the preferred high-capacity transit mode
- Clark College as the preferred northern terminus for the light rail extension.

The LPA is most similar to DEIS Alternative 3—Replacement bridge with light rail and the Clark College MOS terminus.

The LPA has been refined since its adoption. The changes were the result of on-going evaluation of design issues, costs, impacts, benefits and constructability, and have been determined through ongoing public and other stakeholder input. These elements are described in detail in the *Description of Project Changes* section below.

The following are the primary transportation improvements included in the LPA as currently described. All of these elements were included in the DEIS:

- The replacement river crossing over the Columbia River and the I-5 highway improvements, including seven interchanges, north and south of the river.
- Extension of light rail from the Expo Center in Portland to Clark College in Vancouver, and associated transit improvements, including transit stations, park and rides, bus route changes, and expansion of a light rail transit maintenance facility.
- Bicycle and pedestrian improvements throughout the project corridor.
- A toll on motorists using the river crossing.
- Transportation demand and system management measures to be implemented with the project.

DESCRIPTION OF PROJECT CHANGES OR NEW INFORMATION

For the purpose of this re-evaluation, all project changes and associated changes in environmental impacts from the DEIS to the current LPA are analyzed (the *Change in Impacts* matrix at the end of this document describes these changes in environmental impacts). For the project as a whole, the total impacts from the current LPA are compared to the range of impacts reported in the DEIS. The current LPA is similar to DEIS Alternative 3 (replacement bridge with light rail and the Clark College MOS terminus). In general, the total impacts from the LPA are within the range reported in the DEIS.

The re-evaluation is divided into two sections:

(1) *Main Project Changes* and
(2) *Other Design Changes and Refinements.*

The *Main Project Changes* are described first, and entail the main project changes since the DEIS was published. The changes in environmental impacts resulting from these design changes are described in the *Change in Impacts* matrix at the end of this document. The *Main Project Changes* occur in the North Portland Harbor, Marine Drive, and Hayden Island interchange areas. These changes are reflected in "LPA Option A" and to a lesser extent in "LPA Option B".

All other project changes are included in the *Other Design Changes and Refinements* section. Most these design changes make no or very little difference in environmental impacts. Any notable changes in environmental impacts are described in the *Change in Impacts* matrix. The project design changes and refinements included in this section are:

- Transit Station Platforms
- Park and Rides
- Marine Drive Interchange Design
- Number of Lanes on the River Crossing
- Number of Bridges over the Columbia River
- Light Rail Alignment over Hayden Island
- Light Rail Alignment in Downtown Vancouver
- Cost Reduction/Saving Measures

- SR 14 Interchange
- Fourth Plain Interchange
- SR 500 Interchange
- Community Connector
- Multi-Use Path
- Construction Buffer in North Portland Harbor

(1) Main Project Changes

The *Main Project Changes* described below are those changes since the DEIS that have resulted in most of the changes in impacts. The changes in environmental impacts resulting from these design changes are described in the *Change in Impacts* matrix at the end of this document.

LPA Option A and Option B

In the DEIS alternatives, the I-5 North Portland Harbor bridge was proposed to be removed and four new structures with added functions built in its place. The largest new structure would accommodate I-5 mainline and the smaller structures would accommodate on and off movements, auxiliary lanes, local traffic connections, light rail transit and a multi-use path. For the LPA (Options A and B), the I-5 North Portland Harbor bridge would be retained rather than replaced. This change occurred as a result of the Cost Reduction/Savings Measures that the project identified in 2009 (as described later in this section). The other smaller structures would still be built with Options A or B, but the functions of some would vary from the DEIS alternatives. Both options, as well as the DEIS alternatives, include two new bridges to carry traffic merging onto or exiting off of mainline I-5 between the Marine Drive and Hayden Island interchanges. The new structure on the west side of I-5 would serve as a collector-distributor road for southbound traffic, while the new structure on the east side of I-5 would serve as a collector-distributor road for northbound traffic.

Other changes in this location were made in response to comments received during the DEIS comment period. These comments led to a public process to refine the Hayden Island interchange design. The City of Portland, a co-sponsor for the project, also raised concerns about the size of the interchange. In the design at that time, the collector-distributor lanes ran adjacent to the I-5 mainline between the Hayden Island and Marine Drive interchanges, adding width to the footprint of the highway on the Island. To address these concerns, the CRC project worked with the City of Portland and local stakeholders to refine the design for the Hayden Island and Marine Drive interchanges, resulting in what is referred to in the FEIS as LPA Option A. Option A and Option B are described in detail below.

LPA Option A:

The main differences between Option A and the DEIS alternatives is that Option A retains rather than replaces the I-5 North Portland Harbor bridge, and it includes vehicle traffic lanes on the proposed LRT bridge to provide local vehicle access from Hayden Island to Marine Drive. In Option B, as well as in the DEIS build alternatives, access between Hayden Island and Marine Drive/Martin Luther King Jr. Blvd (MLK) is via collector-distributor lanes built on new structures adjacent to the I-5 mainline. Option A also has these collector-distributor lanes but they are on generally narrower structures.

Option A would also build four new, narrower parallel structures across the waterway, three on the west side and one on the east side of the existing bridge. The DEIS design also had four structures crossing the river, but the functions and precise locations varied from Option A. All the same traffic movements exist within Option A, Option B, and the DEIS option.

Three of the new structures would carry on- and off-ramps to mainline I-5. This includes two structures west of the existing bridges that would carry traffic merging onto or exiting off of I-5 southbound, and

one new structure on the east side of I-5 that would serve as an on-ramp for traffic merging onto I-5 northbound.

The fourth new structure would be built slightly farther west and would include light rail transit, a multi-use path for pedestrians and bicyclists, and two roadway lanes to carry local traffic to and from Hayden Island. This same bridge, without the local traffic lanes, was included among the range of DEIS alternatives. The length of each new structure would be between 800 and 1,000 feet, depending on its location and the angle relative to the channel. Span lengths would vary by bridge, and the existing navigation channel would be preserved. All of the new structures would have at least as much vertical clearance over the river as the existing North Portland Harbor bridges.

This option is the preferred option and is shown as the "Current Plan" in Exhibits A, B and C, which compare Option A to the DEIS design. Option A and Option B are compared to each other in Exhibit H and Exhibit I.

LPA Option B: As noted above, Option B is also a variation on the DEIS designs. Like Option A, the North Portland Harbor bridges would be retained rather than replaced. The main difference between Option B and Option A is how local traffic would connect from Hayden Island to Marine Drive across North Portland Harbor. This local traffic would travel on the collector-distributor lanes that would parallel each side of I-5 over North Portland Harbor rather than on local traffic lanes on the LRT bridge. Traffic would not need to merge onto mainline I-5 to travel between the island and Marine Drive/MLK. (See Exhibit C – North Portland Harbor)

Option B would build the same number of new structures over North Portland Harbor as Option A, although the locations of certain functions on those bridges would differ. The same movements that are in Option A are in Option B, but in a different configuration.

With LPA Option B, the new structure on the west side of I-5 would serve as a collector-distributor road for southbound traffic, while the new structure on the east side of I-5 would serve as a collector-distributor road for northbound traffic. The overall footprint of the Hayden Island interchange is slightly wider with Option B than Option A due to the collector-distributor lanes running parallel to the I-5 mainline (Option A and Option B are compared to each other in Exhibit H and Exhibit I).

DEIS design:
All DEIS alternatives called for replacing the North Portland Harbor Bridge and building four new structures. Vehicle movements for all DEIS alternatives are very similar to LPA Option B: I-5 through traffic would travel on the mainline; local traffic access would be provided via collector-distributor lanes located on the two new structures adjacent to the highway bridge; the light rail/ multi-use path bridge (located farthest to the west) would not include local vehicle traffic (The DEIS design for Hayden Island, North Portland Harbor and Marine Drive is illustrated in Exhibits A, B and C).

(2) Other Design Changes and Refinements

Transit Station Platforms
Since the publication of the DEIS there have been changes to the light rail transit station platform locations. The current LPA has the same number of station platforms, but the locations of some have changed (see Exhibit E – Vancouver Light Rail). These changes are described below.

The table below shows the locations of the transit station platforms in the DEIS and the current LPA.

DEIS Transit Stations	*LPA Transit Stations*
Elevated on Hayden Island	Elevated on Hayden Island

A split platform on 6th between Washington and Main and between 6th and 7th on Washington	Dual platforms between 5th and 6th on Washington
Between 11th and 12th on Washington and Broadway	Between 9th and Evergreen on Washington and Broadway
Between 15th and 16th on Washington and Broadway	Between 15th and 16th on Washington and Broadway
At Clark College (either in the Park and Ride or on McLoughlin)	At Clark College (on McLoughlin)

Additional investigation, coordination with the City of Vancouver and the public, completed since the DEIS found design constraints that required the relocation of two pairs of stations. The stations near 6th Street were combined into one station between 5th and 6th Streets. This move was made so the stations would not need to be placed on a curve, which requires closing traffic, and so the combined station could be placed as close as possible to the Columbia Park and Ride.

The stations between 11th and 12th Streets in the DEIS were moved to between 9th and Evergreen Streets. This move was made for two reasons: 1) to provide equal spacing between the 6th St. platform and the Mill Plain platforms; and 2) to locate the station closer to planned development in Downtown Vancouver, including the Riverwest development, much of which is expected to occur in the southern part of downtown.

The change in location of the station platforms would not have a change in environmental impacts—there would still be the same number of stations. The blocks for the DEIS and LPA station locations are located in the downtown Vancouver central business district, with commercial retail and office and residential uses. Acquisitions would not be impacted because the station platforms are located within existing ROW.

Park and Rides

The DEIS reported up to 8 park and ride facilities and the current LPA includes three of those park and rides. The table below outlines the locations of the park and rides in the DEIS and the LPA.

DEIS Park and Rides	*LPA Park and Rides*
Clark College: bounded by I-5, McLoughlin, and Clark College	Clark College: bounded by I-5, McLoughlin, and Clark College
Mill Plain (two locations reported in the DEIS): 1) bounded by Washington, Main, 15th and 16th 2) bounded by Broadway, Main, 16th and 17th	Mill Plain: bounded by Washington, Main, 15th and 16th
Columbia: bounded by Washington, Columbia, 4th, and 5th	Columbia, bounded by Washington, Columbia, 5th, and including half the block between 3rd and 4th
Three surface lots: bounded by 5th, railroad tracks,	*Not included in LPA*

I-5 and Columbia.	
Kiggins Bowl	*Not included in LPA*
39th and Main	*Not included in LPA*

The DEIS reported up to 3220 park and ride spaces and up to 3385 trips generated during the AM and PM peak. In the LPA there is a total of 2900 spaces and 3025 trips generated during the AM and PM peak.

Expected utilization of parking spaces, cost-effectiveness, transit operations, and traffic modeling were considered by project staff when recommending the proposed park and ride locations with the LPA. Upon selection of the Clark College area as the terminus of the light rail alignment, it was determined that three park and ride stations in their proposed locations would be the most cost-effective option.

The locations of the park and rides in the LPA are within the range reported in the DEIS. The total number of spaces and trips generated are within the range reported in the DEIS. One of the park and rides (Columbia) would have more displacements than included in the DEIS and traffic impacts would be slightly changed, as described in the *Change in Impacts* Matrix at the end of this document (see the *Transportation* and *Acquisitions, Displacements and Relocations* sections).

Marine Drive Interchange Design

The DEIS evaluated three designs for the Marine Drive interchange that differed in the alignment of Marine Drive west of I-5. These designs included an option for retaining most of the existing alignment, and two designs that realigned the roadway south of its current location. Following the selection of the LPA, the CRC project team established the Marine Drive Stakeholder Group to provide feedback on the function and design of the Marine Drive interchange. This advisory group was comprised of a range of stakeholders with strong interests in the design and operation of this interchange, including TriMet, the Oregon Department of Transportation, the City of Portland, the Port of Portland, trucking and distributions companies, the Audubon Society, nearby property owners such as Diversified Marine and the Metropolitan Exposition Recreation Commission, and community members from the surrounding Bridgeton, Kenton, and East Columbia neighborhoods.

Working with this advisory group, the CRC project team analyzed the traffic operations, property impacts, and potential environmental effects for a range of interchange designs. The Marine Drive interchange design included in the LPA and analyzed in this FEIS was developed in collaboration with this stakeholder advisory group to balance many competing interests, including freight mobility, property impacts to the Expo Center and other nearby properties, financial considerations, and environmental effects.

The specific changes from the DEIS to the current LPA are: a smaller footprint for the overpass structure; North Vancouver Way is extended to connect to the local bridge to/from Hayden Island; the Marine Drive-I-5 N flyover and MLK to I-5 N direct connection are deferred (these movements can still be made, but the direct connections are deferred, as described in Cost Reduction/Saving Measures below) (See Exhibit A – Marine Drive Interchange)

The design included in the LPA is within the range of impacts of the options analyzed in the DEIS.

The process to develop the current design of the Marine Drive interchange was prior to the process to develop LPA Option A. However, due to the proximity and overlap of the improvements in the Marine

Drive interchange and Option A it is not feasible to separate the environmental impacts, therefore impacts in the Marine Drive, North Portland Harbor, and Hayden Island areas are included with Option A in the *Change in Impacts* matrix at the end of this document.

Number of Lanes on the River Crossing

The DEIS evaluated highway alternatives with cross-sections ranging from 8 to 12 lanes at the river crossing. Following the July 2008 adoption of the LPA, the Project Sponsors Council (PSC) met several times to discuss the number of lanes, noting concerns and interests about this design element of the project. The discussion included how the number of add/drop lanes relates to safety and mobility, traffic diversion, greenhouse gases, and congestion; how they might indirectly affect traffic demand and land use; and the need to build this bridge to meet long-term regional needs.

On August 9, 2010, the PSC voted unanimously to recommend that the replacement bridges be constructed with 10 lanes and full shoulders to provide for safe operations between interchanges and efficient movement of people and goods. Three lanes on each bridge would be through lanes for traffic traveling through the project area, while the additional lanes on each bridge would be add/drop lanes that would accommodate traffic entering or exiting I-5 at one of the several closely spaced interchanges immediately north and south of the river.

The current LPA (10 lanes) is within the range reported in the DEIS (8-12 lanes) and traffic performance on the I-5 mainline is within the range reported in the DEIS.

Number of Bridges over the Columbia River

The DEIS evaluated a two-bridge design and a three-bridge design over the Columbia River for the replacement crossing. The three-bridge design included (from east to west) a bridge for northbound I-5 traffic, a bridge for southbound I-5 traffic, and a third bridge for light rail with a separated pathway for bicyclists and pedestrians. A two-bridge design included the two bridges for north and southbound I-5 traffic, with light rail, bicyclists, and pedestrians traveling underneath the decks of these bridges.

Several advantages of the two-bridge design were identified in the DEIS, including fewer piers with less in-water structure, smaller surface area generating less stormwater runoff, and a more compact crossing with less imposing visual obstruction of the river. Additionally, advisory groups and the PSC recommended preference for a two-bridge design. However, the nature of this bridge configuration – operating light rail beneath one highway bridge deck and providing a pedestrian and bicycle path under the other deck, both within the bridge's support structures – is an uncommon design, and required further engineering and evaluation of this design to determine its feasibility. Since the publication of the DEIS, the agencies sponsoring the project have worked with the project's federal lead agencies, FTA and FHWA, and determined that the two-bridge design is feasible. Therefore, the two-bridge design is being carried forward for as the LPA.

The LPA uses a two-bridge design which was included as an option in the DEIS, and the impacts are within the range of impacts reported in the DEIS.

Light Rail Alignment across Hayden Island

The DEIS evaluated two transit alignments across Hayden Island, both on the west side of I-5. One option aligned transit adjacent to the I-5 interchange, and another offset it approximately 450 feet west of the I-5 interchange. Since the publication of the DEIS, the City of Portland completed a separate planning and outreach process that yielded a Hayden Island Plan (City of Portland 2009), which includes a vision for how the incorporated portion of this island should develop and/or redevelop. This plan includes a preference for the light rail transit alignment adjacent to the I-5 interchange. The LPA design includes the adjacent transit alignment on Hayden Island.

The LPA uses an alignment from the DEIS, and impacts are within the range of impacts reported in the DEIS.

Light Rail Alignment in Downtown Vancouver
The DEIS evaluated two transit alignment options through downtown Vancouver – two-way travel on Washington Street, or a couplet with northbound travel on Broadway Street and southbound travel on Washington Street. Following the adoption of the LPA in the summer of 2008, the project formed the Vancouver Working Group (VWG), composed of residents, business owners, transit-dependent populations, and commuters in the Vancouver area. This group met regularly to provide feedback, invite public input, and develop recommendations to the CRC project team, City of Vancouver, and C-TRAN on preferred transit alignments and proposed station locations. Project staff, working with the VWG, identified several advantages of the couplet, including better support for development potential in downtown and the ability to accommodate more uses on these streets than could be afforded with a two-way transit guideway on Washington Street. On March 19, 2009, the VWG voted to recommend that light rail run on the couplet on Washington and Broadway Streets through downtown Vancouver.

The LPA uses an alignment from the DEIS, and the impacts are within the range of impacts reported in the DEIS.

Light Rail Alignment East-west to Clark College
The light rail alignment east-west to Clark College was addressed in a separate re-evaluation in April 2010.

Cost Reduction/Saving Measures
Since the publication of the DEIS, it has become increasingly evident that there will likely not be adequate funding to construct all elements of the LPA in a single phase. This compelled the project sponsors to identify ways to reduce project costs and/or to phase construction. The project team, working with stakeholder groups, identified several elements of the project design that could be modified or postponed to reduce construction costs. These would reduce or delay some of the project benefits but would still allow the project to meet the purpose and need.
These cost reduction measures include:

- *Retain the existing North Portland Harbor bridge*: This would utilize the existing North Portland Harbor bridge for mainline I-5 traffic. By reusing the existing bridge, the freeway across Hayden Island would be shifted slightly east from the designs evaluated in the DEIS. This shift changes some impacts on the island; these are discussed as part of LPA Options A and B.

- *Lower the Hayden Island interchange onto fill and retaining walls*: The DEIS alternatives assumed the Hayden Island interchange ramps and freeway mainline would be on fill. However, after the DEIS, the project team investigated the option of supporting the interchange on structures. That option would be more expensive and was not forwarded to the FEIS.

- *Eliminate one proposed northbound add/drop lane on I-5 from SR 14 to SR 500*: The connection from SR 14 to the I-5 northbound CD would be one lane rather than two lanes. This slightly reduces cost, actually provides for a smoother transition on the CD by reducing the number of merging movements, and provides preference to the I-5 traffic. The result is one less add/drop lane on northbound I-5 between the SR 14 and the SR 500 interchanges. The structures over I-5 and the retaining walls on either side of I-5 would be constructed to allow this additional lane in the future, but this lane would not be built as part of the project. The acquisitions required for this ROW were included in the DEIS so the LPA is within the range of impacts reported in the DEIS.

- *Defer northern improvements to the SR 500 interchange*: This would defer the northernmost I-5 improvements so that they would not be constructed in the initial project phase but could be constructed at some unknown date in the future. This would retain the existing freeway-to-freeway connection at the I-5/SR 500 interchange (I-5 northbound to SR 500 westbound, and SR 500 westbound to I-5 southbound). No added impacts would result.
- *Defer I-5 to Victory Boulevard braided ramp*: This would retain the existing connections between I-5 southbound and Victory Boulevard. The braided ramp connection could be constructed separately in the future as funding becomes available. No added impacts would result.
- *Defer the flyover connection at the Marine Drive interchange*: This would defer the direct connection provided by a flyover ramp between eastbound Marine Drive and I-5 northbound. The CRC project improvements to the interchange would instead provide connection through a signal-controlled intersection. No added impacts would result.

It is important to note that the final three cost-reduction measures that defer certain elements of the project may or may not be funded with construction of the first phase of the LPA. These elements would be included if funding is available, but this will not be known until closer to the time of construction when financing for the project is secured. The likely effects of the project both with and without these potentially deferred elements are compared in the FEIS. Analysis of the LPA assuming that these three elements would be deferred is referred to in the FEIS as "the LPA with highway phasing." For the purpose of this re-evaluation the impacts that would be deferred are still included in the total impacts from the LPA and are reported herein.

Bridge Type

The DEIS did not specify a bridge type but instead described the bridge in terms of dimensions, vertical clearances, alignment, piers and similar descriptions of the footprint and three dimensional envelope. The LPA has specified that the bridge will be a composite truss. This change is addressed in the Composite Truss Re-evaluation submitted in March 2011.

SR 14 Interchange

The DEIS reported two options for the SR 14 interchange replacement crossing – Left Loop and Dual Loop. The LPA is a slightly modified version of the Dual Loop. The LPA removed the tunnel from southbound I-5 to eastbound SR 14, accommodating that movement at-grade. There would be no change in impacts (transportation, acquisition or other), from the tunnels now proposed as at-grade. Local street improvements in the LPA include roundabouts and a realignment of Columbia Way to the west of the interchange. The current LPA also includes a surface parking lot within the loop ramp on the west side of the interchange for parking mitigation. The loop ramp on the east side of the interchange has been shifted to the west to reduce impacts to the Vancouver National Historic Reserve (VNHR). The SR 14 westbound to I-5 northbound ramp has been reduced from two lanes to one, reducing impacts to the VNHR (See Exhibit D – SR 14 Interchange).

The roundabouts and realignment of Columbia Way have evolved through coordination with the City of Vancouver. As modeled, the roundabouts at the connections to SR14 function more efficiently than conventional intersections and are more supportive of the City's vision for waterfront connectivity and circulation. The roundabouts along Columbia Way complement the operations but are not necessarily critical to the operations of the roundabouts connecting to SR14. Other intersection types along Columbia Way are being considered and continue to be developed in coordination with the City of Vancouver.

The change in design resulting from the roundabouts has increased partial acquisitions on two parcels currently used as a surface parking lot. The realignment of Columbia Way and the surface parking lot

have not changed environmental impacts. Acquisition impacts to the VNHR have been reduced from the realignment of the east loop and the redesign of the SR 14 to I-5 ramp.

Fourth Plain Interchange

The DEIS showed two intersections on the east side of I-5 at the Fourth Plain Interchange, one at Fourth Plain Boulevard and one to the south of Fourth Plain regulating on and off-ramps. The LPA would have one intersection at Fourth Plain Boulevard (See Exhibit F – Fourth Plain Interchange). This design change was made to reduce costs and to improve intersection functionality. This change would result in nominal change in ROW acquisition and would not change displacements or other environmental impacts.

SR 500 Interchange

The SR 500 interchange in the LPA would be similar to the DEIS. The tunnels in the DEIS from southbound I-5 to Fourth Plain would be a three-span bridge structure (overpass) in the LPA. There would be minimal change in aesthetics and net decrease in acquisitions and no change in other impacts (transportation, displacement or other), from the change in design (See Exhibit G SR 500 Interchange).

Community Connector

The community connector was reported as a potential mitigation measure in the DEIS. The general location was described in the DEIS as between Evergreen Boulevard and 5th Street. Since publication of the DEIS, the general shape, position and location have been conceptually developed. Acquisition, Historic/Archeological, and 4(f) impacts have been identified and are included in the *Change in Impacts* matrix. The connector would have a positive effect on Land Use, Neighborhoods and Visual. The community connector results in additional acquisition of property from the VNHR than would be required without the connector. However, overall there is a net decrease in property acquisition from the VNHR from the DEIS to the LPA. The property acquisition from the VNHR, including acquisition around the Barracks Hospital, result in a 4(f) use, but the LPA would result in a 4(f) use even without the community connector.

Multi-Use Path

The refinements to the multi-use path concept since the DEIS are the result of on-going coordination with the two cities and the pedestrian bicycle advisory committee. In the DEIS the path was conceived to connect near 5th Street on the Washington side. The length needed to connect varied based on whether the river crossing was 3-bridge or 2-bridge. The path in the 2-bridge option was at a lower elevation (below the bridge deck) so it needed less length to touch down in Vancouver. The touchdown for the 2-bridge design option for Alternatives 2 and 3 was near the Columbia Park and Ride. The path on the 3-bridge option was at a higher elevation (on the bridge deck) and therefore needed a switch back at the touchdown to provide the additional length needed to reach ground level. Through the coordination work with the stakeholders, the current path has been designed to be under the north bound highway bridge deck. The connection to Vancouver is by way of a loop down to the waterfront connecting at Columbia Street which is the existing designated north-south bike route in downtown Vancouver and it connects near the waterfront trail (See Exhibit D – SR 14 Interchange).

In Oregon a similar coordination process has occurred. The multi-use path was conceived in the DEIS to be west of the LRT alignment with options to connect down to Hayden Island with ramps, loops and stairs. In the LPA, the path is located on the east side of the LRT alignment. It includes a loop down to Hayden Island drive with ramps and stairs connecting at the LRT station. The location of the path as it crosses Hayden Island and the location of the Oregon connections will continue to be refined through coordination with the City of Portland, PBAC and the public (See Exhibits A. B and C)

The LPA would still have some out of direction travel and at least one at-grade crossing, but would result in better connectivity, fewer at-grade crossings, and less out of direction travel than reported in the DEIS. There would be no meaningful change in impacts from the DEIS alternatives.

Construction Buffer in North Portland Harbor
Since publication of the DEIS, the temporary construction buffer for in-water work in North Portland Harbor was increased from 20 feet to 50 feet, in order to ensure safety and allow sufficient space for necessary construction machinery. Expanding the temporary construction buffer will require displacing additional floating homes that are located too close to the proposed structures to maintain safety. This change applies to all of the alternatives in the DEIS as well as the LPA Options A and B. The changes in impacts are addressed in Option A in the *Change in Impacts* matrix.

HAVE ANY NEW OR REVISED LAWS OR REGULATIONS BEEN ISSUED SINCE APPROVAL OF THE LAST ENVIRONMENTAL DOCUMENT THAT AFFECTS THIS PROJECT? If yes, please explain.

☐ **NO**
☒ **YES**

Yes, FHWA published a final rule updating 23 CFR 772 on "PROCEDURES FOR ABATEMENT OF HIGHWAY TRAFFIC NOISE AND CONSTRUCTION NOISE" on July 13, 2010.

IS THE LIST OF THREATENED AND ENDANGERED SPECIES (NMFS AND USFWS) MORE THAN 6 MONTHS OLD?
☒ **NO**
☐ **YES (STOP! Endangered Species lists and analysis MUST be updated.)**

WILL THE NEW INFORMATION HAVE THE POTENTIAL TO CAUSE A CHANGE IN THE DETERMINATION OF IMPACTS FROM WHAT WAS DESCRIBED IN THE ORIGINAL ENVIRONMENTAL DOCUMENT FOR ANY OF THE AREAS LISTED BELOW? For each impact category, please indicate whether there will be a change in impacts. For all categories with a change, continue to the table at the end of this worksheet and provide detailed descriptions of the impacts as initially disclosed, new impacts and a discussion of the changes. The change in impact may be beneficial or adverse.

Transportation	☒ **Yes**	☐ **No**
Land Use and Economics	☒ **Yes**	☐ **No**
Acquisitions, Displacements, & Relocations	☒ **Yes**	☐ **No**
Neighborhoods & Populations (Social)	☒ **Yes**	☐ **No**
Visual Resources & Aesthetics	☒ **Yes**	☐ **No**
Air Quality	☐ **Yes**	☒ **No**
Noise & Vibration	☒ **Yes**	☐ **No**
Ecosystems (Vegetation & Wildlife)	☒ **Yes**	☐ **No**

Water Resources	☒ **Yes**	☐ **No**
Energy & Natural Resources	☐ **Yes**	☒ **No**
Geology & Soils	☐ **Yes**	☒ **No**
Hazardous Materials	☒ **Yes**	☐ **No**
Public Services	☐ **Yes**	☒ **No**
Utilities	☐ **Yes**	☒ **No**
Historic, Cultural & Archaeological Resources	☒ **Yes**	☐ **No**
Parklands & Recreation	☒ **Yes**	☐ **No**
Construction	☒ **Yes**	☐ **No**
Secondary and Cumulative	☐ **Yes**	☒ **No**

Will the changed conditions or new information result in revised documentation or determination under the following federal regulations?

Endangered Species Act	☐ **Yes**	☒ **No**
Magnuson-Stevens Act	☐ **Yes**	☒ **No**
Farmland Preservation Act	☐ **Yes**	☒ **No**
Section 404-Clean Water Act	☐ **Yes**	☒ **No**
Floodplain Management Act	☐ **Yes**	☒ **No**
CERCLA (Hazardous Materials)	☐ **Yes**	☒ **No**
Section 106 National Historic Preservation Act	☐ **Yes**	☒ **No**
Uniform Relocation Act	☐ **Yes**	☒ **No**
Section 4(f) Lands	☐ **Yes**	☒ **No**
Section 6(f) Lands	☐ **Yes**	☒ **No**
Wild & Scenic Rivers	☐ **Yes**	☒ **No**
Coastal Barriers	☐ **Yes**	☒ **No**
Coastal Zone	☐ **Yes**	☒ **No**
Sole Source Aquifer	☐ **Yes**	☒ **No**
National Scenic Byways	☐ **Yes**	☒ **No**
Other: Marine Mammal Protection Act	☐ **Yes**	☒ **No**

If you checked yes to any of these, describe how the changes impact compliance and any actions needed to ensure compliance of the new project: There have been changes (reductions) in impacts to Section 106 resources, Section 4(f) resources and Section 6(f) lands since the DEIS, but these have already been included in the current Section 106 documentation, the current Section 4(f) Evaluation and Section 6(f) documentation. There have also been changes relevant to the Endangered Species Act and the Marine Mammal Protection Act but these are covered by the existing Biological Opinion and the

information submitted for MMPA compliance. Future Section 404, Magnuson-Stevens Act, CERCLA and other regulatory documentation will capture the most current impacts at the time of submitting permit applications or approvals.

Will these changes or new information likely result in substantial public controversy?
☐ **Yes** ☒ **No**

Comments: There is substantial public controversy regarding the project but the changes covered in this re-evaluation do not meaningfully affect the controversial elements or add new controversy. Many of these changes were made specifically to address public concerns and reduce controversy.

COMMENTS:

CONCLUSIONS AND RECOMMENDATIONS: As shown in this re-evaluation, impacts associated with the current LPA are generally within the range of impacts reported in the DEIS. Many of the project changes made since the DEIS are in response to public comments through the NEPA process and are in coordination with local officials and the public. Many impacts have been reduced through the LPA refinements. Some of the project refinements or new information result in slightly higher impacts, but none of these would be new significant impacts. The project refinements do not affect any regulatory approvals already received (namely, the Biological Opinion) and they have already been addressed or are being incorporated into on-going documentation for compliance with other environmental regulations (such as Section 106, Section 4(f) and Section 6(f)). Because of these facts, the CRC recommends that the Final EIS would be the appropriate next step in the NEPA process for the current LPA.

LIST OF ATTACHMENTS:

Footprint of DEIS vs. LPA
Project Area Map
Exhibit A: Marine Drive Interchange
Exhibit B: Hayden Island Interchange
Exhibit C: North Portland Harbor
Exhibit D: SR 14 Interchange
Exhibit E: Vancouver Light Rail
Exhibit F: Fourth Plain Interchange
Exhibit G: SR 500 Interchange
Exhibit H: LPA Option A/Option B Marine Drive
Exhibit I: LPA Option A/Option B Hayden Island

SUBMITTED BY:
By signing this, I certify that to the best of my knowledge this document is complete and accurate.

Name Hank Wu Title Environmental Manager	Date 5/19/11

Submit two paper copies of this form, attachments, and a transmittal letter recommending a NEPA finding to the address below. Submit an electronic version to your area FTA Community Planner and FHWA Project Manager. Contact FTA or FHWA at the number below if you are unsure who this is or if you need the email address. Modifications are typically necessary. When the document is approved, FTA and FHWA may request additional copies.

Federal Transit Administration, Region 10 915 2nd Avenue, Suite 3142 Seattle, WA 98174-1002	phone: (206) 220-7954 fax: (206) 220-7959
Federal Highway Administration Oregon Division 530 Center Street NE., Suite 100 Salem, OR 97301	phone**: (**503) 399-5749 fax: (503) 399-5838
Federal Highway Administration Washington Division 711 S. Capitol Way, Suite 501 Olympia, WA 98501	phone: (360) 753-9480 fax: (360) 753-9889

Impact Category	Impacts as Initially Disclosed	New Impacts	Change in Impacts

This matrix describes the environmental impacts from the current LPA and as reported in the DEIS. Total impacts from the current LPA are evaluated and compared to the range of impacts reported in the DEIS. The current LPA is similar to DEIS Alternative 3 (replacement bridge with light rail and the Clark College MOS). Where the range of impacts associated with Alternative 3 or the Clark College MOS differ than the total range of impacts reported in the DEIS the range of impacts from Alternative 3 and/or Clark College MOS is reported in parentheses, below. Where applicable, the main project design changes (LPA Option A/Option B) are listed individually and the relevant change in impacts are described.

The matrix below describes the differences in total impacts between the FEIS LPA and the DEIS alternatives, and between LPA Option A specifically and the DEIS alternatives. There is no discussion of the LPA Option B differences because (1) LPA Option B is not the preferred option and (2) LPA Option B would have no additional impacts beyond those described below for the FEIS LPA, LPA Option A and the DEIS alternatives.

Design changes with few or no changes in environmental impacts are described in the narrative above. *Note: the total change in impacts is the sum of all changes in impacts across the whole project, including the main project changes and all other changes not listed below.*

Impact Category	Impacts as Initially Disclosed	New Impacts	Change in Impacts

Impact Category	Impacts as Initially Disclosed	New Impacts	Change in Impacts
Transportation	**Total** ***Vancouver Local Street Performance:*** The DEIS reported a range of local street performance depending on alternative. 76 intersections analyzed in the DEIS. *2030 AM peak* - up to 20 intersections would degrade from No-Build conditions and operate unacceptably *2030 PM peak* - up to 14 intersections would degrade from No-Build conditions and operate unacceptably (The DEIS reported that Alternative 3 would have up to 9 intersections)	**Total** ***Vancouver Local Street Performance:*** 92 intersections analyzed in FEIS. *2030 AM peak* *LPA:* - 1 intersection would degrade from No-Build conditions and would operate unacceptably. *LPA with highway phasing:* - 2 intersections would degrade from No-Build conditions and would operate unacceptably. *2030 PM peak* *LPA:* - 3 intersections would degrade from No-Build conditions and would operate unacceptably. *LPA with highway phasing:* - 6 intersections would degrade from No-Build conditions and would operate unacceptably Overall, both the LPA and LPA with highway phasing would improve local street operations in Vancouver in comparison with 2030 No-Build conditions.	**Total** ***Vancouver Local Street Performance:*** The number of intersections operating unacceptably in the FEIS is within the range reported in the DEIS.

Impact Category	Impacts as Initially Disclosed	New Impacts	Change in Impacts
	Portland Local Street Performance: 37 intersections analyzed in the DEIS. *2030 AM peak* - up to 2intersections would degrade from No-Build conditions and operate unacceptably (Alternative 3 would have 1 intersection) *2030 PM peak* - up to 8 intersections would degrade from No-Build conditions and operate unacceptably (Alternative 3 would have 1 intersection) ***On-Street Parking:*** The DEIS reported up to 325 on-street parking spaces removed from Vancouver. (The Clark College MOS would have up to 197 parking on-street spaces removed from Vancouver.) ***Access Impacts:*** The DEIS reported that up to 31 access points could be lost from Vancouver for the Clark College MOS.	***Portland Local Street Performance:*** 38 intersections analyzed in FEIS. *2030 morning peak* *LPA & LPA with highway phasing:* - 1 intersection would fail to meet standards. *2030 afternoon/evening peak* *LPA & LPA with highway phasing:* - no intersections would fail to meet standards. ***On-Street Parking:*** The LPA would remove 422 on-street parking spaces from Vancouver. ***Access Impacts:*** The LPA would remove 33 access points.	***Portland Local Street Performance:*** The number of intersections operating unacceptably in the FEIS is within the range reported in the DEIS for Alternative 3. ***On-Street Parking:*** The number of on-street parking spaces removed from the maximum number reported in the DEIS for any transit alignment to the current LPA has increased by 97. The number of on-street parking spaces removed from the maximum number reported in the DEIS for the Clark College MOS to the current LPA has increased by 225. ***Access Impacts:*** The LPA would impact 2 more access points than reported in the DEIS.

Impact Category	Impacts as Initially Disclosed	New Impacts	Change in Impacts
	Park and Rides: The DEIS reported up to 8 park and ride facilities with up to 3220 spaces and up to 3385 trips generated (AM and PM peak). The locations, number of spaces, and total trips generated (AM and PM peak) of the eight park and rides (park and rides in the current LPA are in **bold**): • **Clark College**, bounded by I-5, McLoughlin and Clark College (1100 spaces, 1440 trips) • **Mill Plain**, bounded by Washington, Main, 15th and 16th (460 spaces, 485 trips) • **Columbia**, bounded by Washington, Columbia, 4th, and 5th ***and*** 3 surface lots bounded by 5th, railroad tracks, I-5 and Columbia (1070 trips) • Kiggins Bowl (N/A) • 39th and Main (N/A) (The Clark College MOS would have two park and ride facilities with about 1,300 parking spaces: a surface lot at Kiggins Bowl [160 trips] and a parking structure at Clark College [1440 trips].) *Note that the trips generated of each individual park and ride do not sum to the "total" trips generated because the*	***Park and Rides:*** In the LPA there is a total of 3 park and rides with 2900 spaces and 3025 trips generated (AM and PM peak). The locations, number of spaces, and total trips generated (AM and PM peak) of the three park and rides: • Clark College, bounded by I-5, McLoughlin, and Clark College (1910 spaces, 2005 trips) • Mill Plain, bounded by Washington, Main, 15th and 16th (420 spaces, 430 trips) • Columbia, bounded by Washington, Columbia, 5th, and half the block of between 3rd and 4th (570 spaces, 590 trips)	***Park and Rides:*** The number of park and rides is within the range that was reported in the DEIS. The total number of spaces and trips generated are within the range reported in the DEIS. The LPA would have more spaces at Clark Park and Ride, but fewer at Columbia Park and Ride. The Clark Park and Ride is in essentially the same location as evaluated in the DEIS but the design has been revised to reduce 4(f) resource impacts on the adjacent parcel. Two locations were identified in the DEIS for the Mill Plain Park and Ride. The current location of the park and ride is one of the locations from the DEIS. The chosen location is currently a vacant block and will reduce business impacts as well as enhance accessibility for park and ride users. The location of the Columbia Park and Ride is the same as evaluated in the DEIS, however the footprint of the park and ride has expanded by half a block, adding one additional building displacement (addressed in acquisitions and displacements, below). (The LPA would provide more parking spaces and structures than what was reported in the DEIS for the Clark College MOS)

Impact Category	Impacts as Initially Disclosed	New Impacts	Change in Impacts
	park and rides were designed to different sized in the DEIS depending on alignment and segment options. ***Transit Operation and Maintenance Cost:*** DEIS reported an annual operating and maintenance cost of up to $114.4 million (for combined light rail and bus service). Costs are estimated at $70 million for the No-Build (2007 dollars). ***Pedestrian and Bicycle:*** The DEIS reported a range of bicycle and pedestrian improvements and impacts depending on the alternative. The most substantial changes proposed in the DEIS are described below. From Portland, the existing bike/ped access on the east side of the existing bridge across North Portland Harbor would be removed and users would be required to travel out of direction to access the new pathway along the high-capacity transit alignment. On Hayden Island, the new pathway would require users to exit the path and travel at-grade. Crossing the Columbia River with the	***Transit Operation and Maintenance Cost:*** LPA annual operating and maintenance cost of about $76 million (for combined light rail and bus service). These costs compare with a current annual operating cost of nearly $66 million, and $70 million for the No-Build (2007 dollars). ***Pedestrian and Bicycle:*** The LPA would require out of direction travel to the arterial bridge on the west side of the NPH bridges. The pathway would cross the light rail tracks and arterial bridge roadway at-grade. The multi-use pathway (MUP) across Hayden Island would be entirely grade-separated from vehicle traffic. Access to the multi-use path would be via stairs, a ramp, or potentially an elevator. Over the river, the MUP would be under the deck of the northbound traffic. Access to the MUP from downtown Vancouver would be by a ramp and either stairs or elevator.	***Transit Operation and Maintenance Cost:*** The O & M costs are within the range of those reported in the DEIS. ***Pedestrian and Bicycle:*** The LPA would still have some out of direction travel and at least one at-grade crossing, but would result in better connectivity, fewer at-grade crossings, and less out of direction travel than reported in the DEIS.

Impact Category	Impacts as Initially Disclosed	New Impacts	Change in Impacts
	2-bridge option the MUP would be under the deck of southbound traffic and could have the MUP travel through at-grade intersections. Connections consisting of ramps, stairs, or elevators would connect with existing and planned sidewalks and pathways in Vancouver, Hayden Island and near Marine Drive.		

Impact Category	Impacts as Initially Disclosed	New Impacts	Change in Impacts
	Option A Area ***Local Street Performance:*** The replacement crossing would include auxiliary lanes directly connecting Hayden Island and Marine Drive, but the supplemental crossing would not. With a supplemental crossing, all vehicle trips between Hayden Island and Marine Drive would need to travel on I-5 to either Vancouver or Victory Boulevard and turn around. The supplemental crossing would degrade intersection operations in the Marine Drive and Hayden Island areas. The replacement crossing would improve intersection operations in the Marine Drive and Hayden Island areas, with only one intersection operating unacceptably.	**Option A** ***Local Street Performance:*** For LPA Option A, all vehicle trips between Hayden Island and Marine Drive would be on the arterial bridge separate from I-5. Portland's local street operations would improve, or perform no worse than the No-Build, for all intersections associated with Option A.	**Option A** ***Local Street Performance:*** LPA Option A would result in local access between Hayden Island and Marine Drive on an arterial bridge separate from the I-5 mainline. All intersections associated with Option A would improve or perform no-worse than the No-Build. The impacts from Option A are within the range of the level of impacts reported in the DEIS for the replacement bridge crossing.

Impact Category	Impacts as Initially Disclosed	New Impacts	Change in Impacts
	Pedestrian and Bicycle: The supplemental and replacement options would remove the current bike/ped access on the east side of the existing bridge and require users to travel out of direction to access the new pathway along the high-capacity transit alignment. The DEIS reported that with the supplemental option, the new pathway could require users to exit the path and travel at-grade on Hayden Island. On Hayden Island, the replacement option would be entirely grade separated.	***Pedestrian and Bicycle:*** LPA Option A would require out of direction travel to the arterial bridge on the west side of the NPH bridges. The pathway would cross the light rail tracks and arterial bridge roadway at-grade. The multi-use pathway across Hayden Island would be entirely grade-separated from vehicle traffic.	***Pedestrian and Bicycle:*** LPA Option A would still result in out of direction travel and at least one at-grade crossing, the within the range reported in the DEIS.
	Temporary Effects: Local Traffic During construction of the replacement crossing, staging the construction of the North Portland Harbor structure would be the main issue at the Hayden Island interchange. Restricted lane widths, loss of existing auxiliary lanes, and associated loss of capacity would likely expand the hours of congestion and lower the level of service during other heavily traveled times of day.	***Temporary Effects: Local Traffic*** For Option A construction staging would cause increased congestion on traffic between Hayden Island and Marine Drive, until the arterial bridge is opened for traffic.	***Temporary Effects: Local Traffic*** LPA Option A would result in increased congestion during construction, the same as reported in the DEIS. Option A has the potential to reduce temporary traffic impacts if the arterial bridge opens for traffic while construction on the I-5 mainline is still being completed.

Impact Category	Impacts as Initially Disclosed	New Impacts	Change in Impacts
	Temporary Effects: Bike/Ped On Hayden Island, once construction of the North Portland Harbor Bridge begins, it would be necessary to eliminate the current bike path. The transit crossing of the harbor to accommodate non-motorized travel would ideally be finished before this closure. Construction of the interchange and crossing could be delayed approximately 13 months and not delay the overall completion of the interchange, which would allow for this sequencing. If this is not feasible then a shuttle or construction of a temporary structure may be possible, but could present access issues.	***Temporary Effects: Bike/Ped*** Bike/ped detour routes would require temporary out-of direction travel.	***Temporary Effects: Bike/Ped*** LPA Option A would result in bike/ped detours but would keep the NPH crossing open. This is less impact than the greatest impact reported in the DEIS, which was a temporary structure or shuttle across NPH.

Impact Category	Impacts as Initially Disclosed	New Impacts	Change in Impacts
Land Use and Economics	**Total** Direct land use impacts ranged from minor to moderate depending on DEIS Build Alternative; commercial impacts ranged from moderate to high; impacts to regional economy ranged from moderately to highly beneficial (Alternative 3 was reported as highly beneficial); consistency with local plans ranged from low to high consistency (Alternative 3 was reported as high consistency); and increased TOD potential ranged from low to high (Alternative 3 was reported as moderate to high TOD potential). Total number of employees impacted by commercial displacements reported for Alternative 3 ranged, with a maximum reported of 565. Total annual sales impact for Alternative 3 ranged, with a maximum of $112 million. Property tax impacts ranged, with a maximum of $240,000.	**Total** Direct land use impacts would be minor; commercial impacts would be moderate; impacts to regional economy would be highly beneficial; LPA would be consistent with local plans; and increased TOD potential would be moderate. The total number of employees impacted by commercial displacements would be 916; total annual sales impact would be $103.6 million, and property tax impacts would be $267,600.	**Total** Direct land use impacts, commercial impacts, impacts to the regional economy, plan consistency, and increased TOD potential are all within the reported DEIS ranges. The LPA would have more employees impacted by commercial displacements than the DEIS alternatives (including Alternative 3). The increase in business displacements and consequently, number of employees impacted by displacements and property tax impacts, is due to design refinements, new information about existing uses, and an increase in area assumed for construction safety and staging activities. Total annual sales impact is within the range of the DIES.

Impact Category	Impacts as Initially Disclosed	New Impacts	Change in Impacts
	Option A Area [The Hayden Island Plan had not been created at publication of the DEIS] The DEIS reported that in the Marine Drive interchange area the project would displace up to 5 businesses with up to 85 employees and up to $14.8 million in annual sales. On Hayden Island, 29 businesses with 430 employees and $56 million in annual sales would be displaced (DEIS Economics Tech Report).	**Option A** The Hayden Island Plan states that *"the CRC project must provide the capability to access local street systems south of North Portland Harbor without using the freeway."* Option A would meet this aspect of the Plan. Option A would provide vehicular access between Marine Drive and Hayden Island on an arterial bridge. In the Marine Drive interchange area, 5 businesses with 25 employees and $10.6 million in annual sales would be displaced with Option A. On Hayden Island, 39 businesses with a total of 643 employees and $62.7 million in annual sales would be displaced.	**Option A** Option A is consistent with the Hayden Island Plan by providing local access to and from Hayden Island separate from the I-5 mainline. The increase in business displacements from the DEIS to the current design (with either Option A or Option B) is not due to the addition of Option A to the LPA. The increase in business displacements is due to other design refinements, new information about existing uses, and an increase in area assumed for temporary construction activities. Either LPA Option A or B (and the DEIS alternatives) would require more business displacements than assumed in the DEIS.

Impact Category	Impacts as Initially Disclosed	New Impacts	Change in Impacts
Acquisitions, Displacements, & Relocations	**Total** The DEIS identified 301 parcels totaling over 73 acres that could be impacted by full or partial acquisitions (From DEIS Appendix D). The DEIS identified 57 residences that could be displaced and up to 68 businesses that could be displaced (From DEIS Appendix D). (The DEIS reported that Alternative 3 would require acquiring up to 46 acres of land; would displace 36 residences--including up to 20 floating homes; and up to 41 businesses.	**Total** The LPA would have 202-214 parcel acquisitions (73 full and 129-141 partial). Total area acquired would be 89-91 acres. The LPA would have 57 residential displacements and 69-70 business displacements.	**Total** The number of parcels acquired and residences and businesses displaced is within the range described in the DEIS. The LPA would result in a greater number of residential and business displacements than reported for Alternative 3 in the DEIS. Changes in specific acquisitions and displacements are due to design refinements, new information about existing uses, and an increase in short-term acquisitions assumed necessary for construction safety, staging and other activities. A large number of the displacements are on Hayden Island. The public process used to develop the current interchange design option on Hayden Island considered environmental impacts, including acquisitions and displacements, and provided many opportunities for the public to comment on these changes. The option preferred by the public (LPA Option A) was unanimously approved by the CRC Project Sponsors Council, made up of local officials, and is now included in the FEIS as the preferred option. In addition, the project increased the assumed safety buffer for constructing the North Portland Harbor bridges, which results in temporarily displacing additional floating homes from

Impact Category	Impacts as Initially Disclosed	New Impacts	Change in Impacts
			North Portland Harbor. *Additional displacements:* Through discussions with a business owner since publication of the DEIS it was determined that the side-running couplet would restrict access and displace one business (a funeral home) and two residential apartments above the business.
	Option A Area The DEIS reported a range of impacts depending on the alternative. Around the Marine Drive Interchange, up to 5 businesses would be displaced. On Hayden Island, up to 29 businesses would be displaced. In North Portland Harbor, up to 27 floating homes were identified as potentially displaced. (Alternative 3 was reported as having up to 20 floating homes impacted)	**Option A** Option A would displace 5 businesses around the Marine Drive Interchange and displace 39 businesses on Hayden Island. LPA Option A (or Option B) would require displacement of 32 floating homes on Hayden Island and 3 floating homes and two on-land residences around the Marine Drive Interchange.	**Option A** The LPA would displace 10 more businesses and 10 more residences (8 floating homes and 2 on-land residences) in the Marine Drive/Hayden Island area than the most identified as displaced in the DEIS. (The LPA would displace 15 more residences than reported in the DEIS for Alternative 3). The increase in acquisitions and displacements from the DEIS to the current design (with either Option A or Option B) is not due to the addition of Option A to the LPA. The increase in acquisitions and displacements is due to design refinements, new information about existing uses, and an increase in area assumed for construction activities. Either LPA Option A or B (or the DEIS alternatives) would require more commercial and residential displacements than assumed in the DEIS.

Impact Category	Impacts as Initially Disclosed	New Impacts	Change in Impacts
	Park and Ride Columbia: The DEIS reported that one city block would be acquired in downtown Vancouver for the Columbia Park and Ride: the block bounded by 4th, 5th, Columbia and Washington. ***Community Connector*** The DEIS reported up to 2.7 acres of property acquisition from the VNHR.	***Park and Ride*** Columbia: The current footprint includes the block bounded by 4th, 5th, Columbia and Washington, which now includes an auto sales business. The footprint has expanded to include the half-block south of 4th, which would displace one office building with 11 small businesses. ***Community Connector*** The LPA would acquire 1.8 acres from the VNHR. The community connector would increase acquisitions from the VNHR compared to if it was not included in the LPA.	***Park and Ride*** Columbia: The auto sales business is located on a property that the DEIS indicated would be a full acquisition. The expanded footprint of the park and ride results in 11 additional business displacements. Most of the businesses that are displaced are very small and located in one building. ***Community Connector*** The LPA is within the range of impacts reported in the DEIS for property acquisitions to the VNHR.

Impact Category	Impacts as Initially Disclosed	New Impacts	Change in Impacts
Neighborhoods & Populations (Social)	**Total** The DEIS reported the displacement of Safeway on Hayden Island. The DEIS reported that the offset transit alignment on Hayden Island could divide the JBMI floating home community. Tolls require higher share of income for low-income populations and could impact these populations without mitigation. The DEIS identified potentially disproportionately high and adverse impacts to EJ populations, but did not make a final determination.	**Total** The LPA would displace the Safeway on Hayden Island. The LPA would not divide the JBMI floating home community but it would displace floating homes at the east end of the facility. The LPA would improve community cohesion in neighborhoods with light rail stations and transit oriented development, but would negatively impact some neighborhoods with displacement of households and commercial resources. Tolling would not be a disproportionately high and adverse impact on Environmental Justice populations. Overall, the project would not have disproportionately high and adverse impacts to EJ populations.	**Total** Impacts to community cohesion and displacement of community resources from the LPA are within the range reported in the DEIS. The FEIS states that tolling would not be a disproportionately high and adverse impact on EJ populations, and, overall, the project would not have disproportionately high and adverse impacts to EJ populations. The DEIS did not make an assertion on whether there would be a disproportionately high and adverse impact on EJ populations. The FEIS refines the information in the DEIS and reports that EJ impacts are not disproportionately high and adverse. Impacts from the LPA to neighborhoods and populations are addressed in the other impact categories of this document (e.g. displacements, air quality, plan consistency, traffic, and noise impacts).

Impact Category	Impacts as Initially Disclosed	New Impacts	Change in Impacts
	Option A Area	**Option A**	**Option A** Impacts reported from the LPA in the FEIS to neighborhoods and populations are not specific to LPA Option A (e.g. displacement of Safeway, impact to community cohesion). Impacts from Option A to neighborhoods and populations are addressed in the other impact categories of this document (e.g. displacements, air quality, plan consistency, traffic, and noise impacts).

Impact Category	Impacts as Initially Disclosed	New Impacts	Change in Impacts
Visual Resources & Aesthetics	**Total** Visual effects from either replacement or supplemental river crossing would result in some views improving and some degrading. The DEIS reported a range of impacts, with the maximum associated with the replacement bridge reported below: *- Burnt Bridge Creek: No or minor impact* *- Vancouver Downtown: New bridge and interchange facilities could degrade view.* *- Columbia River: High-level visual change. Impacts ranged from positive (removal of lift towers to open up views of river) to negative (wider, less uniform bridges).* *- North Portland Harbor: Minor impacts.* *Greater Central Park (except VNHR): Minor impacts* *- VNHR: SR 14 and Mill Plain interchanges would encroach on HBC Village area and degrade views from VNHR.*	**Total** LPA results in some views improving and some degrading. Impacts to the landscape units are reported below: *- Burnt Bridge Creek: No or minor impact* *- Vancouver Downtown: Generally positive impact with removal of lift towers and removal of existing substructure from shoreline* *- Columbia River: Mostly positive impacts with removal of lift tower, truss structures, and visual obstructive piers.* *- North Portland Harbor: Minor impacts. The bridges over NPH would clutter views along the slough and reduce views of open water.* *- Greater Central Park (except VNHR): Moderate impact from SR 14 structures. Other views improve with Community Connector. Overall minor.* *- VNHR: Moderate impacts. Certain views would experience high degree of change. Change in visual context contributes to determination of adverse effect to historic resources.*	**Total** Impacts to visual character and quality from the LPA are within the range reported in the DEIS.
	Option A Area Visual effects would be high from widening and reconfiguring the I-5 bridges over North Portland Harbor, adding a new transit bridge and elevated guideway. The Marine Drive	**Option A** North Portland Harbor would experience moderately negative visual impacts from the addition of piers for the light rail transit bridge and collector/distributor ramps; these	**Option A** Visual effects from LPA Option A would be within the range reported in the DEIS.

Impact Category	Impacts as Initially Disclosed	New Impacts	Change in Impacts
	interchange ramp would be slightly taller, but the overall impact is likely to be low. The Marine Drive Interchange Designs could change the visual character of the Expo Center parking area and the adjacent light rail station. Expanding the Expo Center transit station would not change its existing character. However, the Southern or Diagonal Marine Drive Interchange designs would.	would clutter views along the slough and reduce views of open water.	
Air Quality			Air pollutant emissions are expected to be substantially lower in the future than under existing conditions. On a regional basis, future differences between build and No-build alternatives are small enough not to be meaningful within the accuracy of estimation methods. Based on the hotspot analysis, no violations of NAAQS were shown. There would be no meaningful difference in impacts between the DEIS alternatives and the LPA.
Noise & Vibration	**Total** The DEIS reported, before mitigation, up to 334 highway noise impacts, up to 70 moderate transit noise impacts, up to 51 severe transit noise impacts, and up to 47 transit vibration impacts.	**Total** Before mitigation, the LPA would have up to 332 highway noise impacts, 24 moderate transit noise impacts, 0 severe transit noise impacts, and 15 transit vibration impacts.	**Total** Before mitigation, the LPA would have fewer noise and vibration impacts than reported in the DEIS. After mitigation, the LPA would have the

Impact Category	Impacts as Initially Disclosed	New Impacts	Change in Impacts
	The DEIS reported, after mitigation, that mitigation could potentially reduce traffic noise impacts to 52, but stated that the "number of residual impacts could be higher than 52, depending on final decisions regarding sound walls." The DEIS reported that residential sound insulation could mitigate the noise impacts for all receivers impacted by transit. The DEIS reported that most vibration impacts could be mitigated. The highest vibration impact reported in the DEIS Noise and Vibration Technical Report was that there could possibly be residual vibration impacts between E 19th and E 25th Streets (These vibration impacts are not associated with the Clark College MOS).	After mitigation, the LPA would have 91 highway noise impacts, 0 moderate transit noise impacts, 0 severe transit noise impacts, and 0 transit vibration impacts.	same transit noise and vibration impacts as reported in the DEIS. The LPA would have 91 residual highway noise impacts. The DEIS reported 52, but stated that the number could be higher depending on final decisions (which will occur during Final Design) regarding sound walls. ODOT and WSDOT evaluate the suitability of noise walls based on the criteria of feasibility and reasonableness. 16 potential noise walls were evaluated to determine if they meet these criteria. 11 met the criteria and are included as proposed mitigation. The higher number reported for residual noise impacts is due to refinement in design of the LPA, and the evaluation (based on the criteria above) of potential noise walls to include for mitigation.
	Option A Area Up to 44 residences in NPH would be impacted by bus rapid transit and/or light rail.	**Option A** Option A would have 9 moderate light rail noise impacts on floating homes. There would be no vibration impacts.	**Option A** Option A would have fewer noise impacts than reported in the DEIS.

Impact Category	Impacts as Initially Disclosed	New Impacts	Change in Impacts
Ecosystems (Vegetation & Wildlife)	**Total** *Long-term Effects* The DEIS reported a range of impacts depending on the alternative. With the supplemental bridge option there would be some improvement to the water quality of aquatic habitat but not as much as the replacement option. The supplemental bridge would cause an adverse impact by increasing the number of piers in the water that would provide shade for predatory species. The replacement bridge would have fewer piers in the water and would benefit fish. *Temporary Effects* Cofferdams would displace aquatic habitat. In-water work would increase turbidity. Underwater noise from pile driving and heavy machinery could injure or kill fish.	**Total** *Long-term Effects* The LPA would cause a net loss of shallow water habitat in North Portland Harbor with the construction of new piers in the water. The LPA would provide benefit to water quality of aquatic habitat by greatly decreasing the amount of untreated storm water (as described in *Water Resources* below). The impacts to aquatic habitat from in-water structures would be about the same under the LPA and No-Build—piers in the water would continue to provide shade for predatory species. *Temporary Effects* Cofferdams would temporarily displace aquatic habitat. In-water work has potential to increase turbidity. Construction activities and underwater noise from impact pile driving would injure or kill nearby fish and disturb sea lions. For all construction scenarios, the maximum impact on any of the ESA-listed salmon runs in any given year would be less than one percent of the annual run.	**Total** *Long-term Effects* The LPA would cause a loss of shallow water habitat in North Portland Harbor. Off-site restoration in Oregon and Washington is proposed to mitigate for impacts. The LPA would be within the range of benefits to water quality of aquatic habitat as described in the DEIS. The LPA would have less impacts to aquatic habitat from in-water structures than the supplemental bridge and about the same as the replacement bridge. *Temporary Effects* The LPA is within the range of impacts reported in the DEIS from in-water work.

Impact Category	Impacts as Initially Disclosed	New Impacts	Change in Impacts
	Option A Area The DEIS reported impacts based on replacing the North Portland Harbor bridge, resulting in considerable in-water work.	**Option A** The current LPA is based on retaining the North Portland Harbor bridge, resulting in some in-water work.	**Option A** The current LPA would result in less in-water work in North Portland Harbor than reported in the DEIS.
Water Resources	**Total** The DEIS alternatives would result in up to 249 acres of total impervious surface area. The DEIS alternatives would result in up to 38 acres of untreated impervious surface area.	**Total** The LPA would result in 267 acres of Pollution Generating Impervious Surfaces (PGIS), but would have no acres of untreated PGIS.	**Total** The increase in PGIS for the LPA is a result of a more precise understanding of the project footprint and storm water basins developed since publication of the DEIS. Although the LPA would result in more acres of PGIS than reported in the DEIS, the amount of untreated PGIS is below the amount reported in the DEIS.
	Option A Area	**Option A**	**Option A** The increase in PGIS for the LPA is not a result of Option A, but rather a more precise understanding of the project footprint and storm water basins has been developed since publication of the DEIS. Although the LPA as a whole would result in more acres of PGIS than reported in the DEIS, the amount of untreated PGIS is below the amount reported in the DEIS.
Energy & Natural Resources			No change

Impact Category	Impacts as Initially Disclosed	New Impacts	Change in Impacts
Geology & Soils	**Total** The DEIS reported a range of benefits from the alternatives. All alternatives would improve the bridges' ability to withstand earthquakes and volcanic eruptions. The highest impacts reported in the DEIS were impacts to soils (steep slopes) near Burnt Bridge Creek and the Columbia River and potential impacts to groundwater for park and ride facilities and other excavation. The Troutdale sole source aquifer was identified in the DEIS, and the range of impacts to groundwater would apply to the sole source aquifer. The DEIS reported that continued coordination with EPA will occur to address the review approval process for impacts to the sole source aquifer.	**Total** The LPA would improve the bridges' ability to withstand earthquakes and volcanic eruptions and would have positive benefits on soils (steep slopes, soil erosions, landslides) mineral resources and groundwater resources. The LPA would provide long-term management and treatment of storm water from new and existing surfaces, resulting in improved local groundwater quality, including the groundwater in the sole source aquifer. LPA construction would include best management practices, including obtaining all necessary permits and ongoing monitoring of groundwater by the City of Vancouver, to avoid adverse impacts to the sole source aquifer.	**Total** The LPA is within the range of impacts reported in the DEIS for impacts to geology and soils.
	Option A Area	**Option A**	**Option A** No change in impacts due to Option A
Hazardous Materials	**Total** The DEIS alternatives are associated with up to 200 known hazardous materials sites, including up to 29 high-risk sites. (The Clark College MOS is associated with up to 165 total	**Total** The LPA would result in the acquisition of, or entail easements onto, up to 55 properties identified as hazardous materials sites with recognized environmental conditions,	**Total** The LPA would result in fewer acquisitions/easements of sites with recognized environmental conditions than reported in the DEIS. (The LPA would result in fewer

Impact Category	Impacts as Initially Disclosed	New Impacts	Change in Impacts
	sites and up to 26 high risk sites)	including up to 27 high risk sites.	acquisitions/easements of sites with recognized environmental conditions and slightly higher acquisitions of high risk sites than reported in the DEIS as associated with the Clark College MOS)
	Option A Area	**Option A**	**Option A** No change in impacts due to Option A
Public Services & Utilities	**Total** The DEIS reported a range of impacts depending on alternative. The potential effect of traffic congestion on mobile public services in Vancouver would range from moderate to high; on I-5 it would range from improve to substantially improve traffic congestion (Alternative 3 was reported as "substantially improve"). The potential need to relocate utilities as a result of the transit component would range from low-moderate to high (Alternative 3 ranged from "moderate to high"). The DEIS reported the potential displacement of the ODOT Permit Station and Field Office, FHWA Western Federal Lands Building, WSDOT maintenance facility and Clark Public Utilities building.	**Total** The potential effect of traffic congestion on mobile public services in Vancouver local streets would be moderate; on I-5 the LPA would substantially improve traffic congestion. The potential need to relocate utilities as a result of the transit component is moderate. The LPA would potentially displace the ODOT Permit Station and Field Office and Clark Public Utilities building.	**Total** The LPA would be within the range of impacts reported in the DEIS for public services and utilities.

Impact Category	Impacts as Initially Disclosed	New Impacts	Change in Impacts
	Option A Area	**Option A**	**Option A** No change in impacts from Option A
Historic, Cultural & Archaeological Resources	**Total** The DEIS reported a range of impacts depending on the alternative. The DEIS identified 33 resources that could be impacted by the different alternatives and transit alignments. The DEIS reported a potential impact to up to 14 NRHP-listed or eligible historic properties with any one alternative (up to 13 with the Clark College MOS). The DEIS reported preliminary adverse impacts on up to 8 historic properties (up to 7 with the Clark College MOS). The eight sites with adverse impacts included the three sites described as adversely affected in the FEIS: the 1917 bridge (removed), the Pier 99 building (displaced) and the VNHR. The DEIS reported up to 2.7 acres of acquisitions from the VNHR. The DEIS also reported the following impacts to the VNHR: *Effects to the historic built environment within the VNHR include the construction vibration and visual setting of the Barracks Hospital (both river crossings), small acquisitions*	**Total** The LPA would potentially impact 18 NRHP-listed or eligible historic properties and have adverse impacts to 3. The three sites with adverse impacts are the 1917 bridge (demolished), Pier 99 building (displaced), and the VNHR (partial acquisition, parking/access impact, noise impact, visual impact) The LPA would permanently acquire 1.67 acres and place a permanent easement on 0.16 acre from the VNHR. There would be loss of access to the west side of the Barracks Hospital. The setting associated with the Hospital, and accompanying cultural landscape, would be adversely affected by placing highway facilities and sound walls close to the building. The western and southwestern perimeter portions of the VNHR along I-5 and SR 14 would experience a noise impact negatively affecting the setting and use, though mitigation with sound walls is recommended. There would be a visual impact from the ramp structures adjacent to the HBC Village.	**Total** The LPA would impact fewer historic properties than the number of potential impacts identified in the DEIS. (The LPA would impact 5 more NRHP-listed or eligible historic properties than reported in the DEIS for Alternative 3 with the Clark College MOS). The LPA would have a preliminary adverse impact to 3 sites, fewer than the 8 reported in the DEIS (or 7 for the Clark College MOS). The impacts to the 1917 bridge and Pier 99 building would be the same by the LPA as reported in the DEIS. The impact to the VNHR would be adverse with the LPA and as reported in the DEIS. The amount of property acquired from the VNHR would be less than reported in the DEIS. The impacts to significant archaeological sites were not quantified in the DEIS, but were reported as “high.” The 32 sites impacted by the LPA would fall within the range of impacts in the DEIS.

Impact Category	Impacts as Initially Disclosed	New Impacts	Change in Impacts
	from the most western parking lot of Officer's Row (replacement river crossing), minor acquisitions or potential shading of the Old Apple Tree Park (replacement river crossing), and minor obstructions to Pearson Field's airspace (supplemental river crossing). *The impact to the Barracks Hospital would likely be considered an adverse impact because without mitigation the vibration impacts during construction may damage the unreinforced masonry structure. The proximity of the proposed freeway would negatively impact the visual setting.* *The acquisition impacts to Officers Row and the Old Apple Tree Park, and potential obstructions of Pearson Field's airspace, would be very minor and would not change the characteristics for which these resources are considered contributing to the VNHR Historic District but these resources are included in the District and are therefore included in the adverse effect to the District.* *Noise levels at the VNHR Historic District could decrease with highway sound walls potentially constructed with the highway improvements. This*	The LPA would impact up to 32 significant archaeological sites. The acquisitions associated with the community connector, as with most acquisitions on the VNHR, could impact archaeological resources.	

Impact Category	Impacts as Initially Disclosed	New Impacts	Change in Impacts
	would likely result in a benefit to the two non-commissioned officers duplexes closest to I-5 south of the Barracks Post Hospital, as well as the Hospital itself. Noise levels at these contributing residential units currently exceed impact criteria, and would worsen with the No-Build Alternative. In addition to these benefits, these sound walls could potentially alter the historic setting of the buildings adjacent to the wall. The DEIS reported a High potential to impact archaeological historic properties.		

Impact Category	Impacts as Initially Disclosed	New Impacts	Change in Impacts
	Option A Area	**Option A**	**Option A** The only historic or archaeological resource in the area impacted by Option A is Pier 99. It would be displaced by Option A and it was reported as displaced in the DEIS. No change in impacts.
Parklands & Recreation	**Total** The DEIS reported a range of impacts depending on the alternative. Up to 6.47 acres of park and recreation resources would be acquired (up to 6.11 for Alternative 3), including up to 2.7 acres from the VNHR. Up to 230 linear feet of trails potentially realigned.	**Total** The LPA would acquire 4.4 total acres of park and recreation resources, including 1.8 acres from the VNHR. 580 linear feet of trails would need to be permanently realigned.	**Total** The LPA would acquire less total acreage of park and recreation resources than reported in the DEIS, and less acreage from the VNHR. The LPA would realign more linear feet of trails than reported in the DEIS. However, a large portion of the trail to be realigned is Waterfront Trail. The location and realignment of that trail has been developed in coordination with the City of Vancouver through its waterfront redevelopment planning process.
	Option A Area	**Option A**	**Option A** Option A would not cause a change in impacts to parks and recreation resources.
Construction			Construction-related impacts are discussed separately for each element of the

Impact Category	Impacts as Initially Disclosed	New Impacts	Change in Impacts
			environment. See the other sections of this matrix.
Secondary and Cumulative	The DEIS reported a range of impacts depending on the alternative. The replacement bridge options reduced CO_2 emissions while the supplemental bridge options increased CO_2 emissions, compared to No-Build.	The LPA is estimated to reduce CO_2e emissions compared to the No-Build.	The LPA is within the range of impacts reported in the DEIS.
Other			
4(f) Resources	The DEIS reported a Section 4(f) use on the following historic resources: *- Pier 99 building (full displacement)* *- 1917 bridge (full displacement)* *- VNHR NRHP District/Cultural Landscape (partial permanent acquisition).* *-Heritage Apple Tree (adverse/Use)* *- Kiggins House (adverse/Use)* *- Providence Academy (adverse/Use)* *- 401 E McLoughlin (adverse/Use)* *- 611 E McLoughlin (adverse/Use)* *- 903 E 31st St (adverse/Use)* *- 3000 K St (adverse/Use) (No Adverse Effect with Alternative 3)* *- 3110 K St (adverse/Use) (No Adverse Effect with Alternative 3)* *- 2901 Main St (adverse/Use) (No impact with Clark College MOS)*	The LPA would have no adverse effect/4(f) use on: *-Heritage Apple Tree* The LPA would use the following Section 4(f) historic resources: *- Pier 99 building (full displacement)* *- 1917 bridge (full displacement)* *- VNHR NRHP District/Cultural Landscape (partial permanent acquisition)*	The LPA would have less impact on the Heritage Apple Tree than reported in the DEIS. The LPA would have the same impact on the existing 1917 I-5 bridge. The LPA would have fewer Section 4(f) uses of historic resources than reported in the DEIS. (The LPA would have fewer Section 4(f) uses of historic resources than reported in the DEIS for Alternative 3 or the Clark College MOS).

Impact Category	Impacts as Initially Disclosed	New Impacts	Change in Impacts
	- 3212 Main St (adverse/Use) (No impact with Clark College MOS) *- 300 E 37th St (adverse/Use) (No impact with Clark College MOS)* The DEIS reported a potential use of 4(f) park and recreation resources: *- Waterfront Renaissance Trail: new bridge crosses over 180 feet of trail and likely relocation of path, possible de minimis impact.* *- Waterfront Park: bridge spans up to 0.23 acre of park shoreline and waterfront plaza/views, potential bridge piers in park, possible de minimis impact.*	The LPA would use the following Section 4(f) park and recreation resources: *- Waterfront Renaissance Trail: Permanently realigns approximately 450 linear feet of trail under the existing and future proposed I-5 bridges. A Section 4(f) use.* *- Waterfront Park: Acquires 0.4 acre (18,730 sq. ft.) of park land; displaces plantings, Waves Plaza and Boat of Discovery monument. A Section 4(f) use.*	The LPA would have a Section 4(f) use of the Waterfront trail, which was reported as a potential use in the DEIS. The LPA would have a Section 4(f) use of the Waterfront park, which was reported as a potential use in the DEIS. LPA would have greater area of use than reported in the DEIS.

Impact Category	Impacts as Initially Disclosed	New Impacts	Change in Impacts
	- Vancouver National Historic Reserve (VNHR): Acquires up to 2.7 acres of park land, possible impacts to Federal Lands Building and a storage garage owned by the Army. Potential for use of up to 0.54 acres of temporary construction easement.	*- Vancouver National Historic Reserve (VNHR): Acquires 1.8 acres (72,787 sq. ft.) of park land and additional 0.2 acre (7,176 sq. ft.) for permanent airspace easement. Impacts to Federal Lands Building parking lot. No historic structures would be displaced. Temporary occupancy of 0.2 acre (7,407 sq. ft.). Includes impacts to Fort Vancouver National Historic Site and Old Apple Tree Park described below. A Section 4(f) use.*	The LPA would have a Section 4(f) use of the VNHR, which was reported as a potential use in the DEIS. LPA would have less area of acquisition than reported in the DEIS. The Section 4(f) use of the VNHR would not change based on the impact from the community connector.
	- Fort Vancouver National Historic Site (FVNHS): Up to 1.5 acres of park land near I-5/SR 14. Land is vacant but contains archaeological resources. Potential for up to 0.23 acre of temporary construction easements.	*- Fort Vancouver National Historic Site (FVNHS): Acquires 1.0 acre of park land (41,589 sq. ft.) and additional 0.1 acre (4,253 sq. ft.) for airspace easement. Included in the VNHR impacts described above. No historic structures would be displaced. A Section 4(f) use.*	The LPA would have a Section 4(f) use of the FVNHS, which was reported as a potential use in the DEIS. LPA would have less area of acquisition than reported in the DEIS.
	- Old Apple Tree Park: Up to 0.27 acre of viewing courtyard and passive recreation space.	*- Old Apple Tree Park: Acquires less than 0.1 acres (209 sq. ft.) for airspace easement over northwest corner of parcel. Included in the VNHR impacts described above. A Section 4(f) use.*	The LPA would have a Section 4(f) use of the Old Apple Tree Park, which was reported as a potential use in the DEIS. LPA would have less area of acquisition than reported in the DEIS.
	- Marshall Community Park: 1.2-acre strip of landscaped passive recreation area adjacent to parking and fields.	*Marshall Community Center, Luepke Senior Center, and Marshall Park: Acquires 0.6 acre (24,803 sq. ft.) strip*	The LPA would have a Section 4(f) use of Marshall Park, which was reported as a potential use in the DEIS.

Impact Category	Impacts as Initially Disclosed	New Impacts	Change in Impacts
	Could displace up to 3 horseshoe courts.	*of landscaped passive recreation area adjacent to parking. Displaces 4 horseshoe pits, 8 parking spaces permanently, and 30-40 spaces temporarily. Temporary occupancy of 0.5 acre (24,061 sq. ft.). A Section 4(f) use.* The LPA would have a de minimis impact on the following Section 4(f) park and recreation resources:	
	- Clark College Recreation Fields: 1.24-acre strip with portions of ball field, batting cage, park path, grass field.	*- Clark College Recreation Fields: Acquires a 1.0-acre (42,662 sq. ft.) strip of landscaped area adjacent to recreation fields. Temporary occupancy of 0.2 acre (8,919 sq. ft.). A de minimis impact.*	The LPA would have a de minimis impact on the recreation fields, which was reported as a potential use in the DEIS. LPA would have less area of acquisition than reported in the DEIS.
	- Leverich Park: 0.33 acre of park border, berms and landscaping. Airspace over park entrance road. Possible de minimis impact.	*- Leverich Park: Acquires 0.3 acre (13,739 sq. ft. of park border, berms and landscaping. Temporary occupancy of 1.3 acres (54,777 sq. ft.) of parkland for construction access, staging, and utility relocation. A de minimis impact.*	The LPA would have a de minimis impact on Leverich park, which was reported as a potential use in the DEIS.
	- Kiggins Bowl: Relocate 50 linear ft of trail; up to 0.35 acre landscaped area. Possible de minimis impact.	*- Kiggins Bowl: Acquires less than 0.1 acres (1,675 sq. ft.) portion of parcel used to access fields and additional 0.3 acre (11,814 sq. ft.) of subsurface easement in same area. Temporary occupancy of less than 0.1 acre (2,982 sq. ft.). A de minimis impact.*	The LPA would have a de minimis impact on Kiggins Bowl, which was reported as a potential use in the DEIS.

Impact Category	Impacts as Initially Disclosed	New Impacts	Change in Impacts
	Option A Area	**Option A**	**Option A** Pier 99, a historic 4(f) resource would be displaced with Option A and was reported as displaced in the DEIS. No change in impacts.

Impact Category	Impacts as Initially Disclosed	New Impacts	Change in Impacts
Aviation and Navigation	**Total** The DEIS reported a range of impacts for aviation and navigation. The highest impact reported to aviation was that with the Supplemental alternatives the lift spans on the existing bridge would be retained and would remain a hazard to aviation at Pearson Field. (Alternative 3 would remove the lift spans of the existing bridges, reducing the intrusion into Pearson Field airspace) The highest impact reported to river navigation was an adverse impact due to the addition of the supplemental bridge making the S-curve maneuver more difficult. There would be more piers in the water and narrower channels. (Alternative 3 would eliminate the S-curve maneuver and reduce the number of piers in the water)	**Total** The LPA would remove the lift spans of the existing bridges, reducing the intrusion into Pearson Field airspace. For river navigation, the LPA would eliminate the S-curve maneuver and reduce the number of piers in the water.	**Total** The LPA would be within the range of aviation and navigation impacts as reported in the DEIS.
	Option A Area	**Option A**	**Option A** There is no change in impacts from Option A.

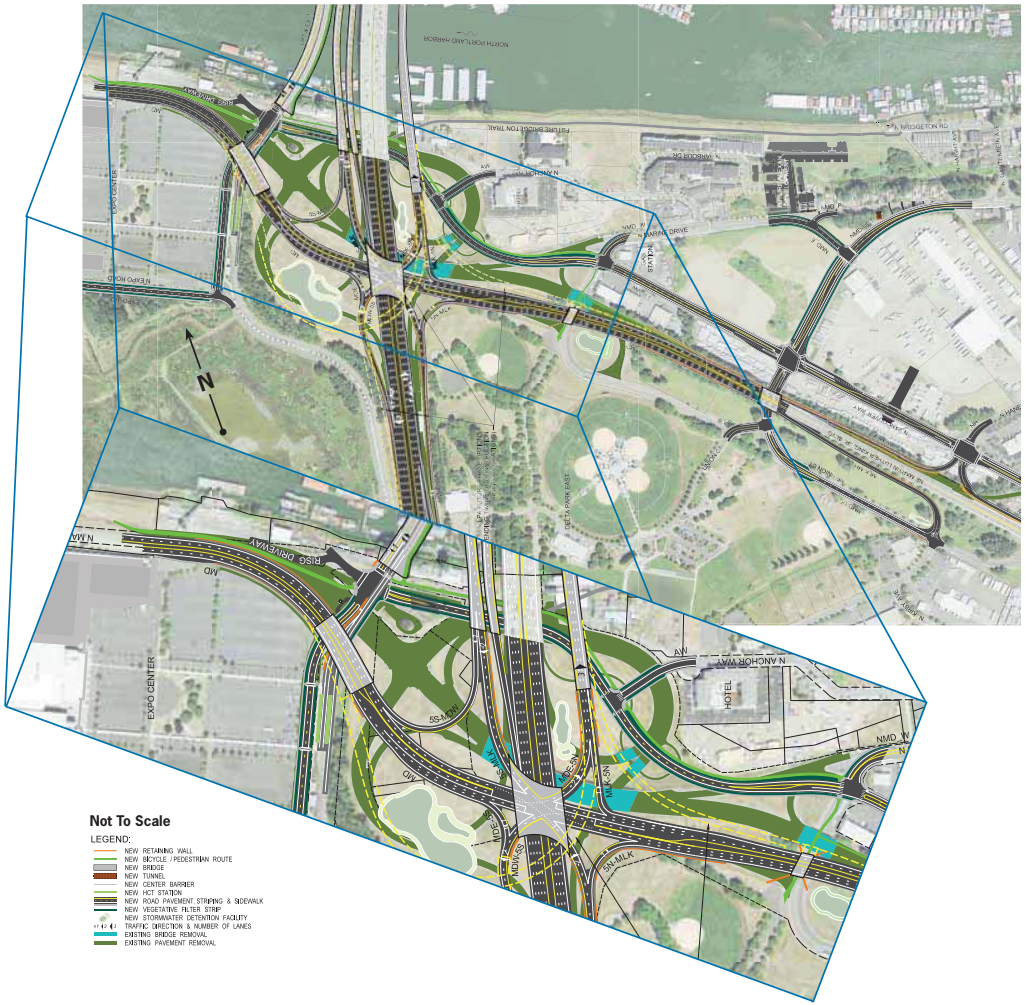
Columbia River CROSSING
LPA PHASE I
SCALE IN FEET
0 250 500 750 1000
DRAFT
4/21/2011
LEGEND
Exhibit G
SR 500 Interchange
Exhibit F
Fourth Plain Interchange
Exhibit E
Vancouver Light Rail
Exhibit D
SR 14 Interchange
Exhibit B
Hayden Island Interchange
Exhibit C
North Portland Harbor
Exhibit A
Marine Drive Interchange

Columbia River CROSSING

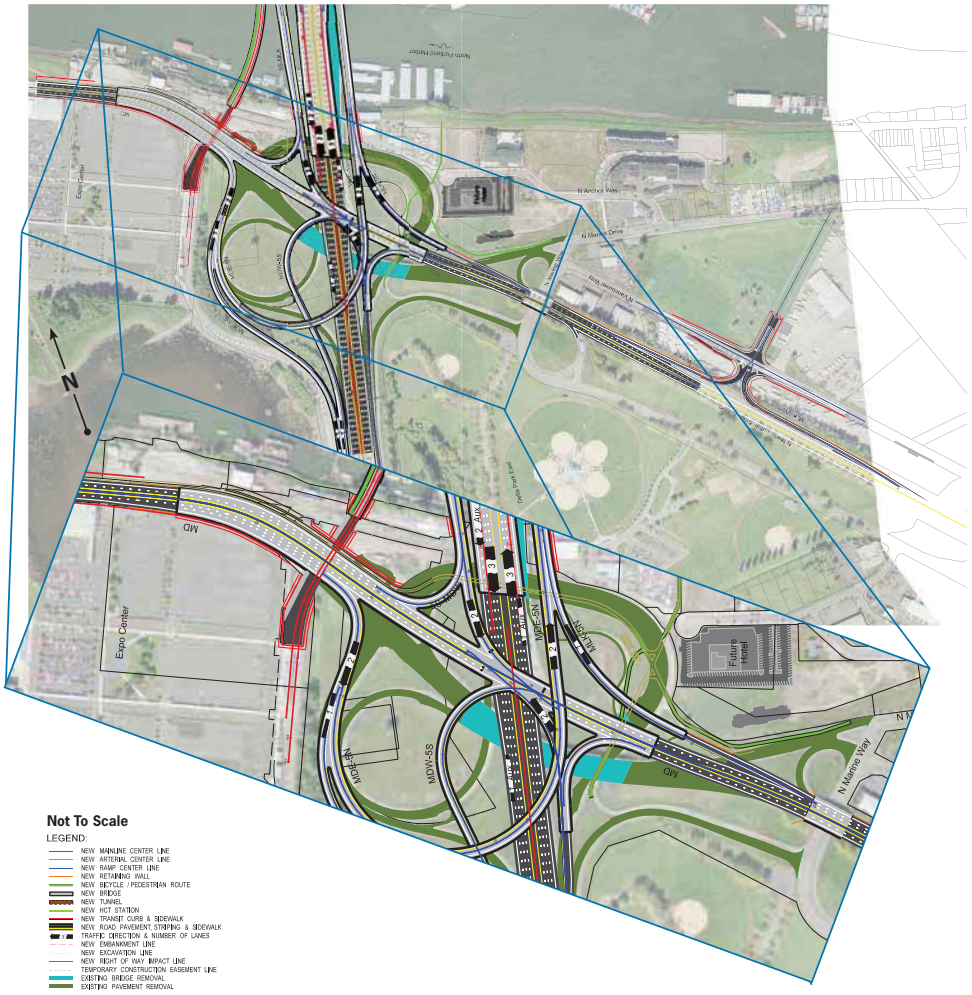
FEIS Project Area compared to DEIS Project Area

Exhibit A - Marine Drive Interchange

Current Plan



DEIS Plan

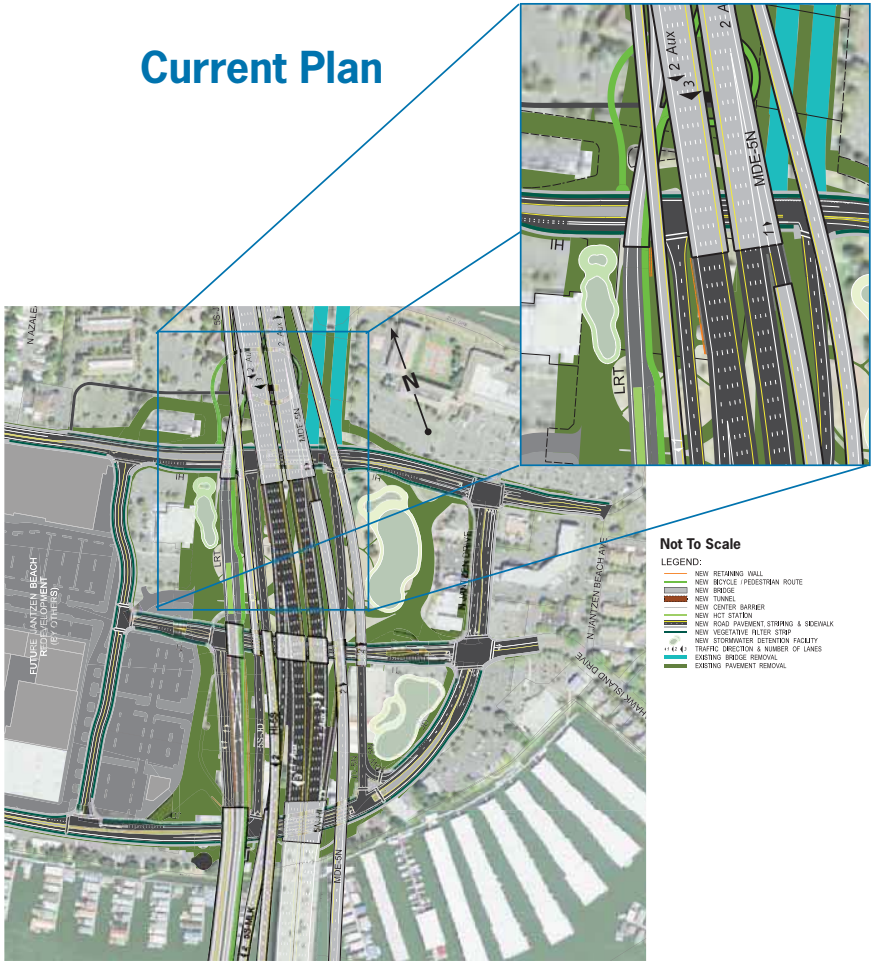


Columbia River CROSSING

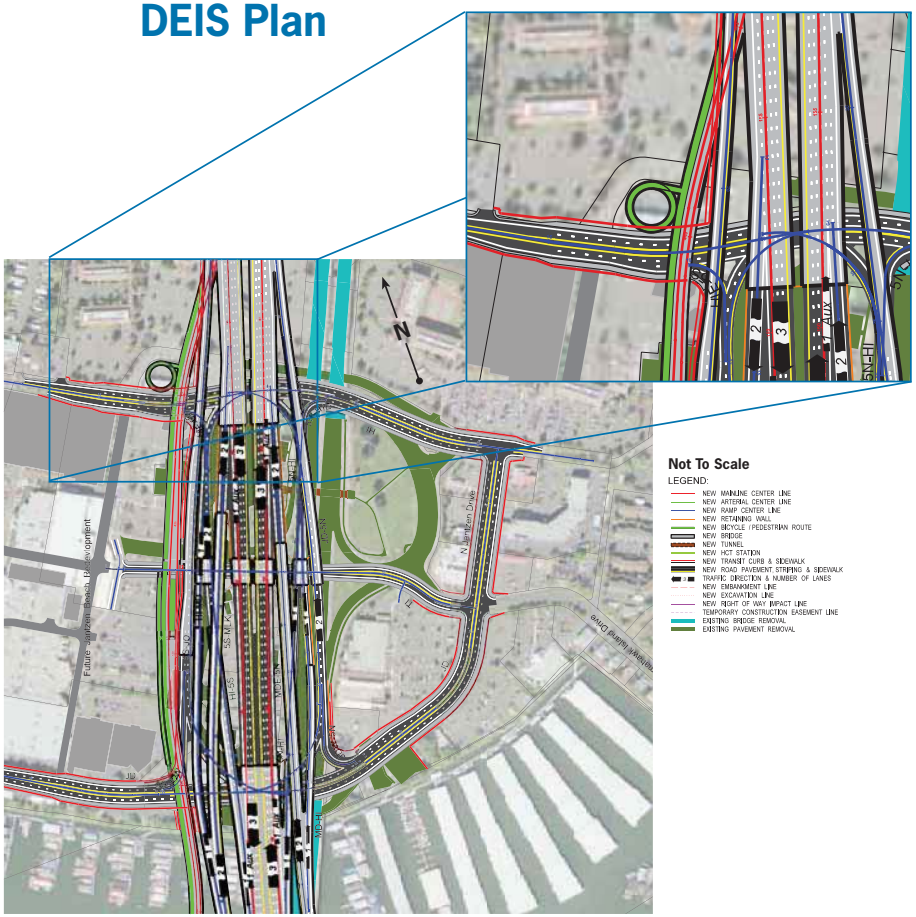
FEIS Project Area compared to DEIS Project Area

Exhibit B - Hayden Island Interchange

Current Plan



DEIS Plan

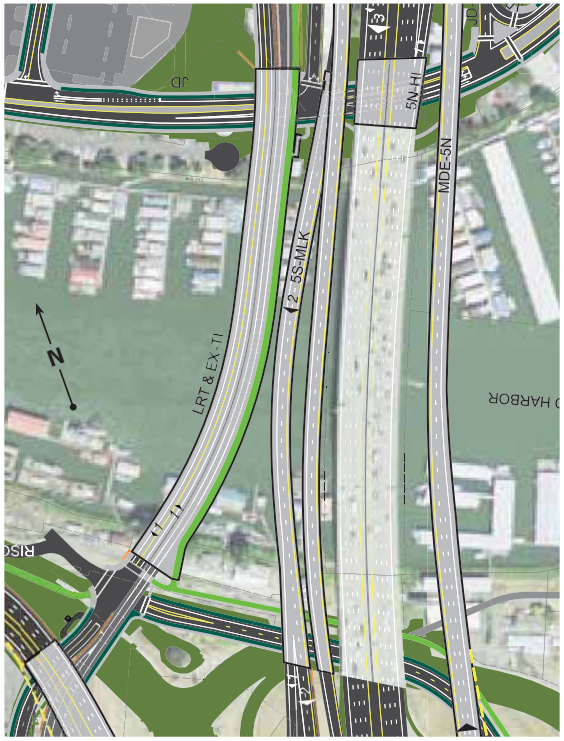


Columbia River CROSSING

FEIS Project Area compared to DEIS Project Area

Exhibit C - North Portland Harbor

Current Plan



Not To Scale

LEGEND:

- NEW RETAINING WALL
- NEW BICYCLE / PEDESTRIAN ROUTE
- NEW BRIDGE
- NEW TUNNEL
- NEW CENTER BARRIER
- NEW HCT STATION
- NEW ROAD PAVEMENT, STRIPING & SIDEWALK
- NEW VEGETATIVE FILTER STRIP
- NEW STORMWATER DETENTION FACILITY
- TRAFFIC DIRECTION & NUMBER OF LANES
- EXISTING BRIDGE REMOVAL
- EXISTING PAVEMENT REMOVAL

DEIS Plan

Not To Scale

LEGEND:

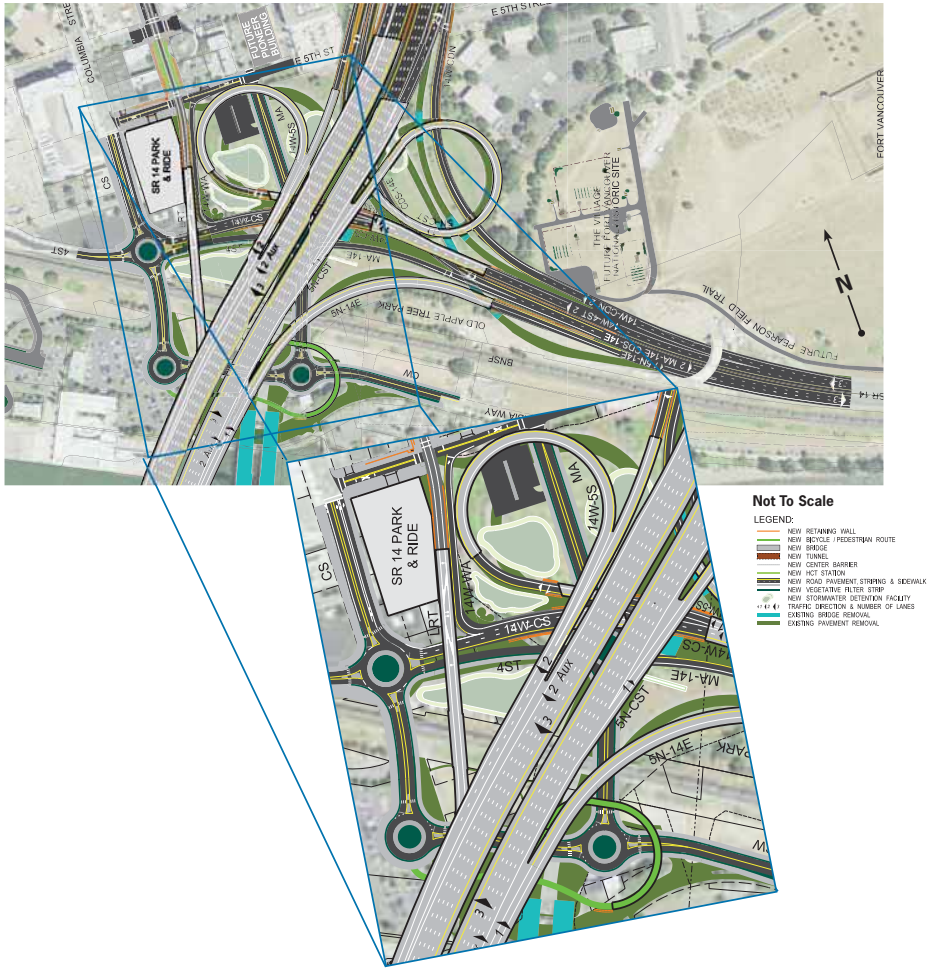
- NEW MAINLINE CENTER LINE
- NEW ARTERIAL CENTER LINE
- NEW RAMP CENTER LINE
- NEW RETAINING WALL
- NEW BICYCLE / PEDESTRIAN ROUTE
- NEW BRIDGE
- NEW TUNNEL
- NEW HCT STATION
- NEW TRANSIT CURB & SIDEWALK
- NEW ROAD PAVEMENT, STRIPING & SIDEWALK
- TRAFFIC DIRECTION & NUMBER OF LANES
- NEW EMBANKMENT LINE
- NEW EXCAVATION LINE
- NEW RIGHT OF WAY IMPACT LINE
- TEMPORARY CONSTRUCTION EASEMENT LINE
- EXISTING BRIDGE REMOVAL
- EXISTING PAVEMENT REMOVAL

Columbia River CROSSING

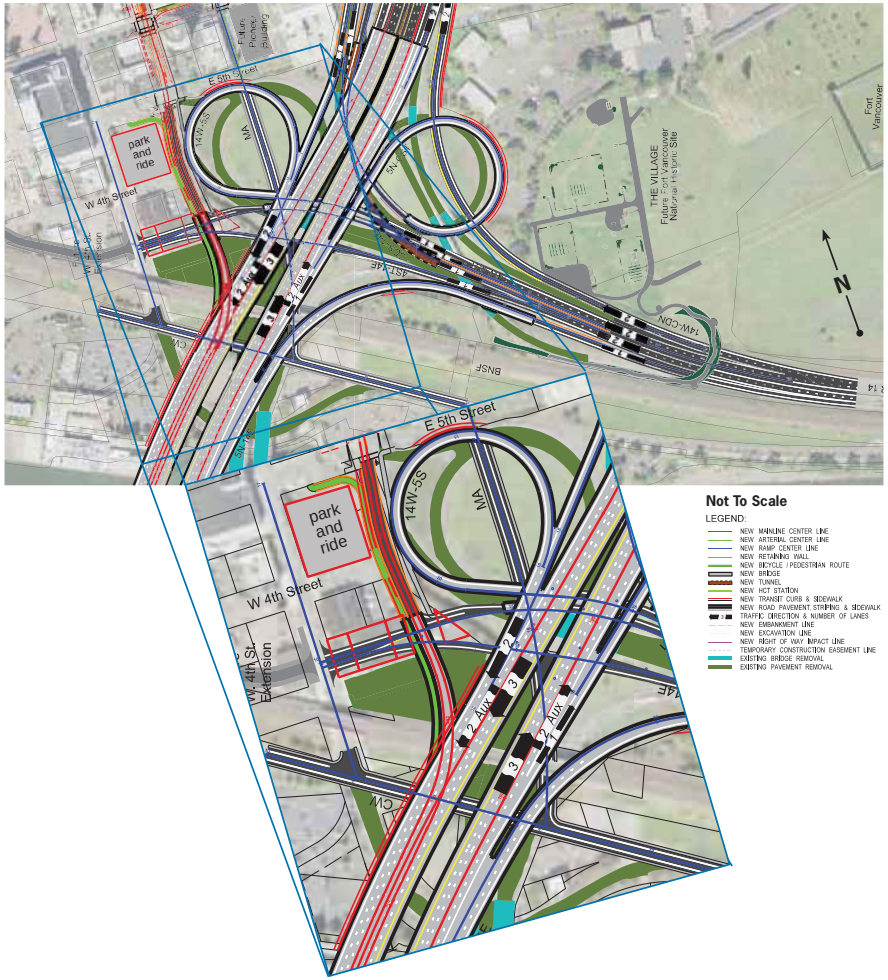
FEIS Project Area compared to DEIS Project Area

Exhibit D - SR 14 Interchange

Current Plan



DEIS Plan



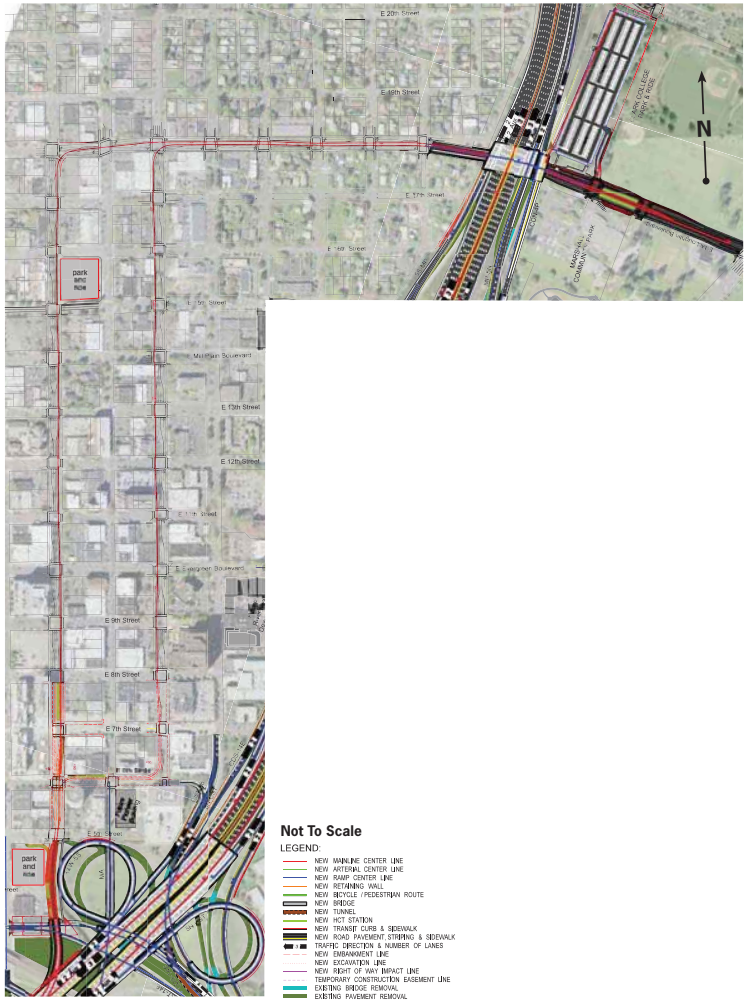
Columbia River CROSSING

FEIS Project Area compared to DEIS Project Area

Exhibit E - Vancouver Light Rail

Current Plan

DEIS Plan

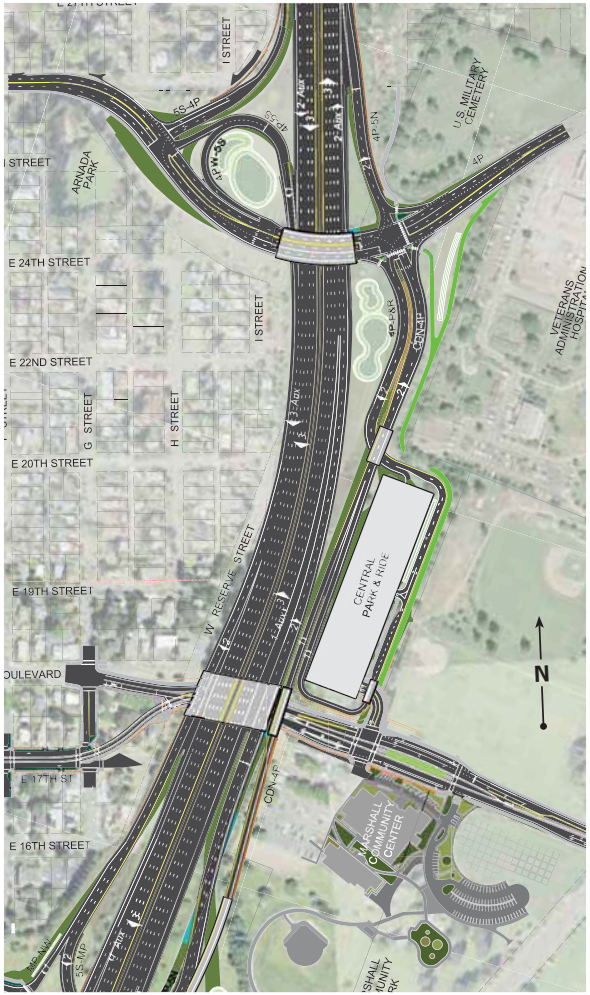


Columbia River CROSSING

FEIS Project Area compared to DEIS Project Area

Exhibit F - Fourth Plain Interchange

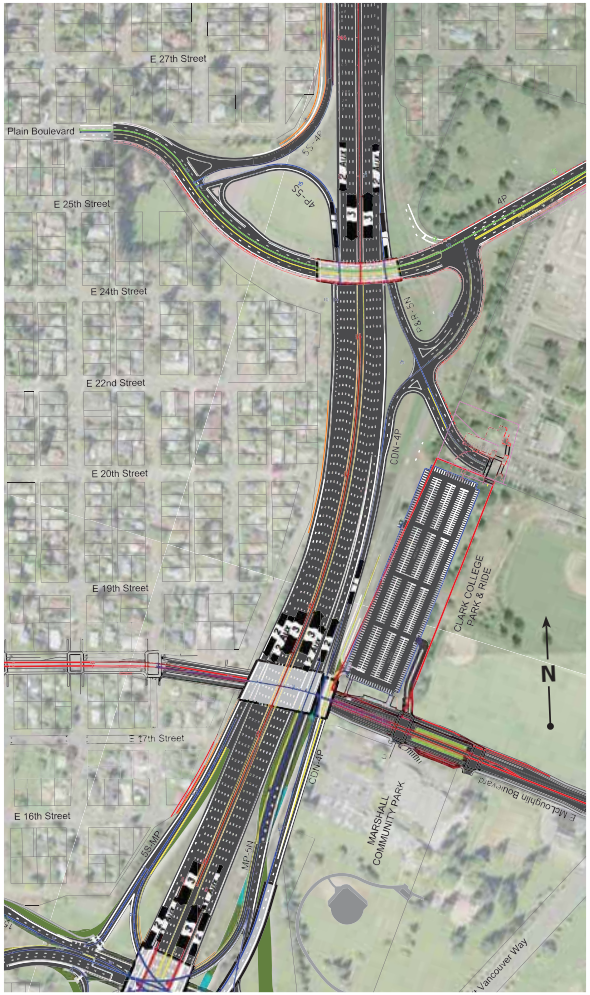
Current Plan



Not To Scale

LEGEND:
- NEW RETAINING WALL
- NEW BICYCLE / PEDESTRIAN ROUTE
- NEW BRIDGE
- NEW TUNNEL
- NEW CENTER BARRIER
- NEW HCT STATION
- NEW ROAD PAVEMENT STRIPING & SIDEWALK
- NEW VEGETATIVE FILTER STRIP
- NEW STORMWATER DETENTION FACILITY
- TRAFFIC DIRECTION & NUMBER OF LANES
- EXISTING BRIDGE REMOVAL
- EXISTING PAVEMENT REMOVAL

DEIS Plan



Not To Scale

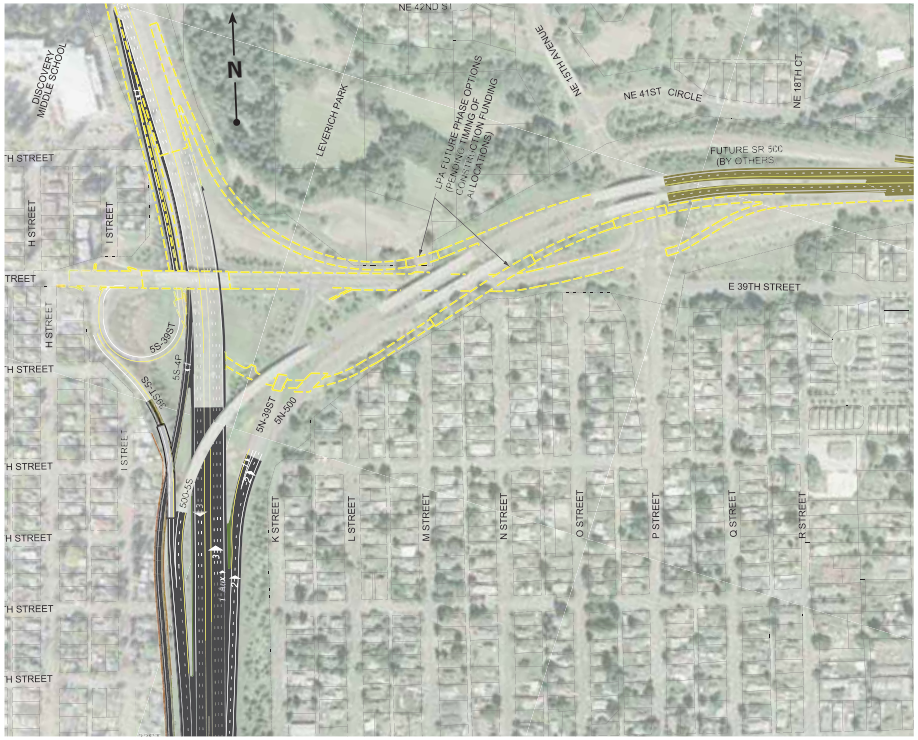
LEGEND:
- NEW MAINLINE CENTER LINE
- NEW ARTERIAL CENTER LINE
- NEW RAMP CENTER LINE
- NEW RETAINING WALL
- NEW BICYCLE / PEDESTRIAN ROUTE
- NEW BRIDGE
- NEW TUNNEL
- NEW HCT STATION
- NEW TRANSIT CURB & SIDEWALK
- NEW ROAD PAVEMENT STRIPING & SIDEWALK
- TRAFFIC DIRECTION & NUMBER OF LANES
- NEW EMBANKMENT LINE
- NEW EXCAVATION LINE
- NEW RIGHT OF WAY IMPACT LINE
- TEMPORARY CONSTRUCTION EASEMENT LINE
- EXISTING BRIDGE REMOVAL
- EXISTING PAVEMENT REMOVAL

Columbia River CROSSING

FEIS Project Area compared to DEIS Project Area

Exhibit G - SR 500 Interchange

Current Plan



Not To Scale

LEGEND:
- NEW RETAINING WALL
- NEW BICYCLE / PEDESTRIAN ROUTE
- NEW BRIDGE
- NEW TUNNEL
- NEW CENTER BARRIER
- NEW HCT STATION
- NEW ROAD PAVEMENT, STRIPING & SIDEWALK
- NEW VEGETATIVE FILTER STRIP
- NEW STORMWATER DETENTION FACILITY
- TRAFFIC DIRECTION & NUMBER OF LANES
- EXISTING BRIDGE REMOVAL
- EXISTING PAVEMENT REMOVAL

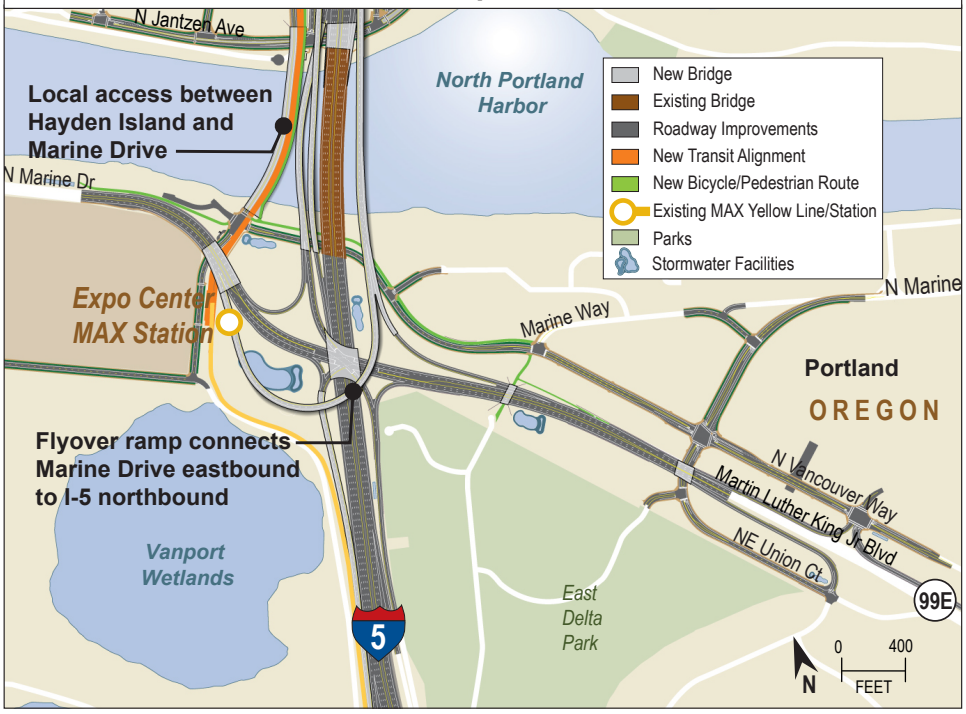
DEIS Plan

Not To Scale

LEGEND:
- NEW MAINLINE CENTER LINE
- NEW ARTERIAL CENTER LINE
- NEW RAMP CENTER LINE
- NEW RETAINING WALL
- NEW BICYCLE / PEDESTRIAN ROUTE
- NEW BRIDGE
- NEW TUNNEL
- NEW HCT STATION
- NEW TRANSIT CURB & SIDEWALK
- NEW ROAD PAVEMENT, STRIPING & SIDEWALK
- TRAFFIC DIRECTION & NUMBER OF LANES
- NEW EMBANKMENT LINE
- NEW EXCAVATION LINE
- NEW RIGHT OF WAY IMPACT LINE
- TEMPORARY CONSTRUCTION EASEMENT LINE
- EXISTING BRIDGE REMOVAL
- EXISTING PAVEMENT REMOVAL

LPA OPTIONS: Marine Drive Interchange

LPA Option A



LPA Option B

DIMENSIONS ARE APPROXIMATE.

Graphic by K. Martinek, Date: April 2011

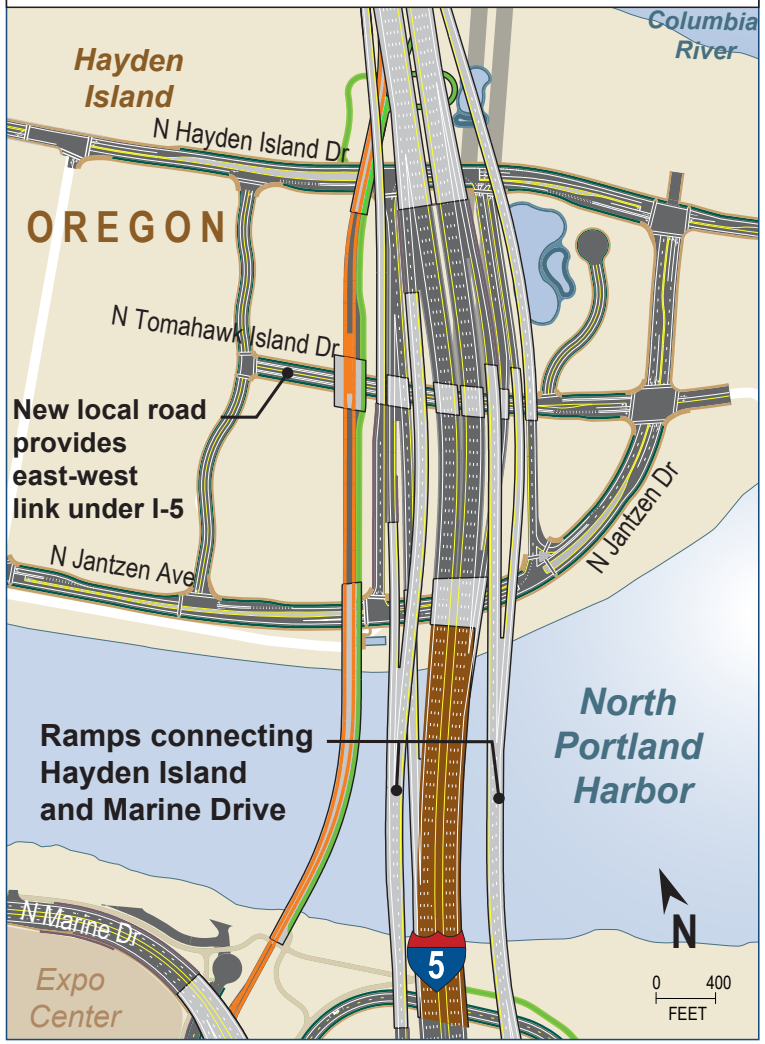
Exhibit H
Highway and Interchange Improvements
Marine Drive

Columbia River CROSSING

LPA OPTIONS: Hayden Island Interchange

LPA Option A

LPA Option B



- New Bridge
- Existing Bridge
- Roadway Improvements
- New Transit Alignment
- New Transit Station
- New Bicycle/Pedestrian Route
- Sidewalks
- Stormwater Facilities
- Planter Strip

DIMENSIONS ARE APPROXIMATE.

Graphic by K. Martinek, Date: April 2011

Exhibit I
Highway and Interchange Improvements
Hayden Island

Columbia River CROSSING

ATTACHMENT

Steel Bridge Documented
Categorical Exclusion
and appendices

November 2010

U.S. Department
of Transportation
**Federal Transit
Administration**

REGION X
Alaska, Idaho, Oregon,
Washington

915 Second Avenue
Federal Bldg. Suite 3142
Seattle, WA 98174-1002
206-220-7954
206-220-7959 (fax)

February 1, 2011

Mr. Don Wagner
Mr. Richard Brandman
Columbia River Crossing
700 Washington St., Suite 300
Vancouver, WA 98660

**RE: Columbia River Crossing: Steel Bridge LRT System Modification Project
Confirmation of Documented Categorical Exclusion**

Dear Mr. Wagner and Mr. Brandman:

The Federal Transit Administration (FTA) has received the Columbia River Crossing (CRC) *Categorical Exclusion and Documented Categorical Exclusion Worksheet* dated November 8, 2010 regarding the Steel Bridge LRT System Modification Project. Based on the Worksheet and supplemental information, we understand that CRC proposes to use FTA funds to modify certain rail and system features on the Steel Bridge in Portland, OR to allow light rail vehicles to travel across the bridge at higher speeds than are now possible.

Based on the information provided, FTA concurs that the project qualifies as a categorical exclusion as described in the Department of Transportation's Final Rule concerning Environmental Impact and Related Procedures, 23 CFR Section 771.117(d).

This action applies only to the project as described in the above-referenced Worksheet and supporting materials. Any changes to the proposed action which would result in significant environmental impacts not identified in the DCE worksheet, including the disclosure of new information or environmental concerns not previously identified will require re-evaluation of this action.

This confirmation of categorical exclusion does not provide FTA commitment that future Federal funds will be approved for this project. Any costs incurred under FTA pre-award authority must

meet all Federal requirements prior to those costs being incurred in order to retain eligibility of those costs for future FTA grant assistance.

Please contact Dan Drais (206-220-4465) if you require additional information.

Sincerely,

Linda M. Gehrke

for R.F. Krochalis
Regional Administrator

cc: Heather Wills

JOINT FTA & FHWA
CATEGORICAL EXCLUSION and
DOCUMENTED CATEGORICAL EXCLUSION WORKSHEET

Note: The purpose of this worksheet is to assist sponsoring agencies in gathering and organizing materials for environmental analysis required under the National Environmental Policy Act (NEPA), particularly for projects that may qualify as a documented Categorical Exclusion (DCE). The use and submission of this particular worksheet is NOT required. The worksheet is provided merely as a helpful tool in gathering and providing information deemed needed by FTA. It is designed to provide FTA with information needed to do an environmental analysis. In lieu of the worksheet, the sponsoring agency may submit the same information in a different format. **NOTE: Fields are expandable, so feel free to use more than a line or two to describe descriptions.**

Submission of the worksheet by itself does not meet NEPA requirements. FTA (and FHWA if a co-lead project) must concur in writing in the sponsoring agency's NEPA recommendation. Project activities may not begin until this process is complete. Contact the FTA Region 10 office at (206) 220-7954 if you have any questions or require assistance. If this is the first time you have filled out this form, FTA encourages you to contact us for guidance. **Please see the end of this document for new submittal procedures.** Check out Region 10's Environment web site (see link at the end of this document) with a list of topical resources.

I. PROJECT DESCRIPTION

Sponsoring Agency TriMet	Date Submitted 11/8/10	FTA / FHWA Grant Number(s) (if known) /
Project Title Steel Bridge LRT System Modifications		
Project Description (brief, 1-2 sentences) Modifications to the existing light rail transit track and electrical system on the Steel Bridge.		
Purpose and Need for Project (brief, 1-2 sentences, include as an attachment if adopted statement is lengthy) The Steel Bridge has a lift span that requires lift joints in the MAX rails within the track bed. These lift joints limit the crossing speed of LRVs to no more than 10 mph across the bridge and 5 mph specifically at the lift joint itself. This limitation is because the vibrations at these joints disrupt the signaling and electrification system. Modifications to reduce the wheel rise from the lift joint would decrease the bridge vibration, allowing MAX trains a maximum speed of 15 mph on the Steel Bridge, thus improving the speed of the Yellow Line MAX and, as a by-product, all MAX lines crossing the bridge. There is also an existing signal case on the lift span that cannot withstand high levels of vibration. The overhead catenary system (OCS) that supplies electrical power to the trains is also not designed to withstand the high levels of vibration that are generated with speeds above 5 & 10 mph.		
Project Location (include City and Street address) Steel Bridge, Portland Oregon		
Project Contact (include phone number, mailing address and email address) Heather Wills, 700 Washington Street, #300, Vancouver WA 98660. Willsh@columbiarivercrossing.org		
If your project involves construction, include the following maps: • Project Vicinity • Project Site Plan • USGS quad		

II. NEPA Class of Action

Answer the following questions to determine the project's potential class of action. If the answer to any of the questions in Sections A or B is "YES", contact the FTA Regional office to determine whether the project requires preparation of a NEPA environmental assessment (EA).

A. Will the project significantly impact the natural, social and/or economic environment?

☐ YES (contact FTA Regional office)
☒ NO (continue)

B.1 Is the significance of the project's social, economic or environmental impacts unknown?

☐ YES (contact FTA Regional office)
☒ NO (continue)

B.2 Is the project likely to require detailed evaluation of more than a few potential impacts?

☐ YES (contact FTA Regional office)
☒ NO (continue)

B.3 Is the project likely to generate intense public discussion, concern or controversy, even though it may be limited to a relatively small subset of the community?

☐ YES (contact FTA Regional office)
☒ NO (continue)

C.1 Does the project appear on the following list of potential Categorical Exclusions (CEs)?

The projects listed below are generally categorically excluded from further NEPA analysis under 23 CFR 771.117(c) unless certain circumstances exist, such as the presence of wetlands, historic buildings and structures, parklands and floodplains in the project area.

☒ YES (If checked AND there are no special circumstances, mark the applicable checkbox and briefly describe the activity below. Then, proceed to the signature block on the back page.)
☐ NO (continue to Section D)

☐ Activities not involving or directly leading to construction (technical studies, planning, preliminary engineering, etc.)

☐ Utility installations along or across a transit facility

☐ Construction of bicycle and pedestrian facilities, excluding those requiring construction in new right-of-way

☐ Installation of noise barriers or alterations to existing publicly-owned buildings to provide for noise reduction

- [ ] Landscaping
- [ ] Installation of fencing, signs, pavement markings, toll facilities, control centers, vehicle test centers, small passenger shelters, traffic signals, railroad warning devices, and signal controls with no substantial land acquisition or traffic disruption
- [ ] Emergency repairs under 23 USC 125
- [ ] Acquisition of scenic easements
- [ ] Ridesharing activities
- [ ] Bus, ferry, and rail car rehabilitation (including conversions to alternative fuels)
- [ ] Alterations to facilities or vehicles to make them accessible to elderly or handicapped persons
- [ ] Program administration (including safety programs), technical assistance, and operating assistance to continue existing service or increase service to meet routine changes in demand
- [ ] Purchase and lease of vehicles and equipment for use on existing facilities or new facilities that also qualify as CEs (including the capital cost of contracts for transit services)
- [x] Track, railbed, and wayside system maintenance and improvements when carried out in existing right-of-way
- [ ] Purchase and installation of operating, maintenance and Intelligent Transportation Systems (ITS) equipment to be located solely within the transit facility and with no significant off-site impacts
- [ ] Mitigation banking
- [ ] Resurfacing and restriping
- [ ] Routine maintenance

C.2 Brief Activity Description

Include a brief description of the activity and the reasoning for its categorical exclusion.

The Steel Bridge has a lift span that requires lift joints in the MAX rails within the track bed. These lift joints limit the crossing speed of LRVs to no more than 10 mph across the bridge and 5 mph at the lift joints themselves. The work needed to increase the speed limits from 5 & 10 mph to 15 mph over the Steel Bridge as a whole and at the lift spans would include the following:

1. Grind the transit rails within the track bed to remove the lift joint bumps, rail corrugation, and any rough field welds. Some repair and reconstruction of the hardware that fastens the lift joints to the bridge deck will also be required.
2. Install a vibration pad under the signal case to dissipate vibration.
3. Stiffen the OCS brackets to allow for greater impact as the catenary transfers from the fixed to movable span.
4. Make light rail transit and traffic signal adjustments for NW Everett Street and N Interstate Avenue to accommodate the higher speeds.

The Steel Bridge is a NRHP-eligible through-truss, double-lift bridge across the Willamette River in Portland, Oregon. The proposed modifications would not alter character-defining features of the bridge or introduce new visual components. The changes are very modest and will only be made to elements of the light rail infrastructure not original to the bridge design. There will be no Adverse Effect to this historic resource.

No traffic impacts are expected from the track work or from the traffic signal modifications. Once the Columbia River Crossing Project is completed trains would travel more frequently over the bridge. Traffic impacts from any additional trains are assessed in the Final Environmental Impact Statement of the Columbia River Crossing Project.

D. Does the project appear on the following list of potential documented Categorical Exclusions?

These projects may be categorical exclusions under 23 CFR § 771.177(d), but require additional documentation demonstrating that the specific conditions or criteria for the CEs are satisfied and that significant effects will not result.

☐ YES (Check and continue to Part III)
☒ NO (Contact FTA Regional Office)

☐ Grade separations requiring land acquisition to replace existing at-grade railroad crossings and bridge rehabilitation (including approaches to bridges and excluding historic bridges or bridges providing access to ecologically sensitive areas)

☐ Corridor Fringe Parking facilities (generally located adjacent to a mass transportation corridor such as an Interstate highway system)

☐ Carpool programs and activities requiring land acquisition and construction

☐ Safety improvements including seismic retrofit and mitigation of wildlife hazards

☐ Construction of new bus storage and maintenance facilities and new ITS control centers in areas used predominantly for industrial or transportation purposes where such construction is consistent with existing zoning and located on a street with adequate capacity to handle anticipated traffic

☐ Rehabilitation or reconstruction of existing rail and bus buildings and ancillary facilities where only minor amounts of additional land are required and there is not a substantial increase in the number of users

☐ Construction of bus transfer facilities (an open area consisting of passenger shelters, boarding areas, kiosks, and related street improvements) when located in a commercial area or other high activity center in which there is adequate street capacity for projected bus traffic

☐ Construction of rail storage and maintenance facilities (or other similarly sized support facilities) in areas used predominantly for industrial or transportation purposes where such construction is consistent with existing zoning and where there is no significant noise impact on the surrounding community

☐ Area-wide coordination of multiple ITS elements

☐ Advance land acquisition including:

- Acquisition of underutilized private railroad rights-of-way (ROW) to ensure that adjacent land uses remain generally compatible with the continued transportation use of the ROW
- Acquisition of land for hardship or protective purposes, consistent with 23 CFR 771.117 (D)(12)

(Note: the eligibility of hardship and protective buys is very limited and must be approved, in writing, by the Regional FTA office before proceeding with any acquisition activities. Failure to do so will render the project ineligible for Federal participation.)

III. Information Required for Documented Categorical Exclusions

If you checked "Yes" to any of the options in Part II, Section D, complete Part III and submit to FTA.

A. Detailed Project Description

Include a project description and explain how the proposal satisfies the purpose and need identified in Part I.

This project would include minor modifications to a critical element of the existing MAX light rail transit system which will be part of the Yellow Line MAX planned for extension as part of the Columbia River Crossing Project. These modifications would improve the existing light rail transit track and electrical system on the Steel Bridge over the Willamette River in Portland, Oregon. These improvements would allow the Yellow Line trains, as well as all other MAX line trains, to increase their travel speed over the Steel Bridge.

Currently, all light rail transit lines within the regional MAX system cross the Willamette River via the Steel Bridge. The Steel Bridge was built in 1912 and was retrofitted to receive LRVs in 1984. In 1986, when the first light rail line opened, 40 LRVs crossed the bridge during the 4-hour PM peak period; in 2007, with the Red and Yellow Lines opened, 116 LRVs crossed the bridge during the 4-hour PM peak period. In 2009, TriMet opened the I-205 South Corridor Project, increasing the number of vehicles that cross the Steel Bridge to 152 during the 4-hour PM peak period. With a peak headway of 7.5 minutes, the Columbia River Crossing (CRC) project would increase the number of LRVs that cross the Steel Bridge in 2030 during the 4-hour PM peak period to 176 trains. To accommodate these additional trains, this modification project would retrofit the existing rails on the Steel Bridge to increase the allowed light rail transit speed over the bridge, increasing the speed of the line and helping ensure adequate LRV throughput of the bridge.

The Steel Bridge has a lift span that requires lift joints in the MAX rails within the track bed. These lift joints limit the crossing speed of LRVs to no more than 10 miles per hour (mph) across the bridge and no more than 5 mph at the lift joint itself. This limitation is because the vibrations at these joints disrupt the signaling and electrification system. Modifications to reduce the wheel rise from the lift joint would decrease the bridge vibration, allowing MAX trains a maximum speed of 15 mph on the Steel Bridge, thus improving the speed of all MAX lines crossing the bridge. There is also an existing signal case on the lift span that cannot withstand high levels of vibration. The overhead catenary system (OCS) that supplies electrical power to the trains is also not designed to withstand the high levels of vibration that are generated with speeds above 5 & 10 mph. The work needed to increase the speed limits from 5 & 10 mph to 15 mph over the Steel Bridge lift spans would include the following:

1. Grind the transit rails within the track bed to remove the lift joint bumps, rail corrugation, and any rough field welds. Repair and reconstruction of the hardware that fastens the lift joint to the bridge deck will also be required.
2. Install a vibration pad under the signal case to dissipate vibration.
3. Stiffen the OCS brackets to allow for greater impact as the catenary transfers from the fixed to movable span.
4. Make light rail transit and traffic signal adjustments for NW Everett Street and N Interstate Avenue to accommodate the higher speeds.

B. Location and Zoning

Attach a map identifying the project's location and surrounding land uses. Note any critical resource areas (historic, cultural or environmental) or sensitive noise or vibration receptors (schools, hospitals, churches, residences, etc). Briefly describe the existing zoning of the project area and indicate whether the proposed project is consistent. Include a description of the community (geographic, demographic, economic and population characteristics) in the vicinity of the project.

See attached map and Location and Zoning exhibit.

C. Traffic

Describe potential traffic and parking impacts, including whether the existing roadways have adequate capacity to handle increased bus or other vehicular traffic. Include a map or diagram if the project will modify existing roadway configurations. Describe connectivity to other transportation facilities and modes.

The light rail tracks occupy the center lanes of the Steel Bridge. Automobile traffic is excluded all days and all hours from these lanes. Therefore, no traffic impacts are expected from the track work or from the traffic signal modifications. Once the Columbia River Crossing Project is completed trains would travel more frequently over the bridge. Traffic impacts from any additional trains are assessed in the Final Environmental Impact Statement of the Columbia River Crossing Project.

D. Aesthetics

Will the project have an adverse effect on a scenic vista?

☒ No
☐ Yes, describe

Will the project substantially degrade the existing visual character or quality of the site and its surroundings?

☒ No
☐ Yes, describe

Will the project create a new source of substantial light or glare which would adversely affect day or nighttime views in the area?

☒ No
☐ Yes, describe

E. Air Quality

Does the project have the potential to impact air quality?

☒ NO
☐ YES, describe

Is the project located in an Environmental Protection Agency (EPA)-designated non-attainment or maintenance area?

☐ NO

☒ YES, indicate the criteria pollutant and contact FTA to determine if a hot spot analysis is necessary.

- ☒ Carbon Monoxide (CO)
- ☐ Ozone (O_3)
- ☐ Particulate Matter (PM_{10})

If the non-attainment area is also in a metropolitan area, was the project included in the MPO's Transportation Improvement Program (TIP) air quality conformity analysis?

☐ NO

☒ YES

Date of USDOT conformity finding: February 29, 2008

F. Coastal Zone

Is the proposed project located in a designated coastal zone management area?

☒ No

☐ Yes, describe coordination with the State regarding consistency with the coastal zone management plan and attach the State finding, if available.

G. Environmental Justice

Indicate whether the project will have disproportionately high and adverse impacts on minority or low-income populations. Describe any potential adverse effects. Describe outreach efforts targeted specifically at minority or low-income populations.

As addressed in this document herein, the project will not have adverse impacts on the surrounding communities therefore there will be no impact to minority, low-income, or any other EJ populations.

H. Floodplains

Is the proposed project located within the Federal Emergency Management Agency (FEMA) 100-year floodplain?

☒ No

☐ Yes, describe potential impacts and include the FEMA map with the project location identified.

I. Hazardous Materials

Is there any known or potential contamination at the project site?

☐ No, describe the steps taken to determine whether hazardous materials are present on the site.

☒ Yes, note mitigation and clean-up measures that will be taken to remove hazardous materials from the project site.

The Oregon Department of Environmental Quality (DEQ) facility profiler (http://deq12.deq.state.or.us/fp20/StartPage.aspx) and the EPA environmapper (http://www.epa.gov/emefdata/em4ef.home) web sites were used to determine the location of identified hazardous material site in the vicinity of the Steel Bridge project site. There are no known sites on the bridge itself. There are sites on either bank of the Willamette River. However, these sites will not be affected because all work is confined to the small area around the lift joints on the bridge and therefore are not a concern to the project.

The project will involve grinding metal from rails. The metal debris from this rail grinding will be recovered as described in Section Q (Construction Impacts). Waste will be determined as hazardous or non-hazardous as defined in 40 CFR 262.11 and Oregon Administrative Rule (OAR 340-102-0011) and OAR 340-101-0033.

Based on the hazardous waste determination, the material will be disposed of as a hazardous waste according to 40 CFR Part 264/265 and OAR 340-104 at a permitted hazardous waste landfill, or it will be disposed as a solid waste according to 40 CFR, Part 258 and OAR 340-094-0040. Chemical Waste Management in Arlington, Oregon is the nearest such facility. Although the upright structural members of the bridge are painted with potentially metal-containing paint, none of the work is planned to touch or disturb these painted surfaces. Painted metal surfaces are not planned to be disturbed as part of the project; however, prudent containment measures will be employed. Any debris coming from the metal surfaces of the bridge will be recovered and disposed in a manner consistent with local, state, and federal requirements for metal containing materials (as referenced below).

J. Navigable Waterways

Does the proposed project cross or have the potential to impact a navigable waterway?

☐ No

☒ Yes, describe potential impacts and any coordination with the US Coast Guard.

The project is on a bridge that crosses a navigable waterway, but since work would only make modifications to trackway at lift joints it would not affect clearance on the waterway. There would be no in-water work or closures of the waterway during construction.

K. Noise and vibration

Does the project have the potential to increase noise or vibration?

☐ NO

☒ YES, describe impact and provide map identifying sensitive receptors such as schools, hospitals, parks and residences. If the project will result in a change in noise and vibration sources, you must use FTA's "Transit Noise and Vibration Impact Assessment" methodology to determine impact.

The resulting change in noise levels related to the increased light rail traffic across the Steel Bridge was calculated at 6 dBA L_{eq} during peak-hour and the 24-hour L_{dn} increase is approximately 5 dBA. There are no noise sensitive receivers located within 350 feet of the alignment and no noise impacts are projected.

Wheel squeal is not predicted to result in any noise impacts because squeal is associated with track curvature and not related to the number or trains. The track at the site of work at the lift joints is not curved.

The closest building to the light rail alignment is the Oregon Department of Transportation Region 1 headquarters on NW Flanders at NW 1st Ave. Current vibration levels are projected to range from 65 to 68 VdB at this location. The building is adjacent to the retained fill and elevated structure that connects to the Steel Bridge and is approximately 60 to 70 feet from the near track. Because no modifications are proposed in this area, the vibration levels are not predicted to change from the 65 to 68 VdB projections, which are well below the FTA criteria of 75 VdB for a commercial building.

For more information about noise and vibration, please see *Noise and Vibration Impact Analysis* attached to this document.

L. Prime and Unique Farmlands

Does the proposal involve the use of any prime or unique farmlands?

☒ No

☐ Yes, describe potential impacts and any coordination with the Soil Conservation Service of the U.S. Department of Agriculture.

M. Resources

Does the project have the potential to impact any of the resources listed below?

☐ NO

☒ YES, if checked, describe resource and impacts. Impacts to cultural, historic, or recreational properties may trigger Section 4(f) evaluation, which requires consideration of avoidance alternatives.

☐ Natural

☐ Cultural

☒ Historic—Indicate whether there are any historic resources in the vicinity of the project. Attach photos of structures more than 45 years old that are within or adjacent to the project site. The Steel Bridge is a NRHP-eligible through-truss, double-lift bridge across the Willamette River in Portland, Oregon. The proposed modifications would not alter character-defining features of the bridge or introduce new visual components. The changes are very modest and will only be made to elements of the light rail infrastructure not original to the bridge design. There will be no Adverse Effect to this historic resource.

☐ Recreational

☒ Biological--The project sponsor must obtain a list of threatened and endangered species in the project area from the US Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration-Fisheries (NOAA-Fisheries). Attach a current species map (within six (6) months. Describe any critical habitat, essential fish habitat or other ecologically sensitive areas. Check out Region 10's Environment web site (see below for link) more information.
No water quality impacts will result from proposed project activities. No debris will enter the Willamette River. Noise levels resulting from the rail grinding activities are not expected to exceed ambient levels for fish or terrestrial species, and noise is expected to be similar to existing ambient noise levels from traffic associated with the light rail trains and automotive vehicles that currently use the bridge.

No indirect effects will result from this project. There will be no habitat disturbance, and no effects to prey resources.

Therefore, the modifications would have no effect to ESA-listed fish and no effect on designated critical habitat. For more information, please see the technical memo that describes the Analysis and Findings Regarding a No Effect Determination to Threatened and Endangered Species included with this document.

☐ Other, describe

N. Seismic

Are there any unusual seismic conditions in the project vicinity? If so, indicate on project map and describe the seismic standards to which the project will be designed.

☒ No
☐ Yes, describe

The Pacific Northwest is a geologically active region that experiences occasional earthquakes. However, there is nothing unusual about the Steel Bridge with respect to seismic conditions compared to other locations in the region. Geological hazards will not affect the proposed modifications to the Steel Bridge because the work would not impact the structural integrity of the bridge.

O. Water Quality

Does the project have the potential to impact water quality, including during construction.

☒ No
☐ Yes, describe potential impacts

Will there be an increase in new impervious surface or restored pervious surface?

☒ No
☐ Yes, describe potential impacts and proposed treatment for stormwater runoff.

Is the project located in the vicinity of an EPA-designated sole source aquifer?

☒ No
☐ Yes, describe potential impacts and include a map of the sole source aquifer with project location identified.

P. Wetlands

Does the proposal temporarily or permanently impact wetlands or require alterations to streams or waterways?

☒ No
☐ Yes, describe potential impacts

Q. Construction Impacts

Describe the construction plan and identify impacts due to construction noise, utility disruption, debris and spoil disposal, and staging areas. Address air and water quality impacts, safety and security issues, and disruptions to traffic and access to property.

Estimated costs of the improvements are $220,000. A total of 12 hours of rail grinding would occur for 4 hours each night over 3 nights. Depending on noise level, a noise variance from the City of Portland may be required. The grinding equipment has a built-in vacuum system that operates during grinding. The machine is also skirted to direct debris into that system. A small percentage (approximately 5 percent) of grinding debris does not make it into the vacuum. The remaining debris will likely settle on the roadway or in the track flange. Manual vacuuming and sweeping will capture the remaining rail grindings. Fine mesh material will be installed around and under the work area to prevent wastes from entering the Willamette River.

On-site spill containment materials will be present in case work materials are spilled or dropped.

No in-water work or ground disturbance will occur with this element of the project. All activities will take place on the top deck of the Steel Bridge, and mostly within the existing LRT guideway.

Utilities would not be disrupted and staging areas, if necessary, would be located within the right-of-way.

There would be no road or rail closures and no traffic impact from construction. No impacts to property access would occur.

TriMet would be required to follow all safety and security measures required to do any maintenance or improvement project.

R. Cumulative and Indirect Impacts

Are cumulative and indirect impacts likely?

☒ No

☐ Yes, describe the reasonably foreseeable:

a) Cumulative Impacts, which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

b) Indirect impacts, which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect impacts may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air, water and other natural systems, including ecosystems.

S. Property Acquisition

If property is to be acquired for the project, indicate whether acquisition will result in relocation of businesses or individuals.

Note: To ensure the eligibility for federal participation, grantees may not acquire property with either local or federal funds prior to completing the NEPA process and receiving written concurrence in the NEPA recommendation. For acquisitions over $500,000, FTA concurrence in the property's valuation is also required.

No property acquisition is expected for this project.

T. Public Notification

Describe public outreach efforts undertaken on behalf of the project. Indicate opportunities for public hearings, (e.g. board meetings, open houses, special hearings). Indicate any significant concerns expressed by agencies or the public regarding the project.

Due to the minimal impacts of this improvement within existing right of way with no road or rail closures public notification has not been deemed necessary.

U. Mitigation Measures

Describe all measures to be taken to mitigate project impacts.

The above sections describe the measures and practices that will be included during construction to ensure that any potential impacts are avoided or minimized. No additional mitigation would be required beyond the measures that are already part of the project construction approach, as described above.

V. Other Federal Actions

Provide a list of other federal NEPA actions related to the proposed project or in the vicinity.

The Steel Bridge LRT modification project is related to the Columbia River Crossing and project. The purpose of the aforementioned modifications to the Steel Bridge is to allow for greater speeds of LRVs traveling over the bridge.

W. State and Local Policies and Ordinances

Is the project in compliance with all applicable state and local policies and ordinances?

☐ No, describe

☒ Yes

X. Related Federal and State/Local Actions

- ☐ Corps of Engineers (Section 10, Section 404)
- ☐ Coast Guard Permit
- ☐ Coastal Zone Management Certification
- ☐ Critical Area Ordinance Permit
- ☐ ESA and EFH Compliance
- ☐ Flood Plain Development Permit
- ☐ Forest Practice Act Permit
- ☐ Hydraulic Project Approval
- ☐ Local Building or Site Development Permits
- ☐ Local Clearing and Grubbing Permit
- ☐ National Historic Preservation Act-Section 106
- ☐ National Pollutant Discharge Elimination System Baseline General for Construction
- ☐ Shoreline Permit
- ☐ Solid Waste Discharge Permit
- Sole Source Aquifer
- ☐ Section 4(f) or 6(f) (Recreational and Historic Properties)
- ☐ Section 106 (Historic Properties)
- ☐ Stormwater Site Plan (SSP)
- ☐ Temporary Erosion and Sediment Control Plan (TESC)
- ☐ Water Rights Permit
- ☐ Water Quality Certification—Section 401
- ☐ Tribal Permits (if any, describe below)
- ☒ Other

Describe as applicable:
City of Portland Noise Variance

Y. Submitted By:

	Date: 11/8/10

Z: Approved By:

Federal Transit Administration	**Date:**
Federal Highway Administration	**Date:**

Submit two paper copies of this form, attachments, and a transmittal letter recommending a NEPA finding to the address below, or submit an electronic version to deborah.ensor@dot.gov. Contact FTA at the number below if you are unsure of these procedures. Modifications are typically necessary. When the document is approved, FTA may request additional copies.

Federal Transit Administration, Region 10
915 2nd Avenue, Suite 3142
Seattle, WA 98174-1002

phone: (206) 220-7954
fax: (206) 220-7959

For additional links to other agencies or for further topical guidance go to Region 10's Environment web site.

Location and Zoning Supplement

Attach a map identifying the project's location and surrounding land uses. Note any critical resource areas (historic, cultural or environmental) or sensitive noise or vibration receptors (schools, hospitals, churches, residences, etc). Briefly describe the existing zoning of the project area and indicate whether the proposed project is consistent. Include a description of the community (geographic, demographic, economic and population characteristics) in the vicinity of the project.

Land Use and Zoning

The Steel Bridge stretches over the Willamette River connecting downtown Portland to the west with the Rose Quarter/Convention Center to the east side of the river. On the west side of the bridge the surrounding land uses are typical of the downtown area, with low to high-level buildings and surface parking lots. Zoning is Central Commercial (CX), which the City of Portland Zoning Code describes as:

> The CX zone is intended to provide for commercial development within Portland's most urban and intense areas. A broad range of uses is allowed to reflect Portland's role as a commercial, cultural and governmental center. Development is intended to be very intense with high building coverage, large buildings, and buildings placed close together. Development is intended to be pedestrian-oriented with a strong emphasis on a safe and attractive streetscape.

North of the west bridge approach along the water are residential condominiums and apartments. The condominiums are located in the Central Residential Zone (RX), described in City of Portland Code as:

> The RX zone is a high density multi-dwelling zone which allows the highest density of dwelling units of the residential zones. Density is not regulated by a maximum number of units per acre. Rather, the maximum size of buildings and intensity of use are regulated by floor area ratio (FAR) limits and other site development standards. Generally the density will be 100 or more units per acre. Allowed housing developments are characterized by a very high percentage of building coverage. The major types of new housing development will be medium and high rise apartments and condominiums, often with allowed retail, institutional, or other service oriented uses. Generally, RX zones will be located near the center of the city where transit is readily available and where commercial and employment opportunities are nearby. RX zones will usually be applied in combination with the Central City plan district.

South of the west bridge approach along the water is a waterfront park located in the Open Space Zone (OS), described as follows:

> The Open Space zone is intended to preserve and enhance public and private open, natural, and improved park and recreational areas identified in the Comprehensive Plan. These areas serve many functions including:
>
> - Providing opportunities for outdoor recreation;
> - Providing contrasts to the built environment;
> - Preserving scenic qualities;
> - Protecting sensitive or fragile environmental areas;
> - Preserving the capacity and water quality of the stormwater drainage system; and
> - Providing pedestrian and bicycle transportation connections.

The east end of the bridge is an area known as the Rose Quarter/Convention Center. Interstate 5 runs north-south above grade about 500 feet from the bridge approach. The area directly at the end of the bridge is mainly road way and a few industrial parcels. A large industrial storage facility sits on the waterfront north of the bridge ramps. The zoning in this area is General Industrial 1 (IG1), described as:

> The General Industrial zones are two of the three zones that implement the Industrial Sanctuary map designation of the Comprehensive Plan. The zones provide areas where most industrial uses may locate, while other uses are restricted to prevent potential conflicts and to preserve land for industry. The development standards for each zone are intended to allow new development which is similar in character to existing development. The intent is to promote viable and attractive industrial areas.
> **1. General Industrial 1. IG1** areas generally have smaller lots and a grid block pattern. The area is mostly developed, with sites having high building coverages and buildings which are usually close to the street. IG1 areas tend to be the City's older industrial areas.

The Oregon Convention Center, Rose Garden Arena and Memorial Coliseum are located very near the bridge. These are large buildings used for events such as conventions and professional sporting events. They are within the CX zone.

An approximately 6 block residential area, zoned RX, is located approximately 1000 feet northeast of the bridge approach, surrounded by the CX zone. A hospital, church, hotels and office buildings are located within the RX zone.

A park and access to the esplanade is on the river south of the bridge. It is within the OS zone.

The proposed project would not affect land use or zoning in the area because the work would be done entirely within existing right-of-way that already carries light rail.

Surrounding Community Characteristics
As outlined in the land use section above, the community in the vicinity of the project is mainly commercial, with some residential, industrial, and parks. The closest residences to the area where work will be done are the condominiums on the west side of the river, northwest of the bridge, over 350 feet away. The geography is generally flat, with a major river, the Willamette, running NW-SW under the bridge. The river in this area is used for recreation, tourism, and shipping.

Census data from 2000 shows that the block groups within ½ mile of each end of the bridge there are about 8,000 residents. The percent of population whose income is below the poverty level is 36.5%, compared to 13.1% in the city of Portland as a whole.

Population in the surrounding community is 75.5% White, 10.9% Black, 2.6% American Indian and Alaska Native, 2.5% Asian, 0.4% Pacific Islander, 2.7% some other race, and 5.3% two or more races. Persons of Hispanic or Latino origin make up 7.3%.

Population in Portland as a whole is 77.8% White, 6.4% Black, 1.0% American Indian and Alaska Native, 2.5% Asian, 6.4% Pacific Islander, 3.6% some other race, and 4.5% two or more races. Persons of Hispanic or Latino origin make up 6.8%.

Primary API

Zones

Fire Station

0 310 620
Feet

Exhibit 1. Zoning and Land Use
Steel Bridge, Portland

Analysis by J. Koloszar; Analysis Date: July 7, 2010; File Name: PublicServices_FEIS_SteelBrdg.mxd

Noise and Vibration Impact Analysis

Steel Bridge Improvements
New Starts Portion of CRC Project

July 2010

Prepared for:

Metro
Portland, Oregon

Prepared by:

Michael Minor & Associates
Portland, Oregon

Contents

Summary

1. Introduction ... 3
1.1. Project Description ... 3
1.2. Analysis Requirements ... 4
2. Methodology ... 5
2.1. Introduction to Noise ... 5
2.2. Introduction to Vibration ... 5
2.3. FTA Noise and Vibration Criteria ... 6
2.3.1. FTA Noise Impact Criteria ... 6
2.3.2. Ground-Borne Vibration and Ground-Borne Noise Criteria ... 8
3. Noise and Vibration Analysis ... 10
3.1. Land Use ... 10
3.2. Noise Analysis ... 11
3.2.1. Wheel Squeal Noise ... 11
3.3. Vibration Analysis ... 13
4. Noise and Vibration Mitigation ... 13
5. Construction Noise Analysis ... 13
5.1. Construction Noise Levels ... 13
5.2. Construction Mitigation Measures ... 14
5.3. Construction Vibration Methods and Impact Guidelines ... 14

Tables

Table 1. Criteria for Vibration Impacts ... 9

Figures

Figure 1: Project Location and Area Overview ... 4
Figure 2. Typical L_{dn} Noise Levels and Compatible Land Uses ... 5
Figure 3. Typical Vibration Levels ... 6
Figure 4. FTA Noise Impact Criteria for Category 1 or 2 Land Uses ... 8
Figure 5. Land Use near Project Site ... 10
Figure 6. Peak Hour L_{eq} Noise Levels versus Distance ... 12
Figure 7. Peak Hour L_{dn} Noise Levels versus Distance ... 12

Appendices

References ... A

Acronyms and Abbreviations

dB	decibel
dBA	A-weighted decibel
FTA	Federal Transit Administration
Hz	hertz
L_{eq}	equivalent sound level
Ldn	24-hour equivalent sound level with 10 dB penalty factor for nighttime hours
USDOT	U.S. Department of Transportation

1. Introduction

This noise analysis was prepared at the request of Metro, the FTA and Parametrix, Inc. The purpose of the study is to provide an analysis of potential noise and vibration related issues and impacts associated with the proposed improvements to the Steel Bridge light rail alignment.

1.1. Project Description

Currently, all Light Rail Transit (LRT) lines within the regional TriMet MAX system cross over the Willamette River in downtown Portland via the Steel Bridge. The Steel Bridge was built in 1912 and retrofitted to receive light rail vehicles in 1984 to accommodate the TriMet Blue Line MAX light rail to Gresham. In 1986, when the light rail opened, there were 40 light rail vehicles that crossed the bridge during the 4-hour PM peak period; in 2007, with the Red and Yellow Lines constructed, 116 light rail vehicles crossed the bridge during the 4-hour PM peak period. Currently, TriMet has completed constructing the I-205 South Corridor Project that extended LRT to Clackamas Town Center increasing the number of vehicles that cross the Steel Bridge to 152 during the 4-hour PM peak period. With a peak period headway of 8 minutes, the CRC Project will increase the number of light rail vehicles that cross the Steel Bridge in 2030 during the 4 hour PM peak period to 176 trains counting both directions of travel. Included in the New Starts portion of the CRC project is a retrofit to the existing rails within the Steel Bridge to increase the allowed LRT speed over the Willamette River on the Steel Bridge.

The Steel Bridge lifts to allow large boats to navigate the Willamette River. Currently, the lift joints in the rails limit the crossing speed of LRT vehicles to 10 miles per hour (mph) or less. This is due to the vibrations at these joints disrupting the signaling and electrification system. Modifications to reduce the wheel rise from the lift joint would decrease the bridge vibration, allowing an increase to the travel speed over the bridge to 15 mph and improving the speed of the regional LRT system as a whole.

There is an existing signal case on the lift span that cannot withstand high levels of vibration. Furthermore, the OCS (overhead catenary system) is not designed to withstand the high levels of vibration that are generated with speeds above 10 mph.

The work needed to increase the speed limits to 15 mph over the lift spans would include the following:

1. Grind the rails to remove the lift joint bumps. Also, grind all of the existing rail on the tangent portion of the Steel Bridge to remove rail corrugation and any rough field welds.
2. Install a vibration pad under the signal case to dissipate vibration.
3. Stiffen the OCS brackets to allow for greater impact as the catenary transfers from the fixed to movable span.
4. Make LRT signal adjustments and traffic signal adjustments for NW Everett Street and N Interstate Avenue to accommodate the higher speeds.

1.2. Analysis Requirements

This report was prepared as required the FTA. A complete description of the procedures and methodology used in the analysis is given in the Methodology Section. A bibliography of the technical support documents used for this report is in Appendix A.

Figure 1: Project Location and Area Overview

2. Methodology

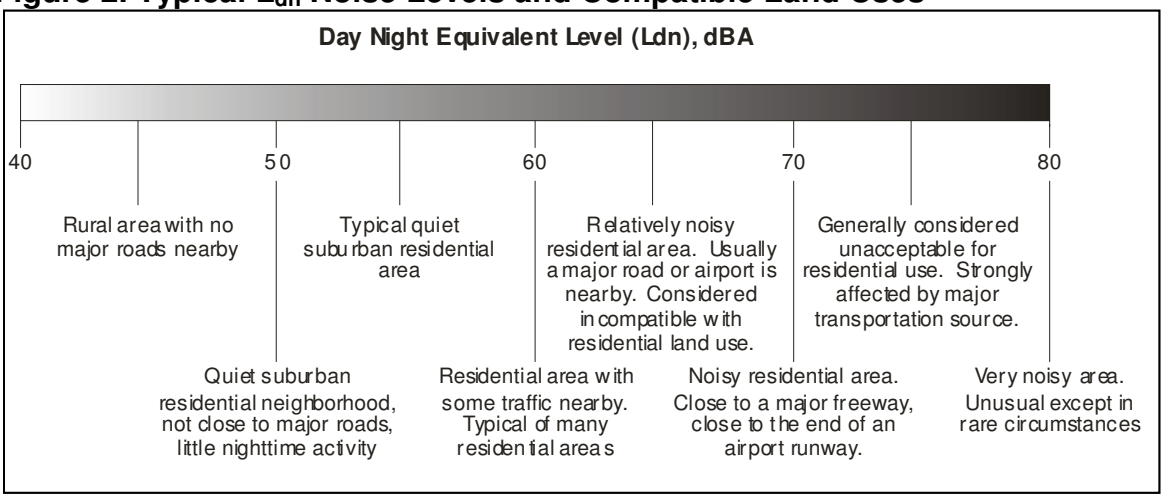
This section provides the results of the noise and vibration impact assessment conducted for the Steel Bridge Improvement Project. The following sections provide an introduction to noise and vibration, the FTA criteria and analysis methods.

2.1. Introduction to Noise

Noise is defined as unwanted sound, which is measured in terms of sound pressure level and is usually expressed in decibels (dB). The human ear is less sensitive to higher and lower frequencies than to mid-range frequencies. Therefore, a weighting system that filters out higher and lower frequencies in a manner similar to the human ear was developed. Measurements made with this weighting system are termed "A-weighted" and are specified as "dBA" readings.

The L_{max} is the loudest instantaneous noise level during a pre-set measurement period. The equivalent sound level (L_{eq}) is the level of a constant sound for a specified period of time that has the same sound energy as an actual fluctuating noise over the same period of time. The day-night sound level (L_{dn}) is an L_{eq} over a 24-hour period, with a 10 dBA penalty factor added to nighttime sound levels occurring between 10 p.m. and 7 a.m. The L_{dn} is the primary noise level descriptor for light rail noise at residential land uses. The peak-hour L_{eq} is used for all traffic and light rail noise analysis for locations with daytime use, such as schools and libraries. Figure 2 is a graph of typical L_{dn} noise levels and residential land use compatibility.

Figure 2. Typical L_{dn} Noise Levels and Compatible Land Uses



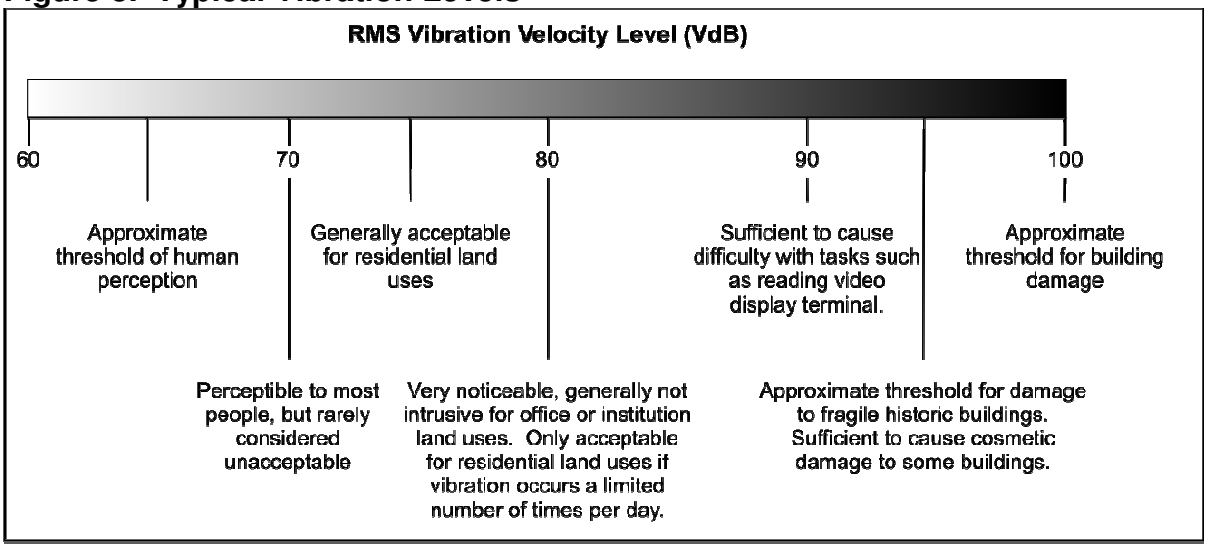
Source: FTA 2006.

2.2. Introduction to Vibration

There are two components of vibration, ground-borne noise and ground-borne vibration. Ground-borne noise is normally associated with subway systems and is not an issue on this

project because all alignments are at-grade or elevated. Ground-borne vibration is defined as a rapidly fluctuating motion that is transmitted through the ground from the vibration source to a receiver. Although ground-borne vibration attenuates over distance, some soil types transmit the vibration quite efficiently, while others do not. The response of humans, buildings, and sensitive equipment to vibration is described in this section in terms of the root-mean-square (RMS) velocity level in decibel units (VdB). As a point of reference, the average person can just barely perceive vibration velocity levels below 70 VdB. Figure 3 compares typical ground-borne vibration levels.

Figure 3. Typical Vibration Levels



Source: FTA 2006.

2.3. FTA Noise and Vibration Criteria

The impact criteria given in the Transit Noise and Vibration Impact Assessment Manual, Federal Transit Administration (FTA, revised May 2006), is based on research of community reaction to noise, and it reflects changes in noise exposure by using a sliding scale. The vibration criteria is also based on use, and for most land uses is based on a single number, however the vibration criteria also has several categories of special use buildings, such as recording studios and concert halls, where vibration and ground-borne noise can impact the facilities operations.

2.3.1. FTA Noise Impact Criteria

The FTA Noise Impact Criteria group noise-sensitive land uses into the following three categories that are taken directly from the FTA Manual:

- **Category 1.** Buildings or parks where quiet is an essential element of their purpose.

- **Category 2.** Residences and buildings where people normally sleep. This includes residences, hospitals, and hotels where nighttime sensitivity is assumed to be of utmost importance.
- **Category 3.** Institutional land uses with primarily daytime and evening use. This category includes schools, libraries, and churches.

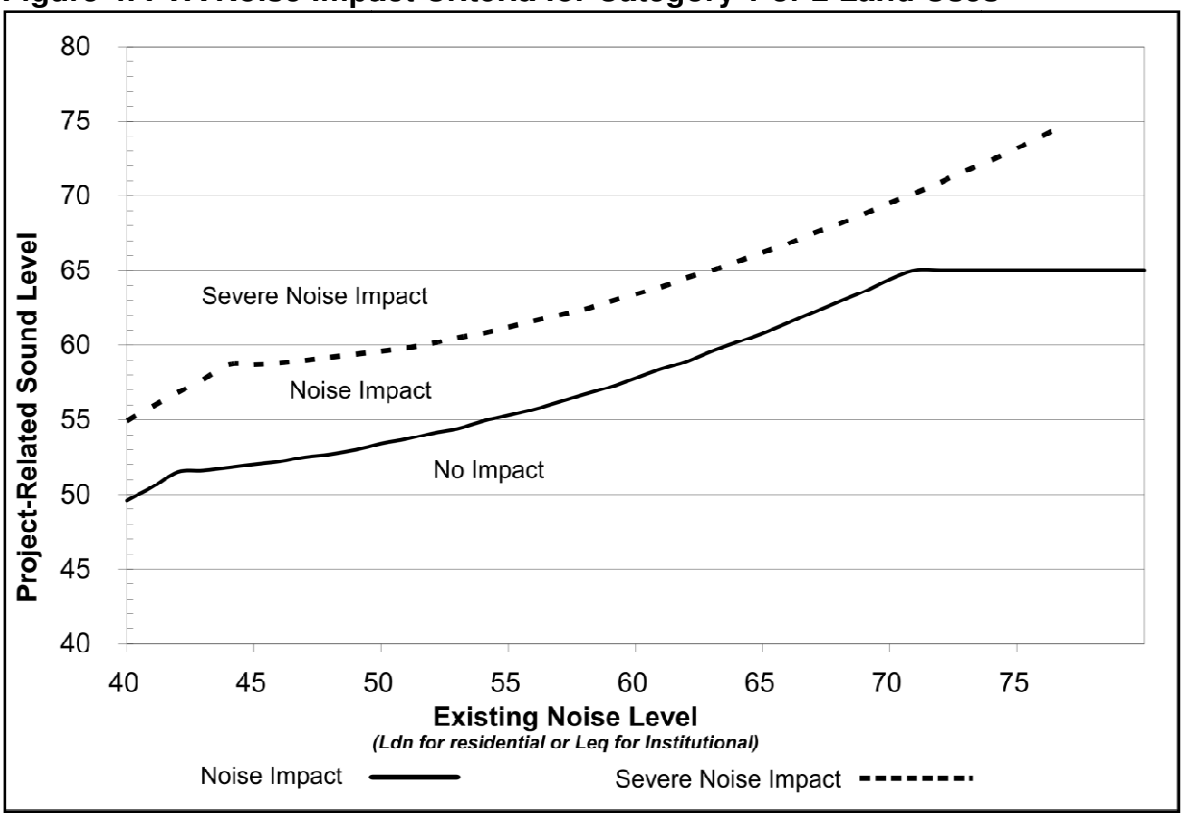
The L_{dn} descriptor is used to characterize noise exposure for residential areas (Category 2). Maximum one-hour L_{eq} during the period that the facility is occupied is used for other noise-sensitive land uses, such as school buildings (Category 3). The Portland-Milwaukie Light Rail Project corridor was examined extensively, and the only Category 1 land use identified in the corridor is the Digital One production studio. There are no noise impact criteria for commercial or industrial land use under FTA criteria.

There are two levels of impact—severe and moderate—included in the FTA noise criteria. The interpretation of these two levels of impact is summarized below:

- **Severe.** Severe noise impacts are considered "significant," as this term is used in the National Environmental Policy Act (NEPA). Noise mitigation will normally be specified for severe, or significant, impact areas unless there is no practical method of mitigating the noise.
- **Moderate.** In this range, other project-specific factors, such as the types and number of noise-sensitive land uses that are affected, existing outdoor-indoor sound insulation, and the cost-effectiveness of mitigating noise, must be considered to determine the magnitude of the impact and the need for mitigation.

The noise impact criteria for light rail operations are summarized in Figure 4. The bottom axis of the graph represents the existing L_{dn} at the receiver location, and the side axis represents the noise resulting from the project. The graph shows that as the existing noise exposure increases, the amount of the allowable increase in the overall noise exposure caused by the project decreases. For example, a receiver with an existing L_{dn} of 65 dBA would have an impact if project noise levels equaled, or were greater than, 61 dBA L_{dn}, and the impact would be considered severe if the project L_{dn} was greater than 66 dBA L_{dn}.

Figure 4. FTA Noise Impact Criteria for Category 1 or 2 Land Uses



2.3.2. Ground-Borne Vibration and Ground-Borne Noise Criteria

FTA has developed impact criteria for acceptable levels of ground-borne noise and vibration. Experience with ground-borne vibration from rail systems and other common vibration sources suggest that:

- Ground-borne vibration from transit trains should be characterized in terms of the RMS vibration velocity amplitude. A one-second RMS time constant is assumed. This is in contrast to vibration from blasting and other construction procedures that have the potential of causing building damage. When looking at the potential for building damage, ground-borne vibration is usually expressed in terms of the peak particle velocity (PPV).
- The threshold of vibration perception for most humans is around 65 VdB, levels in the 70 to 75 VdB range are often noticeable but acceptable, and levels greater than 80 VdB are often considered unacceptable.
- For urban transit systems with 10 to 20 trains per hour throughout the day, limits for acceptable levels of residential ground-borne vibration are usually between 70 and 75 VdB.
- Ground-borne vibration from any type of train operations will rarely be high enough to cause any sort of building damage, even minor cosmetic damage. The only real concern is that the vibration will be intrusive to building occupants or interfere with vibration-sensitive equipment.

Table 1 summarizes the FTA impact criteria for ground-borne vibration and ground-borne noise. These criteria are based on previous standards, criteria, and design goals, including ANSI S3.29 and the noise and vibration guidelines of the American Public Transit Association. Land use categories are described in the following paragraph.

Table 1. Criteria for Vibration Impacts

Land Use Category	Category Comment	Ground-borne Vibration (VdB re 1 micro in/sec)		Ground-borne Noise (dBA re 20 micro Pa)	
		Events*			
		Frequent	Infrequent	Frequent	Infrequent
1	Low interior vibration and noise is essential	65	65	n/a	n/a
2	Residential & sleep	72	80	35	43
3	Institutional & daytime	75	83	40	48

* Frequent is defined as greater than or equal to 70 events per day.

** See section 12.2.2 of FTA Manual re: potential for structural damage to fragile structures if operational during transit events.

Source: FTA 2006

As shown in Table 1, some land use activities are more sensitive to vibration than others. The FTA assigns sensitive land uses to the following three categories:

- Vibration Category 1: High Sensitivity – Buildings where low ambient vibration is essential for the interior operations in the building. Vibration levels may be below the level of human perception.
- Vibration Category 2: Residential – Residences and buildings where people normally sleep. This includes private dwellings, hospitals, and hotels where nighttime sensitivity is assumed to be of utmost importance. It is common practice to also use this category as a standard for some special uses such as auditoriums or theaters.
- Vibration Category 3: Institutional – Land uses with primarily daytime use including schools, churches, other institutions, and quiet offices that do not have vibration-sensitive equipment.

2.3.2.1. Light Rail Noise and Vibration Analysis Methods

The light rail noise and vibration analysis was performed in accordance with the Transit Noise and Vibration Impact Assessment Manual, Federal Transit Administration (FTA, revised May 2006). Models were developed to predict noise and vibration using the methods given in the FTA Manual. Inputs to the models include the track type (elevated, at-grade, and embedded), distance from the light rail tracks to sensitive properties, train speed, number of trains per hour per day, and special trackwork such as switches. The FTA manual provides the following factors for special and elevated trackwork:

- At-grade ballast and tie track + 0 dBA
- Jointed track and switches + 5 dBA
- Elevated trackway + 4 dBA
- Embedded trackway + 3 dBA

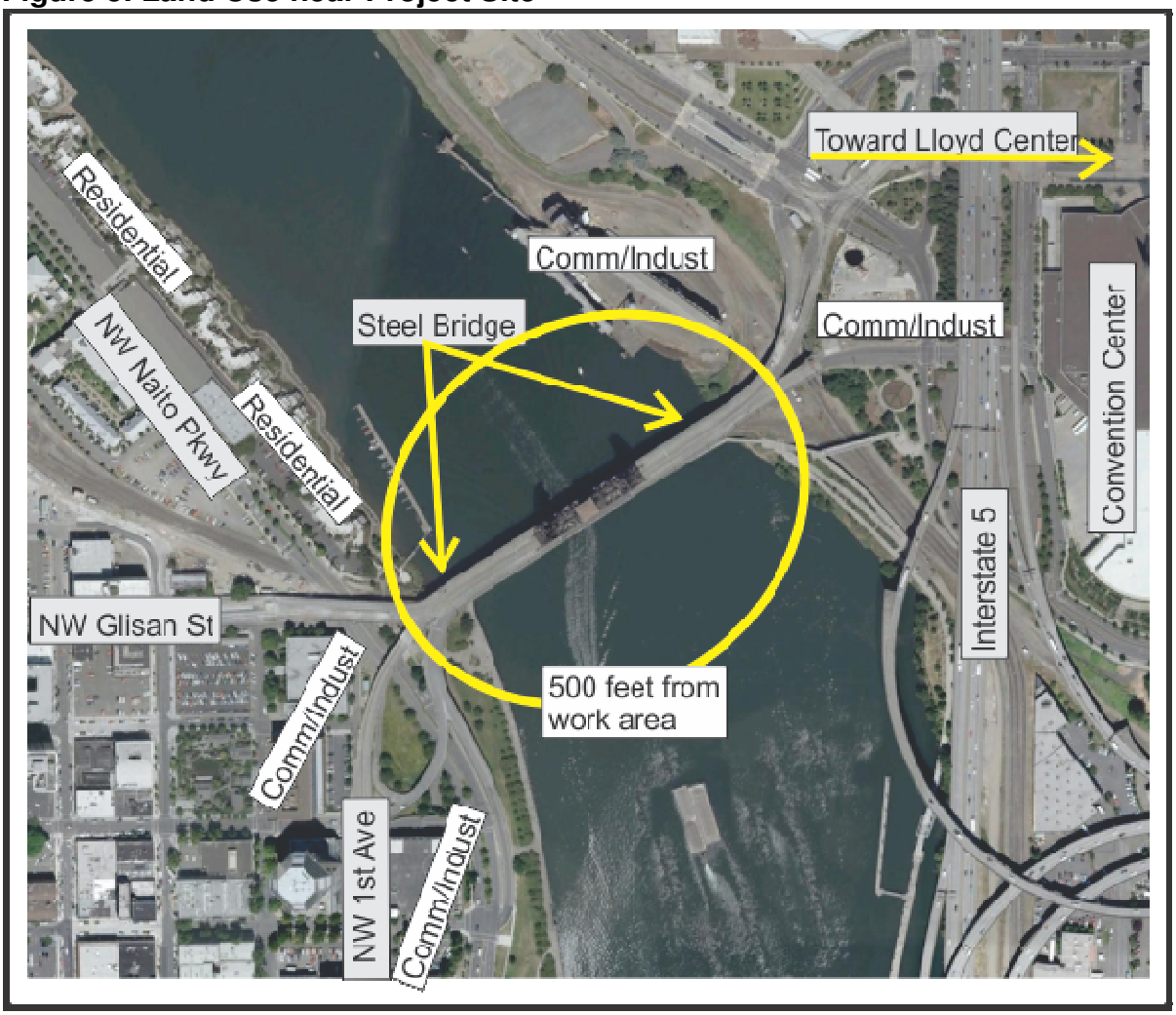
Light rail vibration impacts were determined using the equations provided by the FTA and the measured vibration levels from TriMet's light rail vehicles. The measured levels were adjusted to the specific location and track type. The corrected vibration levels were compared to the appropriate vibration criteria, and vibration impacts were identified.

3. Noise and Vibration Analysis

3.1. Land Use

Land use near the work area includes a large multi-family community that is over 600 feet from the light rail alignment along with several commercial and industrial uses. The residences are located on the west side of the bridge, north of the alignment. All other uses are commercial and industrial or well shielded from the site. Figure 5 is an aerial view with nearby land use identified.

Figure 5. Land Use near Project Site



3.2. Noise Analysis

Peak hour noise levels were predicted for the existing conditions and future build conditions. Currently, the number of vehicles that cross the Steel Bridge is 152 during the 4-hour PM peak period. With a peak period headway of 8 minutes, the CRC Project will increase the number of light rail vehicles that cross the Steel Bridge in 2030 during the 4 hour PM peak period to 176 trains counting both directions of travel. This would result in one two car train crossing the bridge every 3 minutes.

Included in the New Starts portion of the CRC project is a retrofit to the existing rails within the Steel Bridge to increase the allowed LRT speed over the Willamette River on the Steel Bridge. Currently, the lift joints in the rails limit the crossing speed of LRT vehicles to 10 miles per hour (mph) or less. This is due to the vibrations at these joints disrupting the signaling and electrification system. Modifications to reduce the wheel rise from the lift joint would decrease the bridge vibration, allowing an increase to the travel speed over the bridge to 15 mph and improving the speed of the regional LRT system as a whole.

The resulting change in noise levels related to the increased light rail traffic across the Steel Bridge was calculated at 6 dBA L_{eq} during peak-hour and the 24-hour L_{dn} increase is approximately 5 dBA. Figure 6 is a graph of the peak-hour L_{eq} versus distance and Figure 7 provides the results for the L_{dn}. There are no noise sensitive receivers located within 350 feet of the alignment and no noise impacts are projected.

3.2.1. Wheel Squeal Noise

Wheel squeal occurs on tight radius curves and is a result of the inner wheels slipping on the rails. It typically happens on curves with a radius of 300 feet or less, but has, on occasion, been identified on larger curves when combined with elevation changes or super elevations. The only two curves near this site are the curves on either side of the bridge. Both of these curves have radii of around 500 feet or more and have been in use for several years, and no major wheel squeal was identified. Because the squeal is associated with track curvature, and not related to the number or trains, wheel squeal is not predicted to result in any noise impacts.

Figure 6. Peak Hour L_{eq} Noise Levels versus Distance

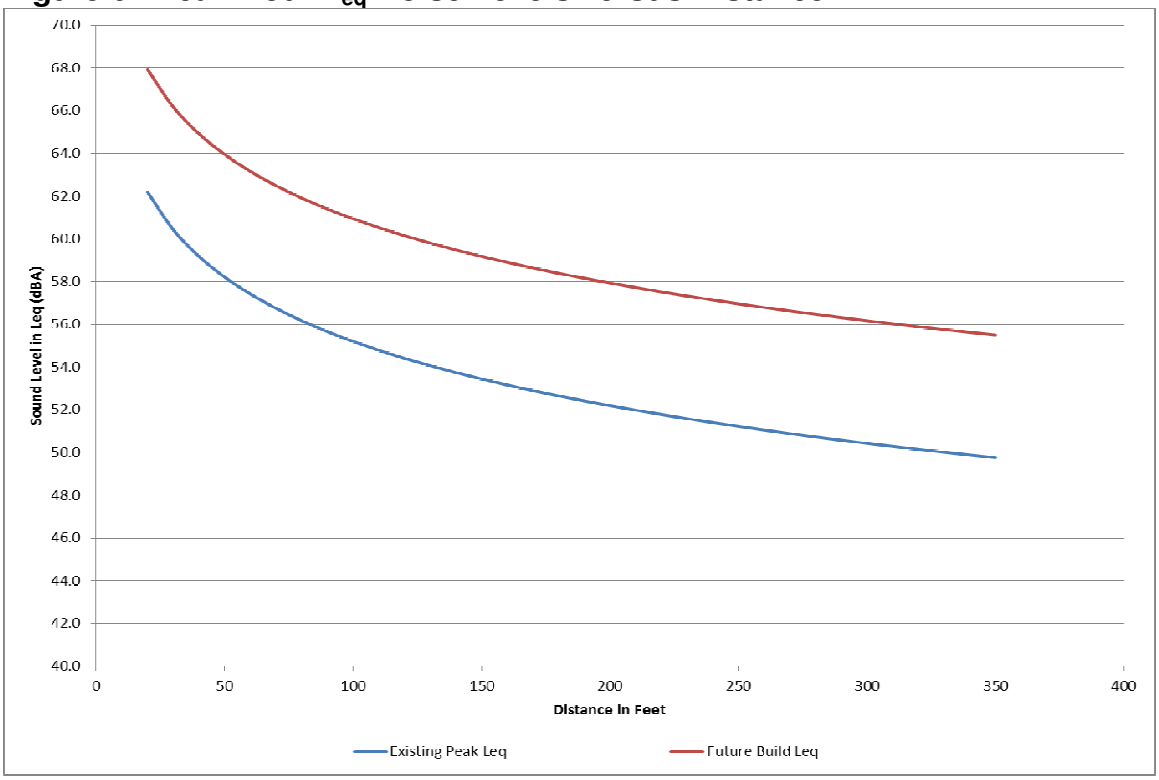
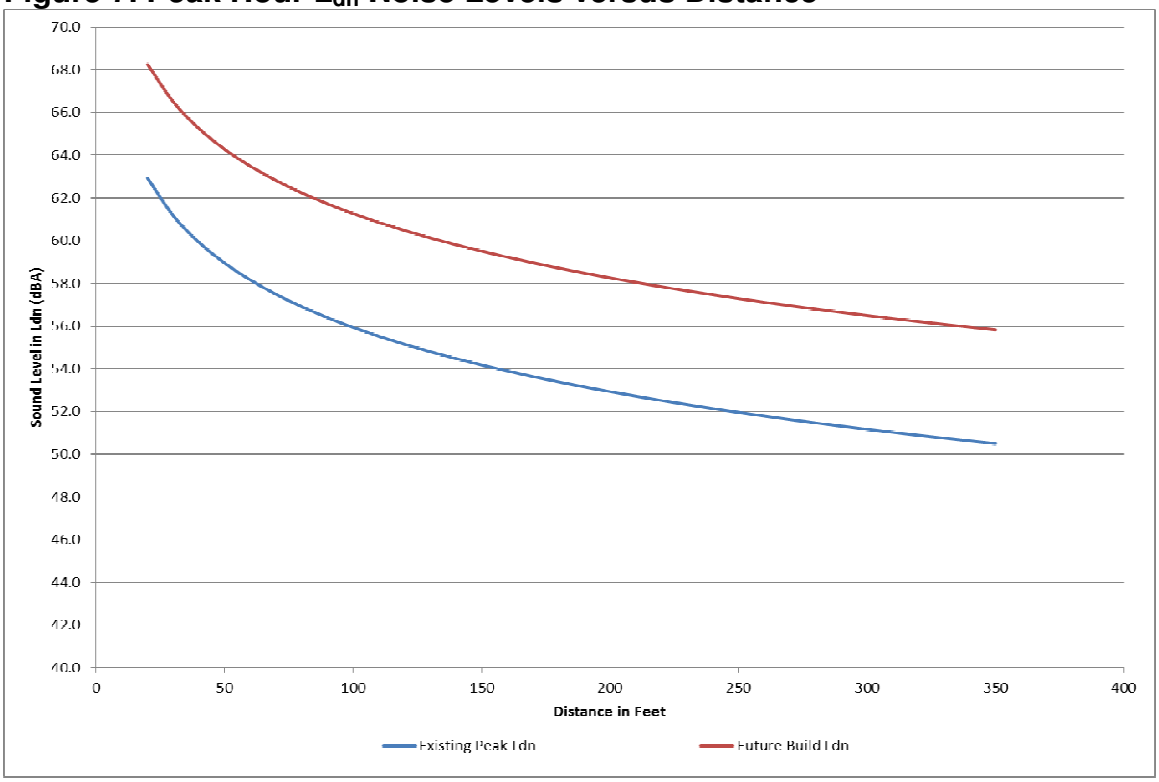


Figure 7. Peak Hour L_{dn} Noise Levels versus Distance



3.3. Vibration Analysis

There is a break in the rail required for lift span operation. The break in the rails leaves a small gap that produces a vibration peak when the train wheels cross over. By modifying the break in the rail on the structure with a flange bearing, the usual impact that occurs when the train crosses over the opening will be greatly reduced. Vibration reductions of up to 5 Vdb are typical for this type of modification.

The closest building to the light rail alignment is the Oregon Department of Transportation Region 1 headquarters on NW Flanders at NW 1st Ave. Current vibration levels are projected to range from 65 to 68 VdB at this location. The building is adjacent to the retained fill and elevated structure that connects to the Steel Bridge and is approximately 60 to 70 feet from the near track. Because no modifications are proposed in this area, the vibration levels are not predicted to change from the 65 to 68 VdB projections, which are well below the FTA criteria of 75 VdB for a commercial building.

The only other concern is for vibration levels on the bridge causing issues with the electronics that control the bridge functions. Current vibration levels are predicted at 82 to 84 VdB at the control box. With the switch modifications, vibration reducing mats, and increased speed, vibration levels are actually predicted to reduce to between 77 and 80 VdB or lower. Since the future vibration levels are predicted to be lower than the current levels, the proposed project is not predicted to cause any issues with the overhead catenary system. The vibration mats under the existing signal case on the lift span are also predicted to reduce overall vibration levels for the equipment to less than the current levels.

4. Noise and Vibration Mitigation

No noise or vibration impact was identified and no mitigation is proposed.

5. Construction Noise Analysis

Construction noise and vibration as related to the project are given in the following sections. Information provided includes potential construction noise levels and construction noise mitigation.

5.1. Construction Noise Levels

Construction noise would be generated by equipment used during modifications to the bridge structure. Construction activities would be limited to the bridge structure. Equipment required for the project could include generators, metal grinders, fork lifts, welders, compressors and light plants. The nearest noise sensitive properties would be the multi-family units located to the north of the bridge, approximately 450 feet from the worksite.

There are currently no criteria for construction noise during daytime hours in the City of Portland. Therefore, if the work can be performed during daytime hours, no construction noise impacts would be predicted. However, given the volume of trains using the bridge daily, it is

unlikely that the project could be completed with daytime only work. If nighttime work was proposed, a noise variance from the City of Portland would be required.

5.2. Construction Mitigation Measures

Several construction noise abatement methods can be implemented to limit the impacts. All engine-powered equipment can be required to have mufflers installed according to the manufacturer's specifications, and all equipment can be required to comply with pertinent equipment noise standards of the U.S. Environmental Protection Agency.

If specific noise complaints are received during construction, the contractor, at his own expense, may be required to implement one or more of the following noise mitigation measures, as directed by the project manager:

- Locate stationary construction equipment as far from nearby noise-sensitive properties as possible.
- Shut off idling equipment.
- Reschedule construction operations to avoid periods of noise annoyance identified in the complaint.
- Notify nearby residents whenever extremely noisy work will be occurring.
- Install temporary or portable acoustic barriers around stationary construction noise sources.

Finally, because of the local noise ordinance, construction activities outside the hours of 7:00 a.m. and 10:00 p.m. on weekdays, and 9:00 a.m. and 10:00 p.m. on weekends may require a noise variance.

5.3. Construction Vibration Methods and Impact Guidelines

There are no specific regulations or criteria that are applicable to vibration related to construction activities. However, SEPA and NEPA guidelines allow federal, state, and local agencies the authority to determine acceptable levels of construction vibration using guidelines, research, and professional standards. The USDOT guidelines for acceptable vibration levels from construction activities recommend that the maximum peak-particle velocity levels remain below 1.27 inches per second at structures nearest the construction site. Vibration levels above 1.27 inches per second have the potential to cause architectural damage to normal dwellings. The USDOT also states that vibration levels above 0.64 inch per second can be annoying to people and disrupt normal working or living environments (USDOT 1978). No vibration related issues are predicted during construction.

Appendix A

References

FTA. 2006. *Transit Noise and Vibration Impact Assessment*. See U.S. Department of Transportation, 1995.