Multnomah County Willamette River Bridges Capital Improvement Plan

Seismic Vulnerabilities and Retrofit Report



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- **APPENDIX A Seismic Vulnerabilities Forms**
- APPENDIX B Vulnerability Figures
- APPENDIX C Retrofit Cost Details
- APPENDIX D Probabilistic Seismic Hazard Plots

Multnomah County Willamette River Bridges Capital Improvement Plan

Seismic Vulnerabilities and Retrofit Report

1 INTRODUCTION

Multnomah County intends to develop a 20 year Capital Improvement Program which includes a programmatic evaluation and assessment of the seismic retrofit needs for the four major downtown Willamette River bridges owned by the County.

This report summarizes the vulnerabilities and proposed retrofits for the four moveable bridges: Broadway, Burnside, Morrison, and Hawthorne. The retrofits were developed based on the performance and earthquake levels outlined in Section 2 of this report.

The following guiding assumptions were used in developing this report.

- Identification of seismic vulnerabilities was based on existing reports, examination of existing bridge plans, simple hand calculations, and engineering judgment. No analyses or finite element models of the bridges were developed.
- Standard retrofit types was based on commonly used retrofit measures such as those noted in the Federal Highway Administration Seismic Retrofit Manual (FHWA), Oregon Department of Transportation (ODOT) Bridge Design and Drafting Manual, and the California Department of Transportation (Caltrans) Seismic Design Criteria.
- Detailed quantity breakdowns of the retrofit costs for each bridge were not developed.
- The geotechnical hazard vulnerabilities of liquefaction and lateral spreading were assessed based on existing geotechnical data.
- Retaining wall structures were not included in the seismic vulnerability assessment.
- Consistent retrofit strategies and costs were applied to similar components between the bridges.
- Retrofit strategies that address vulnerabilities in multiple components, such as base-isolation, were considered as system behavior modification retrofits.

The tables in Section 4 of the report briefly summarize the bridge component vulnerability and the retrofit course of action recommended for each earthquake level.

The vulnerabilities and retrofits for each bridge are provided in the appendices of this report. The appendices include comprehensive Seismic Vulnerability Forms for each bridge, representative figures showing the vulnerable components, and the background, notes and assumptions used to develop the construction cost estimates for each retrofit.

2 PERFORMANCE CRITERIA

In assessing the level of retrofit required, target performance levels and earthquake type are both required to determine the level of retrofit appropriate for each bridge. These, as well as the overall philosophy of the retrofit strategy, were developed for this project at a workshop session with Multnomah County and Consultant team staff.

2.1 Performance Levels

In determining the level of retrofit required, a desired performance level for each bridge was first determined. The Performance level definitions are provided in Table 1. These were developed using the FHWA Seismic Retrofit Manual as a guideline, but modified to provide definitions applicable to the Willamette River bridges.

Table 1. Performance Level Definitions

Performance Level	Abbr.	Definitions for Retrofit of Existing Structures
Do Nothing	DN	No retrofit measures undertaken.
No Collapse (Life Safety)	NC	No collapse with damage to foundations and some permanent deformation. May require significant repair and potential replacement of major structural components. Serviceability after the event is not assured.
Limited Operation	LO	Inelastic behavior allowing for emergency vehicles after inspection and removal of debris. Moveable components may not be able to operate without inspection, repairs, replacement and maintenance activities. Damage is repairable with or without impacts to traffic including limited permanent deformation. Foundations remain essentially elastic.
Full Operation (Serviceable)	FO	Essentially elastic for all main structural components, moveable components able to be operated after inspection, some repairs and maintenance activities. All traffic able to operate including river navigation.

2.2 Earthquake Levels

Three different Earthquake levels were selected for consideration. The probabilistic seismic hazard plots for each event are provided in Appendix D.

The 1000-yr event is the baseline major design event used by ODOT, FHWA, and the American Association for State Highway and Transportation Officials (AASHTO). This event in the Portland area has anticipated peak ground acceleration (PGA) of 0.28g.

The 500-yr event is used to capture a large event occurrence on the Cascadia Subduction Zone (CSZ) fault which has roughly 500 year return period and is a large contributor to the risk associated with a 500-yr CSZ event. According to ODOT, there is an estimated 37 percent chance of a large event (M8.0 - 9.0) on the Cascadia Subduction Zone Fault within the next 50 years. The anticipated PGA of the 500-yr CSZ event is 0.20g.

The 100-yr event is intended to capture a relatively minor seismic event and identify a minimal level of seismic upgrade that would provide some protection from collapse of the structures. The anticipated PGA of the 100-yr event is 0.07g.

The performance level targeted for each bridge and earthquake level is summarized in Table 2. In assigning importance categories to the bridges, the Burnside Bridge was considered essential and therefore was assigned higher performance levels for the given earthquakes than the other three bridges (which were considered standard).

Table 2. Bridge Earthquake Levels Summary

	Performa	nce Level	
Earthquake Level (PGA)	Broadway, Morrison, Burnside Hawthorne		Geotechnical Hazard (Liquefaction and Lateral Spreading)
100-year (0.07g)	NC	NC	Assume geotechnical hazards do not cause a collapse mechanism
500-year CSZ (0.20g)	NC	FO	Investigate / determine if geotechnical hazards cause a collapse mechanism
1000-year (0.28g)	NC	LO	Investigate / determine if geotechnical hazards cause a collapse mechanism

3 VULNERABILITIES AND RETROFITS

The current seismic design guideline for new bridges protects the foundation and superstructure by creating known fuses within the bridge. This is typically located in the columns, where seismic displacement and damage can be contained within a well detailed component. For existing bridges designed prior to the modern seismic codes, this type of fused system is often impractical; and so a variety of retrofit measures are used to develop a predictable and reliable seismic resistance system for the bridge structure. Additionally, ground improvement retrofits are often required to mitigate liquefaction and lateral spreading concerns.

Seismic retrofits are typically categorized according to what type of bridge behavior they are intended to protect. For typical girder type highway bridges, the conventional retrofit strategies are categorized as either a Phase 1 or Phase 2 type. For less common bridge types, such as trusses or arches, there are other general retrofits required to provide adequate seismic load path strengthening. In this report, we have designated these as "Load Path" retrofits. Lastly, for major bridges, there are retrofits that modify the dynamic behavior or interaction of the bridge structure as a means of protecting components. In this report, we have designated these as "System Behavior Modification" retrofits. Each of these retrofit types is discussed further below.

3.1 Phase 1 Retrofit

Phase 1 retrofits are intended to keep the superstructure from becoming disconnected from the substructure and collapsing. Phase 1 retrofits strengthen the first part of the primary load path, the connection of the superstructure to the substructure. These retrofits by themselves do not provide a complete seismic load path transfer mechanism but instead provide a relatively inexpensive solution to one common seismic failure mode.

As part of this study, the component retrofits that fit into a Phase 1 retrofit project are identified in the bridge summary tables shown in Section 4.

Typical Phase 1 retrofits recommended for the Willamette River bridges include:

- Replacement of failure prone bearings
- Extension of bearing seats
- Lateral and longitudinal restraint using cable restrainers or shear blocks
- Strengthening of girder bracing and diaphragms at the bearings
- Live load shoe or anchor strut modification to provide longitudinal restraint

3.2 Phase 2 Retrofits

Phase 2 retrofits are intended to provide a load path for anticipated seismic forces with adequate ductility from the superstructure to the ground. These retrofits typically include strengthening the substructure and typically involve significant costs; but together with Phase 1 retrofits provide a complete seismic retrofit solution for typical girder type bridges.

Typical Phase 2 retrofits recommended for the Willamette River bridges include:

- Encasement of columns using steel, concrete, or FRP to provide increased ductility and lateral strength
- Encasement and/or post-tensioning of bent caps and footings to provide adequate joint strength
- Footing enlargement and/or additional pile installation

3.3 Seismic Load Path Retrofits

The truss bridge and bascule components of the Willamette River bridges will require component retrofits that fall outside of the typical Phase 1 and Phase 2 retrofit types. These are typically component retrofits unique to the specific structure. They are designed to provide either a strengthened load path or to limit displacements of some bridge elements.

The types of retrofits in this category include:

- Strengthening of truss lateral bracing including counterweight braces
- Strengthening of trunnion supports
- Introduction of strengthening shear walls
- Broadway Rall wheel beam or Hawthorne tower strengthening

3.4 System Behavior Modification Retrofits

Each of the prior retrofit types targets a specific component of the bridge. The last type of retrofit employed in this study includes both base isolation and friction damped bracing systems that modify the bridge's dynamic behavior in a seismic event. This is accomplished by changing not only the capacity of a specific component, but the load and displacement demands that the bridge system undergoes in a seismic event.

A base isolation system works by providing a displacement isolation layer coupled with an energy absorbing damping device between components of the bridge. The intent of these measures is to limit the amount of seismic energy that is transferred from the ground into the structure. For the bridges in this study, this involves isolating the trusses and bascule spans from the piers. In most cases this, will serve to reduce the force demands in the superstructure and substructure, while increasing the relative displacements between the superstructure and substructure. A modified gap or joint will also be necessary to accommodate this increased movement.

A friction damped bracing systems acts as a seismic energy shock absorber and limits the overall system response. These are less common in the bridge industry but are more common in tall buildings and towers. Given the limited analysis scope of this study, it is assumed that they will be effective as part of the retrofit of the Hawthorne towers.

These retrofits require significant analysis to determine the right fit for the systems; however, it typically results in less strengthening requirements and less cost than strengthening the substructure to resist anticipated seismic force demands. In the bridge summary tables included in Section 4, the retrofits that will be affected by the inclusion of a system retrofit are identified.

As a consequence of base isolation, due to the higher displacement incurred, there are usually additional bridge components that require retrofit. These include deck joints and other movement limiting elements. This is a particular challenge for moveable bridges because large displacements, which are essential for absorbing energy within the base isolation systems, can negatively impact the operating machinery. As such, the system modification devices must be designed in a manner that does not compromise the bridge's operability following a seismic event. The additional cost of these modifications is usually significantly less, however, than the cost associated with traditional strengthening retrofits.

4 BRIDGE SUMMARIES

4.1 Broadway Bridge

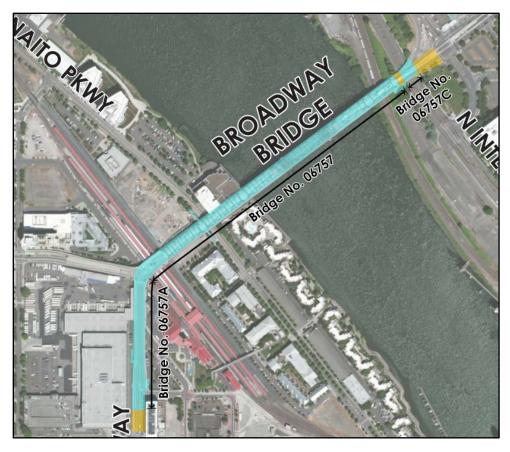
4.1.1 Bridge Background

The Broadway Bridge was originally constructed in 1912. Since then, numerous upgrades have been made to the mechanical systems and the bascule deck has been retrofitted with an FRP deck system. No seismic retrofits have been added to the bridge.

Union Station rail lines and SW Naito Parkway run under the west end of the bridge with an additional Union Pacific rail line under Span 7 on the east bank of the river. The Streetcar was reintroduced across the bridge in 2011 and the MAX lightrail line runs under the east approach structure.

For all earthquake levels on the Broadway Bridge, a performance level of No Collapse (NC) has been set.

Figure 1. Broadway Bridge Overview



4.1.2 West Approach Vulnerabilities

The West Approach of the bridge is made up of a steel floorbeam and stringer system supporting a concrete deck. The floorbeams are supported by steel built-up columns on spread footings.

Under the 500-yr CSZ and 1000-yr events, the primary vulnerabilities are the column and footing strength. Encasement of the columns and strengthening of the footings using an enlarged footing and micro-piles is the recommended retrofit.

Additionally the expansion bearing seats are insufficient and require retrofit for any of the seismic earthquake event levels. According to past studies in the area, there is potential for liquefaction or lateral spreading under the west approach. The mitigation required for this vulnerability is soil strengthening or densification.

4.1.3 Fixed River Spans Vulnerabilities

The Fixed River Spans of the Broadway Bridge are made up of five through truss spans with lengths from 184'-10¾" to 297'-2½" and a steel stringer and floorbeam span (Span 1) with a length of 125'-4¾". The trusses are supported on either concrete filled circular steel columns, or on concrete pier walls with stone cladding. Piers 1 through 3 are founded on concrete footings on concrete and timber piles. Piers 4 through 7 are founded on spread footings with deep caissons. The east abutment supporting span 7 is a retaining structure with fill behind it.

The vulnerabilities relevant to the piers supporting the moveable span (Piers 5 and 6) are described in the Moveable span section. The vulnerabilities of Span 1 and the L-B span, which is the transition between the west approach and the main river spans, are similar to those of the west approach.

The vulnerabilities in the fixed truss spans reside primarily with the columns and pier walls and the connection of the superstructure to the substructure. For the large events, a base isolation system under the truss spans is recommended to reduce the loads in the tall piers and to stabilize their connections to the superstructure. For the 100-yr event, improved connections between the superstructure and substructure are recommended.

According to a prior 1996 seismic analysis, the foundations were found to be stable with the exception of the liquefaction potential. If the recommended base isolation system is used for the truss spans, the loading to the deep foundations will be lessened and the risk will be reduced further.

4.1.4 Moveable Span Vulnerabilities

The Moveable Span of the Broadway Bridge is a 278'-long double leaf Rall wheel type bascule span. The counterweights are held above the bridge deck and the leaves are intended to be supported by the live load shoes and the anchor struts (although it appears that the Rall wheels support much of the weight as well). The bascule deck is a lightweight FRP deck system.

In addition to the vulnerabilities of the tall piers, which are similar to the vulnerabilities described for the fixed river span piers, the composition of the lift mechanism and counterweight present significant seismic vulnerabilities. In particular, the raised counterweight presents challenges for transferring the large inertial forces from the counterweight to the substructure. In its as-constructed state, the path is through the lateral support truss members, to the Rall wheel, and then to the truss components supporting the Rall wheel. Further, the anchor struts are critical members for the stability of the bascule leaves, but are not detailed to perform under seismic displacements.

The recommended retrofit for the moveable portion of Broadway Bridge is a combination of a base isolation system for the bascule spans, strengthening the lateral force transfer trusses, and adding lateral restraints to some components. The base isolation will serve to limit the forces and differential movements that the moveable components see because the superstructure system will move as a unit. It will also reduce forces in the substructure.

4.1.5 East Approach Vulnerabilities

The East Approach of the Broadway Bridge complex is a 2-span cast-in-place frame with fully integral superstructure to abutment and pier connections. In addition, there are concrete ties across the bottom providing a longitudinal link between the footings that result in a closed frame. The structure has good redundancy and the fill on either end of the bridge is anticipated to limit the overall structure movements and demands. For the 500-yr CSZ and 1000-yr events, the frame connections at top and bottom of the abutments and interior pier should be strengthened.

4.1.6 Retrofit Summary

Table 3 summarizes the results of the Seismic Vulnerabilities Assessment for the Broadway Bridge. The table identifies: (1) anticipated Phase 1 retrofit measures; (2) retrofit measures for each earthquake level; and (3) retrofit measures that are modified by the system retrofits. A description of each vulnerability and the recommended retrofit measures for each seismic level is included in Appendix A. Figures associated with each vulnerability can be found in Appendix B.

Table 3. Broadway Bridge Summary Table

Location	Number	Component	Phase 1 Retrofit	100-Yr	500-Yr CSZ	1000-Yr	Modified by System Retrofit
West Approach	1	Steel Columns			Х	Х	
West Approach	2	Exp. Bearing Seat Widths	Х	Х	Х	Х	
West Approach	3	Footings - Strength			Х	Х	
West Approach	4	Footings - Geotech Hazard			Х	Х	
Fixed Spans	1	Pier 2 Steel Columns		Х	Х	Х	Х
Fixed Spans	2	Pier 1, 3, 4, 7 Columns			Х	Х	Х
Fixed Spans	3	Pier 2, 3, 4, 7, E. Abut Brngs	Х	Х	Х	Х	Х
Fixed Spans	4	Pier 2, 3, 4, 7 Conc. Piers			Х	Х	Х
Fixed Spans	5	Staircase Connection	Х		Х	Х	Х
Fixed Spans	6	Piers 1, 2, 3 Geotech Hazard				Х	
Fixed Spans	7	Pier 4 Geotech Hazard				Х	
Moveable Span	1	Piers 5, 6 Pier Walls			Х	Х	Х
Moveable Span	2	Pier 5, 6 Bearings	Х		Х	Х	Х
Moveable Span	3	Pier 5, 6 Footings			Х	Х	Х
Moveable Span	4	Anchor Struts	Х	Х	Х	Х	Х
Moveable Span	5	Rall Wheel Track	Х	Х	Х	Х	Х
Moveable Span	6	Truss Frame Counterweight		Х	Х	Х	X
Moveable Span	7	Truss Frame at Rall Wheel		Х	Х	Х	X
Moveable Span	8	Bascule Lateral Movement	Х	Х	Х	Х	Х
Moveable Span	9	Live Load Shoes	Х	Х	Х	Х	Х
East Approach	1	Conc. Frame Abutments			Х	Х	
East Approach	2	Interior Pier Wall			Х	Х	

4.2 Burnside Bridge

4.2.1 Bridge Background

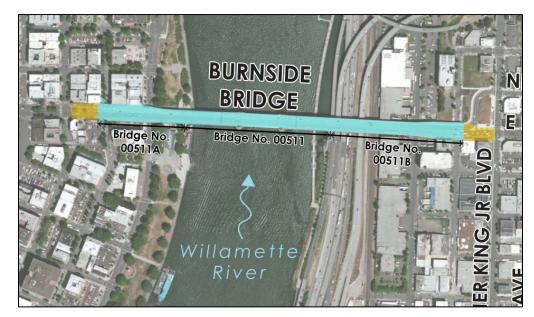
The Burnside Bridge was originally constructed in 1926. Since then, numerous rehabilitations have been made to the bridge's structural, mechanical, and electrical systems. In 2001 a microsillica concrete deck overlay was added to the fixed and approach spans, and the deck for the main river spans was replaced in 2005. The following seismic retrofit improvements have been added to the bridge in either 2001 or 2005:

- Seismic restraints tying the superstructure to the substructure on the bridge approaches at Bents 1, 5, 8, 11, 14, 16-19, 22, 24, 26, 31, 33, 34
- Installation of seismic restraints and modification of bearings on Piers 1 and 4
- Installation of main trunnion support struts.

Tri-County Metropolitan Transportation District of Oregon (Trimet) light rail lines run under the West Approach (Span 3) of the bridge, and Union Pacific Railroad lines run under the East Approach (Span 23). The West Approach (Spans 5-13) and East Approach (Spans 28-32) are all in close proximity to adjacent buildings.

Metro, the elected regional government for the Portland metropolitan area, originally established Burnside Street as the seismic lifeline route across the Willamette River in the Portland area. This designation, which includes the Burnside Bridge, was made as part of its *Regional Emergency Transportation Routes* publication dated March, 1996. Because of this designation, the bridge's performance level for the 1000-year event was set as Limited Operation (LO), and the performance level for the 500-year CSZ event was set as Full Operation (FO). This means that the level of retrofit required to address a given vulnerability could be significantly greater than any of the other three bridges with an equivalent vulnerability. For example, a bearing retrofit under a No Collapse performance level would likely be a seat extender to catch the superstructure element. Under a Full Operation level, however, the bearing will need to be replaced and lateral restraints would need to be installed to control the anticipated movements. The impact of this higher performance level is captured within the higher retrofit costs associated with this bridge.

Figure 2. Burnside Bridge Overview



4.2.2 West Approach Vulnerabilities

The Burnside Bridge West Approach consists of: (1) sixteen spans of a reinforced concrete floor beam with multiple stringers and a concrete deck structure; and (2) three spans of reinforced concrete deck girders (RCDGs). For Spans 1-16, the floor beams are supported by concrete columns on spread footings. For Spans 17-19, the deck girders are supported by concrete columns with enlarged bases and pile caps.

Under the 500-yr CSZ and 1000-yr events, the primary vulnerabilities are in the column lateral strength, superstructure to column connections, pier caps, and footing size. Encasement of the columns, superstructure to column connection and pier caps, and strengthening of the footings using an enlarged footing and micro-piles are the recommended retrofits.

Additionally, the expansion bearing seats are insufficient and require steel or concrete seat extension or catcher block retrofit for any of the earthquake event levels.

4.2.3 Fixed River Spans Vulnerabilities

The two Fixed River Spans are 268 feet long of constant depth steel deck trusses and a reinforced concrete deck. The spans are supported on lightly reinforced columns connected to timber piles footings with unreinforced pile caps on one end, and supported on the bascule piers on the other end.

Under the 500-yr CSZ and 1000-yr events, the timber piles are vulnerable to in uplift for applied loads in the bridge's longitudinal direction. This is due to the effects of the approach spans which are fixed at Piers 1 & 4. However, if the footing is retrofitted to allow it to rock, the uplift in the piles should not constitute a collapse-threatening situation. Additionally, the columns are poorly detailed for ductile behavior and in a high seismic event, would quickly deteriorate and lose vertical load carrying capacity. A steel shell retrofit of the piers is recommended for vertical capacity preservation and ductility. Last, the bearings and joints of the trusses are deficient and require retrofit measures.

According to past studies in the area, there is potential for liquefaction or lateral spreading around Piers 1 and 4. The mitigation required for this vulnerability is soil densification.

For the 100-year seismic hazard event, only the bearing and joint vulnerabilities identified above would be needed. Additionally, the overhead sign structure and light poles could collapse onto the bridge during seismic events and present serviceability challenges. It is also recommended that the truss diagonal and vertical member connections to the top and bottom chords be reviewed for potential overstress at the 500-yr CSZ and 1000-yr events.

4.2.4 Moveable Span Vulnerabilities

The Burnside Bridge's main river crossing span is a 252 feet long (trunnion-to-trunnion) double leaf steel deck truss bascule span. Reinforced concrete decks on the variable-depth bascule leafs are supported on concrete bascule piers which also house the counterweight and bascule machinery. Each bascule pier includes 35-44 foot unreinforced concrete walls from the pit floor to the top of the pile cap. The piers are connected with straight dowels to the unreinforced pile caps founded on timber piles.

In order to meet the designated performance levels for the bridge (including the moveable component's ability to operate after the 500-yr CSZ event), the retrofit is anticipated to be extensive and require a much higher level of effort than a similarly retrofitted component meeting the no collapse criteria.

A prior 1996 seismic analysis report stated that seismic isolation would not lead to a reduction in load demand on the foundations due to the very large and stiff foundations. Instead, alternative methods of foundation strengthening would be required. Based on our assessment, the timber piles would likely fail in both compression and uplift. The mitigation required for this vulnerability is the addition of steel piles around the perimeter of the footings. The pier walls under the truss seats have poor reinforcing details and would fail in a large seismic event - resulting in the loss of axial support capacity. An encasement retrofit of the pier walls is recommended to maintain vertical load capacity.

The bascule leaves and moveable components will require strengthening, and it is recommended that a base isolation system be installed in order to limit the seismic demand into the superstructure. The trunnion support posts are severely undersized and will likely require replacement concurrent with the base isolation system installation. The bracing of the bascule leaf appears significantly undersized to transfer seismic forces from the heavy deck and counterweights down into the substructure. Intermediate braces or replacement of existing braces is recommended.

Lateral and longitudinal restraint is lacking throughout the system. To accommodate this retrofit of this element, the following procedures are recommended:

• Construct a repairable structural fuse in the links in order to alleviate excessive force transfer into the light floor framing of the machinery room.

• Construct a steel strut to restrain the longitudinal movement and weak connection of the counterweight link to the machine room floor framing.

For the 100-year seismic hazard event, it is anticipated that the trunnion vertical posts, expansion joints, restrainers, and machinery room flooring vulnerabilities will need to be retrofitted.

4.2.5 East Approach Vulnerabilities

The Burnside Bridge East Approach consists of: (1) eight spans of 2-concrete encased steel plate girders with integral concrete encased floor beam superstructure; and (2) seven spans of multiple reinforced concrete deck girders superstructure. The steel structure spans are supported on two concrete encased steel columns on timber pile foundations with enlarged bases and pile caps. The concrete superstructure spans are supported on four concrete columns on spread footings.

Bents 21-27 have a low risk of foundation failure due to seismic hazards. This is due to the fill above the footings, the bracing between columns, and the large size of the footing compared to the columns. For Bents 28-34, the spread footings are buried in the ground and the columns are restrained by the roadway pavement at grade. This also results in a low risk of foundation failure.

In general, the vulnerabilities of the structures include the expansion joints between, loss of superstructure support due to unseating, inadequate superstructure to column connection, and large deck overhangs supported by a single floor beam.

For the 500-yr CSZ and 1000-yr events, the primary retrofit measures include columns encasement, in-fill walls, and connection strengthening. Strengthening of some footings and some additional Phase 1 retrofit measures are also required. Because of the higher performance levels required of the Burnside Bridge, these retrofits will be significantly more extensive in order to maintain a nearly elastic response of the structure.

4.2.6 Retrofit Summary

Table 4 summarizes the results of the Seismic Vulnerabilities Assessment for the Burnside Bridge. The table identifies: (1) anticipated Phase 1 retrofit measures; (2) retrofit measures for each earthquake level; and (3) retrofit measures that are modified by the system retrofits. A description of each vulnerability and the recommended retrofit measures for each seismic level is included in Appendix A. Figures associated with each vulnerability can be found in Appendix B.

Table 4. Burnside Bridge Summary Table

Location	Number	Component	Phase 1 Retrofit	100- Yr	500- Yr CSZ	1000- Yr	Modified by System Retrofit
West Approach	1	Bent Columns and super to sub conn.	Х	Х	Х	Х	
West Approach	2	Footings			Х	Х	
West Approach	3	Super. Seating on Expansion Bents	Х	Х	Х	Х	
West Approach	4	Pier Caps			Х	Х	
Fixed River Spans	1	Geotech - Liquefaction hazard			Х	Х	-
Fixed River Spans	2	Geotech - Lateral Spread			Х	Х	
Fixed River Spans	3	Piers 1, 4 Foundation Timber Piles			Х	Х	
Fixed River Spans	4	Piers 1, 4, Columns			Х	Х	
Fixed River Spans	5	Fixed Bearing Conn. & Seat Width	X	Х	Х	Х	
Fixed River Spans	6	Exp. Bearing. Conn. & Seat Width	X	Х	X	Х	
Fixed River Spans	7	Joints in Deck System Piers 1, 4	X	Х	X	Х	
Fixed River Spans	8	Piers 1, 4 Approach Fixed Conn.	X	Х	Х	Х	
Fixed River Spans	9	Truss Conn. of Primary Members			Х	Х	
Fixed River Spans	10	Overhead Sign Structures			Х	Х	
Fixed River Spans	11	Lightings			Х	Х	
Moveable Span	1	Pier 2, 3 Foundation Timber Piles			Х	Х	
Moveable Span	2	Truss Seating on Piers 2, 3 Walls	X		X	Х	X
Moveable Span	3	ConnTrunnion Support Vert. Post	X	Х	X	Х	X
Moveable Span	4	ConnTrunnion Anchorage	X		Х	Х	Х
Moveable Span	5	Joints in Deck System Piers 2, 3	X	Х	X	Х	X
Moveable Span	6	Bascule Leaf Transverse Restraint	X	Х	Х	Х	X
Moveable Span	7	Bascule Leaf Transverse Bracing	X		Х	Х	Х
Moveable Span	8	Counterweight Restrainers	X	Х	Х	Х	X
Moveable Span	9	Counterweight Link Fuse	X	Х	Х	Х	X
Moveable Span	10	Mechanical Working Parts			Х	Х	Х
Moveable Span	11	Pier Houses & Lightings			Х	Х	
East Approach	1	Connection - Pier to Foundation		Х	Х	Х	
East Approach	2	Bent Columns		Х	Х	Х	
East Approach	3	Rocker Bearings	X	Х	Х	Х	
East Approach	4	Seat Width	X	Х	Х	Х	
East Approach	5	RCDG Superstructure to Sub Conn.	X	Х	Х	Х	
East Approach	6	Seating on Abutment	X		Х	Х	
East Approach	7	Large Overhang Floorbeam Support			X	X	

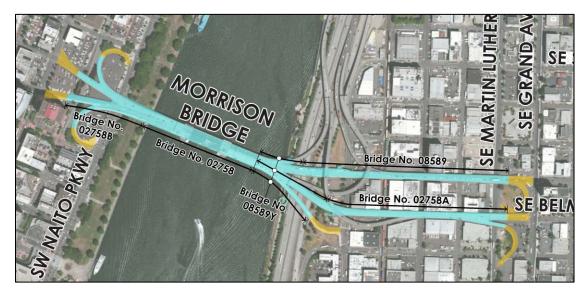
4.3 Morrison Bridge

4.3.1 Bridge Background

The Morrison Bridge was constructed in 1954, and the original design considered an equivalent seismic lateral force of 3% of the total dead load (0.03g). From the original construction some upgrades have been made to the mechanical systems and the bascule deck has been retrofitted with an FRP deck system. No seismic retrofits have been added to the bridge.

For all earthquake levels on the Morrison Bridge, a performance level of No Collapse (NC) was set.

Figure 3. Morrison Bridge Overview



4.3.2 West Approach Vulnerabilities

The bridge structure is comprised of a composite steel plate girder with concrete deck superstructure, reinforced concrete substructure (seat type bent cap with multi-column bent) and pile cap/spread type footing foundation.

The major vulnerabilities of the West Approach are a lack of proper seismic detailing in the columns joint connection to adjacent members such as the footing or bent cap, and a restraint to prevent unseating of the superstructure. Overall, 19 bents and 4 abutment locations require retrofit measures.

The current reinforcement of the Morrison footing-to-column and column-to-cap connection is vulnerable to joint shear failure (a mechanism commonly observed through research testing). This will present major challenges in a 1000-yr and 500-yr CSZ event. Joint replacement or strengthening of the pile cap and footing are also recommended. Additionally, the embedment of the piles in the pile cap is vulnerable to pull out or yielding if the moment transferred into the foundation exceeds the tension capacity of the footing. This is due to a thin concrete cover at the base of the pile cap and no observable anchorage of the pile head. The recommended retrofit measure is to provide an additional layer of concrete to increase the embedment depth.

Other vulnerabilities include a lack of transverse and longitudinal restraints at the bent caps to prevent the superstructure from unseating, strength concerns of the existing diaphragm members to distribute the seismic force to the substructure, and a lack of restraints at the in-span hinges. A traditional Phase I retrofit consisting of longitudinal cable restrainers, transverse reinforced concrete shear keys and diaphragm strengthening is recommended. In a 100-yr event, however, only longitudinal and transverse restraints are required.

4.3.3 Fixed River Spans Vulnerabilities

The East and West Fixed River Spans (referred to as Side Spans in the as-constructed drawings) cross over the Willamette River as steel trusses. They are comprised of a concrete deck supported by steel stringers and floorbeams. The end bearings of the truss rest a pier cap with four columns at the end adjacent to the river banks and the main large river piers on either end of the moveable span at the other end. The four columns at the river banks are supported by a pier wall type substructure and a pile cap foundation. The upper portion of the piles are protected by a seal course and cofferdam.

The deficiencies in the Fixed Spans are similar to the Approach Spans in that the footing, columns, and pier caps all lack proper rebar detailing. This includes insufficient embedment depth, confinement and joint protection. It is also anticipated that the existing fixed and expansion bearings are not adequate to transfer seismic loads or to accommodate large superstructure displacements.

The truss bearing connections utilize a rocker type bearing that often perform poorly under earthquake loads. The support it provides to the girder could be compromised if excessive movement is experienced and a replacement of these bearings is recommended. In addition, the lateral components of the truss superstructure (diaphragms, top and bottom struts) appear to be undersized and are at risk for buckling during cyclic loading. Under a 500-year CSZ or 1000-year event, it would require strengthening or replacement to transfer the seismic forces through the bearings.

Increased ductility is needed to address the substructure and foundation detailing deficiencies. Additional lateral capacity can be provided to the column with steel jacketing. The bent caps and footing will also need strengthening with additional doweled bars or prestressing. These items should also take priority during a 500-yr CSZ and 1000-yr seismic event.

The proposed retrofit measure for the fixed spans is to replace the bearings with base isolation devices. This will serve to minimize the forces in both the substructure and superstructure. Modifications to the joints and gaps on either side of the bascule span piers will also be necessary to enable the base isolation system to displace.

A portion of the Fixed Span extends into the pit area where the bascule counterweight space is located. This span likely has insufficient bearing width and inadequate deck support from the truss members. Seat extenders are commonly used to increase bearing width and replacement of the truss members is recommended.

4.3.4 Moveable Span Vulnerabilities

The Moveable Spans of the Morrison Bridge (referred to as the Bascule Spans in the as-constructed plans) consist of two twin steel truss superstructures, each resting on a mechanical trunnion with a counterweight fixed to the heel of the span. In Figure 3 above, the Movable Spans are includedas part of Bridge No. 02758. It has a concrete slab deck that is supported by a series of stringers and floorbeams. At a distance of approximately 37'-6" to the toe of the bascule, the top and bottom chords of the truss frame into plate girders.

Anticipated deficiencies include the capacity of the lateral supports of the trunnions, and the capacity of the bearings to transfer seismic loads to the substructure. These must be addressed for all earthquake levels. Strengthening of the truss lateral members, such as the top and bottom struts, counterweight bracing, and diaphragms is recommended. The trunnion would also need to be restrained transversely and longitudinally to prevent unseating.

A base isolation system is an option for the higher seismic levels (500-yr CSZ and 1000-yr). The existing trunnion would be replaced with a reduced height trunnion supported by a base isolation device to decrease the seismic loads transferred to the superstructure and the counterweight supports. Strengthening of the concrete trunnion support frame beams are included.

4.3.5 East Approach Vulnerabilities

The East Approach spans of Morrison Bridge end at the intersection two major streets: SE Morrison Street and SE Belmont Street. In Figure 3 above, it is listed as Bridge No. 08589 and No. 02578A. Similar to the West Approach, the East Approach consists of a composite steel plate girder and concrete deck superstructure with a reinforced concrete column substructure on spread footing foundations.

The major vulnerabilities of the East Approach can be summarized by a lack of proper detailing in the columns joint connection to adjacent members, and a lack of restraint to prevent unseating of the superstructure. Overall, 61 bents and 5 abutment locations require retrofit measures.

The retrofit solutions for the West Approach can also be applied to the East Approach due to the similarities in structure type. This includes column joint rehabilitation or replacement, column jacketing, superstructure collapse prevention with bearing restraints, and a strengthening of the spread footings. Only under the 500-yr CSZ and 1000-yr earthquake will substructure and foundation strengthening be required.

4.3.6 Retrofit Summary

Table 5 summarizes the results of the Seismic Vulnerabilities Assessment for the Morrison Bridge. The table identifies: (1) anticipated Phase 1 retrofit measures; (2) retrofit measures for each earthquake level; and (3) retrofit measures that are modified by the system retrofits. A description of each vulnerability and the recommended retrofit measures for each seismic level is included in Appendix A. Figures associated with each vulnerability can be found in Appendix B.

Location	Number	Component	Phase 1 Retrofit	100- Yr	500-Yr CSZ	1000-Yr.	Modified by System Retrofit
West Approach	1	Footing - Rebar Detailing			Х	Х	
West Approach	2	Footing - Pile Embedment			Х	Х	
West Approach	3	Column - Rebar Detailing			Х	Х	
West Approach	4	Bent Cap - Trans/Long Restrainers	Х	Х	Х	Х	
West Approach	5	Bent Cap - Rebar Detailing			Х	Х	
West Approach	6	Superstructure Bearing Connections	Х	Х	Х	Х	
West Approach	7	Superstructure Diaphragms	Х		Х	Х	
West Approach	8	Expansion Joint Restrainers	Х	Х	Х	Х	
Fixed Spans	1	Footing - Rebar Detailing			Х	Х	X
Fixed Spans	2	Column - Rebar Detailing			Х	Х	Х
Fixed Spans	3	Bent Cap - Rebar Detailing			Х	Х	Х
Fixed Spans	4	Trunnion Support Frame		Х	Х	Х	X
Fixed Spans	5	Superstructure Bearing Connections	Х	Х	Х	Х	X
Fixed Spans	6	Superstructure Diaphragms	Х		Х	Х	Х
Fixed Spans	7	Truss Laterals			Х	Х	Х

Table 5. Morrison Bridge Summary Table

Location	Number	Component	Phase 1 Retrofit	100- Yr	500-Yr CSZ	1000-Yr.	Modified by System Retrofit
Fixed Spans	8	Pit Span Bearing Seats	Х	Х	Х	Х	
Fixed Spans	9	Deck Support Columns at Pit Span	Х	Х	Х	Х	Х
Moveable Span	1	Trunnion Bearings/Live Load Shoes	Х	Х	Х	Х	Х
Moveable Span	2	Superstructure Diaphragms	Х		Х	Х	Х
Moveable Span	3	Bascule Truss Lateral Brace	Х		Х	Х	Х
Moveable Span	4	Truss Bearing Anchor Bolts	Х	Х	Х	Х	Х
Moveable Span	5	Counterweight Braces	Х	Х	Х	Х	Х
Moveable Span	6	Trunnion Beam			Х	Х	Х
Moveable Span	7	Piers 2 and 3 (including trunnion support frames)			Х	Х	Х
East Approach	1	Footing - Rebar Detailing			Х	Х	
East Approach	2	Footing - Pile Embedment			Х	Х	
East Approach	3	Column - Rebar Detailing			Х	Х	
East Approach	4	Bent Cap - Trans/Long Restrainers	Х	Х	Х	Х	
East Approach	5	Bent Cap - Rebar Detailing			Х	Х	
East Approach	6	Superstructure Bearing Connections	Х	Х	Х	Х	
East Approach	7	Superstructure Diaphragms	Х		Х	Х	
East Approach	8	Girders			Х	Х	
East Approach	9	In Span Hinge Restrainers	Х		Х	Х	

4.4 Hawthorne Bridge

4.4.1 Bridge Background

The Hawthorne Bridge was originally constructed in 1910 and is now the oldest operating vertical lift bridge in the United States. Since its original construction, numerous upgrades have been made to the bridge including upgraded mechanical/electrical systems and widened sidewalks. In 1992, the transition spans on the East Approach, also known as the Water Avenue ramp, were replaced and some seismic details were included on that structure.

For all earthquake levels on the Hawthorne Bridge, a performance level of No Collapse (NC) was set.



4.4.2 West Approach Vulnerabilities

The West Approach spans are generally comprised of concrete columns and bent caps on concrete spread footings or pile caps. The superstructure consists of prestressed girders with a cast-in-place concrete deck.

Under the 500-yr CSZ and 1000-yr earthquake events, the primary vulnerabilities are insufficient flexural capacity in the columns and footings, and the potential for the superstructure to unseat at the bearings. Encasement of the columns and a strengthening of the footings using an enlarged footing and micro-piles is the recommended retrofit. The bent caps will also need to be strengthened to force hinging in the newly strengthened columns.

Seat extensions will be needed at the expansion joints to prevent the superstructure from falling off for all of the seismic earthquake levels.

4.4.3 Fixed River Spans Vulnerabilities

The Fixed River Spans of the Hawthorne Bridge are comprised of five through truss spans with lengths from 209'-3" to 244'-3½". The trusses are supported on large pile supported unreinforced concrete footings and pier walls. Span 5, the movable span, is supported by tall towers with counterweights in Spans 4 and 6.

At the 500-yr CSZ and 100-yr events, the vulnerabilities in the fixed truss spans are primarily with the footings, pier walls, and connections of the superstructure to the substructure. Sufficient detailing to transfer the seismic loads into the foundation is a concern. Base isolation is recommended at the top of Piers 1-4 and Pier 7 to reduce the load demands to the substructure. It is possible that the piers may yield at their base due to poor lateral strength. Steel confinement jackets are a common retrofit method used to enhance shear capacity for these situations.

For each seismic hazard level, catcher blocks and anchor bolt modifications are recommended at all of the truss bearings, and a Bottom chord lateral bracing strengthening is recommended in the three end panels of each span. Although not as critical as some of the other retrofit strategies, soil densification is also recommended at Piers 1 and 7 due to the potential for liquefaction.

4.4.4 Moveable Span Vulnerabilities

The Movable Span of the Hawthorne Bridge is a 244 foot vertical lift through truss. The primary vulnerabilities with this span are Piers 5 and 6 and the lift towers above them. When the bridge is in the closed position, the 440 ton counterweights are about 180 feet above the bridge deck. The existing towers and piers are severely undersized to carry such a large mass near its top during any seismic event. In particular, the raised counterweight presents challenges for transferring the large inertial forces from the counterweight to the substructure. This is due to the slender truss members that make up the tower.

For the 500-yr CSZ and 1000-yr events, as with the Fixed River Span piers, the tower piers will require isolation bearings to limit substructure demands and steel confinement jackets at their base to increase capacity. Even with the reduced loads in the superstructure from base isolation, the truss towers would see substantial benefits with replacement of the tower back legs, the diagonal bracing between the tower front legs, and the back span trusses where the tower back legs frame in. The three end panels of the span will also require the same strengthening of the bottom chord lateral bracing as described for the fixed spans.

Catcher blocks and anchor bolts modifications are recommended at the truss bearing locations similar to the Fixed River Spans. The notched anchor bolts will act as fuses to prevent excessive force from transmitting into the piers.

4.4.5 East Approach Vulnerabilities

The East Approach of the Hawthorne Bridge consists of 3 separate structures. Starting at Pier 1 near the river, the Water Avenue structure transitions from the main spans to three separate one-way ramp structures over a length of about 550 feet. This structure is comprised of Bulb I prestressed girders with a cast-in-place deck on concrete caps and columns with pile supported footings. The Hawthorne Boulevard viaduct structure is 1233 feet long and consists of simple steel I-girder spans on concrete caps and columns with concrete pile supported footings. The Madison Street viaduct is very similar to the Hawthorne Boulevard viaduct, measuring 1271 feet in length.

The vulnerabilities of the East Approach are mostly associated with the two viaduct structures. The concrete columns, bent caps, and footings are under-reinforced for seismic forces and plastic hinging. Jacketing of the columns is recommended. This will likely also require the footings to be strengthened to take the hinging force of the newly strengthened columns. Strengthening of the bent caps will likely be required.

The steel superstructure is vulnerable to bearing seat pull off. Thus, seat extensions or cable restraints are recommended at all expansion piers. At Pier 1 of the Water Avenue structure, there does not appear to be adequate transverse restraint of the superstructure, and the installation of shear lugs is recommended.

4.4.6 Retrofit Summary

Table 6 summarizes the results of the Seismic Vulnerabilities Assessment for the Hawthorne Bridge. The table identifies: (1) anticipated Phase 1 retrofit measures; (2) retrofit measures for each earthquake level; and (3) retrofit measures that are modified by the system retrofits. A description of each vulnerability and the recommended retrofit measures for each seismic level is included in Appendix A. Figures associated with each vulnerability can be found in Appendix B.

Location	Number	Component	Phase 1 Retrofit	100-Yr	500-Yr CSZ	1000-Yr	Modified by System Retrofit
West Approach	1	Pile to Cap Connection			Х	Х	
West Approach	2	Spread Footings			Х	Х	
West Approach	3	Electrical Vault			Х	Х	
West Approach	4	Columns to Footings Connection			Х	Х	
West Approach	5	Abutments to Footings Connection			Х	Х	
West Approach	6	Columns			Х	Х	
West Approach	7	Seat Widths	Х	Х	Х	Х	

Table 6. Hawthorne Bridge Summary Table

Location	Number	Component	Phase 1 Retrofit	100-Yr	500-Yr CSZ	1000-Yr	Modified by System Retrofit
West Approach	8	Bent Caps			Х	Х	
Fixed Spans	1	Piers 1-4, 7 Bearings	Х	Х	Х	Х	
Fixed Spans	2	Restraint at Piers 1-4,7			Х	Х	Х
Fixed Spans	3	Geotech Liquefaction Hazard			Х	Х	
Fixed Spans	4	Bottom chord lateral bracing			Х	Х	X
Fixed Spans	5	Piers 1-4, 7			Х	Х	Х
Moveable Span	1	Piers 5 - 6 Bearings	Х	Х	Х	Х	Х
Moveable Span	2	Restraint at Piers 5 - 6			Х	Х	Х
Moveable Span	3	Bottom chord lateral bracing			Х	Х	X
Moveable Span	4	Tower			Х	Х	Х
Moveable Span	5	Piers 5 - 6	-		Х	Х	Х
East Approach	1	Pier 1 Transition bearings	Х	Х	Х	Х	
East Approach	2	Girder seats	Х	Х	Х	Х	
East Approach	3	Abutments	Х	Х	Х	Х	
East Approach	4	Columns			Х	X	
East Approach	5	Footings			Х	Х	
East Approach	6	Bent Caps			Х	Х	

5 CONSTRUCTION COST ESTIMATE APPROACH

As part of this assessment, programmatic-level construction cost estimates were prepared for each of the recommended retrofit measures assuming a 2014 construction year. These estimates are for planning purposes only and detailed estimates must be compiled based on project-specific analyses and designs.

In general, typical retrofit measures were identified and unit costs were developed. For each typical retrofit measure, the unit cost was based on the 1000-year earthquake level and a No Collapse criteria. The typical cost was then applied to equivalent retrofit measures across all four of the bridges. For example, the cost for column encasement was developed based on a typical approach structure column. This unit cost was then used for all approach columns regardless of column sizes or bridge specific details.

In order to capture some cost differences between the bridges and/or for the work required, modification factors were implemented for known complexities, as summarized in Table 7.

Table 7.	. Cost Estimate	Modification	Factors
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Cost Modification Reason	Factor
500 yr CSZ event no collapse target design	0.95
100 yr event no collapse target design	0.75
Fully Operational/Limited Operation Performance Level design for Burnside	1.75

The following examples are provided to demonstrate how the modification factors were applied to different situations:

- Because the base costs assumed a 1000-yr event, we anticipate some modest reduction in the cost for designing to the 500 yr CSZ event. As such, a 0.95 factor was used.
- For the 100-yr event, many of the retrofit measures are based on Phase 1 needs. Because much of the cost is in access and placement of the components, a factor of 0.75 was used.
- Meeting the high performance levels for the Burnside Bridge will require significantly more involved and complicated retrofit measures than the 1000-yr No Collapse criteria. As such, a factor of 1.75 was used.

For each retrofit measure, a summary of the construction activities involved were identified. Using those activities, a unit cost was estimated. Cost data from ODOT and Caltrans, and other relevant projects were used as a basis for the unit costs developed herein. In addition, the costs developed as part of the prior 1996 Seismic Retrofit Reports relating to the main river spans were also considered. However, given the unique nature of most of the retrofit projects and the limited number of similar sample projects, the published cost data was not wholly relied on. Error in pricing is anticipated to be absorbed within the Contingency amount.

For many of the retrofits that are unique to a specific bridge, that cost was developed on its own. The details of the cost estimate development are included in Appendix C.

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Attachment A

Seismic Vulnerabilities Forms.

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Multnomah County Willamette River Bridges CIP

2014 UNBURDENED Retrofit Construction Cost Summary Table (w/o Programmatic Costs, ROW, PE, and CEI)

Compiled by:	TCA	Date:	5/30/2014
Checked by:	SMD	Date:	11/7/2014

		BROA	DW	AY	
Bridge Location	Phase 1	1000-yr		500-yr	100-yr
East Approach Spans	\$ -	\$ 300,000	\$	285,000	\$ -
Moveable Spans	\$ 5,750,000	\$ 20,750,000	\$	21,612,000	\$ 8,812,000
Fixed Spans	\$ 10,000,000	\$ 34,850,000	\$	33,107,000	\$ 1,382,000
West Approach Spans	\$ 225,000	\$ 11,725,000	\$	11,143,000	\$ 168,000
Total	\$ 15,975,000	\$ 67,625,000	\$	66,147,000	\$ 10,362,000

		BURN	ISID	Ε	
Bridge Location	Phase 1	1000-yr		500-yr	100-yr
East Approach Spans	\$ 1,560,000	\$ 31,080,000	\$	29,598,000	\$ 19,264,000
Moveable Spans	\$ 17,020,000	\$ 37,680,000	\$	35,802,000	\$ 9,998,000
Fixed Spans	\$ 880,000	\$ 13,650,000	\$	12,974,000	\$ 466,000
West Approach Spans	\$ 1,980,000	\$ 33,960,000	\$	32,298,000	\$ 8,271,000
Total	\$ 21,440,000	\$ 116,370,000	\$	110,672,000	\$ 37,999,000

		HAWT	IOR	NE	
Bridge Location	Phase 1	1000-yr		500-yr	100-yr
East Approach Spans	\$ 900,000	\$ 27,525,000	\$	26,177,000	\$ 730,000
Moveable Spans	\$ 2,150,000	\$ 26,150,000	\$	20,092,000	\$ 564,000
Fixed Spans	\$ 5,375,000	\$ 46,875,000	\$	44,405,000	\$ 1,030,000
West Approach Spans	\$ 1,050,000	\$ 9,175,000	\$	8,721,000	\$ 784,000
Total	\$ 9,475,000	\$ 109,725,000	\$	99,395,000	\$ 3,108,000

		MORE	riso	N	
Bridge Location	Phase 1	1000-yr		500-yr	100-yr
East Approach Spans	\$ 12,625,000	\$ 60,250,000	\$	57,273,000	\$ 14,669,000
Moveable Spans	\$ 4,300,000	\$ 34,300,000	\$	32,584,000	\$ 3,974,000
Fixed Spans	\$ 4,150,000	\$ 35,050,000	\$	31,396,000	\$ 3,448,000
West Approach Spans	\$ 4,800,000	\$ 20,925,000	\$	19,895,000	\$ 5,631,000
Total	\$ 25,875,000	\$ 150,525,000	\$	141,148,000	\$ 27,722,000

		00p00	CSK	Date:	3/26/2014
Bridge Name N Broadway S	over N Interstate Ave [Broadway]	Checked by:	KPBU	Date:	5/1/2014
Bridge Number 06757C					
Bridge Location West Approach	s (Includes 'Span 1' of main structure)				
Seismic Event 1000 Yr	Desired Performance Level	No Coll	apse (NC)		I

Vulnerability Number	1	As-Built Dwg. File	1912-1995_Broadway_	Br_and_App_Misc_Deta	ils.pdf		
Vulnerable Component	Steel Bent Columns	S	• •	Drawing #	C4155/3		
Description of Steel columns have limited lateral load capability and slenderness concerns. Detailing for connections are prone to Vulnerability premature failure. Note: 2 columns have already been encased and will need additional encasing.							
Proposed Retrofit	Proposed Retrofit Encase columns in reinforced concrete sections.						
Number of Locations	20	columns		PDF Page #	73		
Unit Cost of Retrofit	\$75,000	each		Figure Ref. #	BW001		

Vulnerability Number	2	As-Built Dwg. File	1912-1995 Broadway Br and	App Misc Detai	ls.pdf		
Vulnerable Component	Expansion Bearing	Seat Width	· · · · · · · · · · · · · · · · · · ·	Drawing #	C4155/3		
Description of Expansion bearing seats are not sufficient to prevent superstructure from falling off. Vulnerability							
Proposed Retrofit	roposed Retrofit Add concrete beam seat on proposed column encasing.						
Number of Locations	3	piers		PDF Page #	10		
Unit Cost of Retrofit	\$75,000	each		Figure Ref. #	BW002		

Vulnerability Number	3	As-Built Dwg. File					
Vulnerable Component	Footings			Drawing #			
Description of Vulnerability	Vulnerability						
Proposed Retrofit	Proposed Retrofit Widen and deepen footing.						
Number of Locations	20	footings		PDF Page #			
Unit Cost of Retrofit	\$500,000	each		Figure Ref. #			

Vulnerability Number	4	As-Built Dwg. File					
		AS-Built Dwg. File					
Vulnerable Component	Footings		4	Drawing #			
Description of	Spread footings are	e on soil prone to liquifa	iction.				
Vulnerability							
Proposed Retrofit	Provide soil densifi	cation around footings.					
-							
Number of Locations	1	bridge site		PDF Page #			
Unit Cost of Retrofit	\$7,000,000	each	7	Figure Ref. #			

Bridge Complex	Broadway			Compiled by:	CSK	Date:	3/26/2014
Bridge Name	N Broadway St over N Interstate Ave [Broadway]			Checked by:	KPBU	Date:	5/19/2014
Bridge Number	06757C						
Bridge Location	West Approaches						
Seismic Event	500 Yr	Desired	d Performance Level	No Col	lapse (NC)		
Vulnerability Number	1	As-Built Dwg. File	1912-1995_Broadway_Br_and_/	App_Misc_Deta	ils.pdf		
Vulnerable Component	Steel Bent Column	S		Drawing #	C4155/3		
Description of	Stool columns how	limited lateral load o	apability and slenderness concer	na Dotailing fo	roonnooti	one ara r	arono to
Vulnerability			already been encased and will ne			uns are p	Jone (0

Proposed Retrofit	Encase columns in	reinforced concrete sections.		
Number of Locations	20	columns	PDF Page #	73
Unit Cost of Retrofit	\$71,000	each	Figure Ref. #	BW001

Vulnerability Number	2	As-Built Dwg. File	1912-1995_Broadway_Br_and_A	App_Misc_Detai	ils.pdf
Vulnerable Component	Expansion Bearing	Seat Width		Drawing #	C4155/3
Description of Vulnerability	Expansion bearing	seats are not sufficient	t to prevent superstructure from	falling off.	
Proposed Retrofit	Add concrete beam	seat on proposed colu	ımn encasing.		
Number of Locations	3	piers		PDF Page #	10
Unit Cost of Retrofit	\$71,000	each		Figure Ref. #	BW002

Vulnerability Number	3	As-Built Dwg. File			
Vulnerable Component	Footings			Drawing #	
Description of Vulnerability	Additional strength	of columns will require	e additional strength to footings.		
Proposed Retrofit	Widen and deepen	footing.			
Number of Locations	20	footings		PDF Page #	
Unit Cost of Retrofit	\$475,000	each		Figure Ref. #	

Vulnerability Number	4	As-Built Dwg. File			
Vulnerable Component	Footings			Drawing #	
Description of Vulnerability	Spread footings are	e on soil prone to liquifa	action.		
Proposed Retrofit	Provide soil densifi	ication around footings			
Number of Locations	1	bridge site		PDF Page #	
Unit Cost of Retrofit	\$6,650,000	each		Figure Ref. #	

Bridge Complex	Broadway			Compiled by:	CSK	Date:	3/26/2014
Bridge Name	N Broadway St over N Interstate Ave [Broadway]			Checked by:	KPBU	Date:	5/19/2014
Bridge Number	06757C						
Bridge Location	West Approaches						
Seismic Event	100 Yr	Desire	ed Performance Level	No Col	lapse (NC)		
Vulnerability Number	1	As-Built Dwg. File	1912-1995_Broadway_Br_and_	App_Misc_Deta	ils.pdf		
Vulnerable Component	Steel Bent Columns	s		Drawing #	C4155/3		
Description of Vulnerability			capability and slenderness concern already been encased and will ne			ons are	orone to

Proposed Retrofit	No retrofit required	for 100 year		
Number of Locations	20	columns	PDF Page #	73
Unit Cost of Retrofit	\$0	each	Figure Ref. #	BW001

Vulnerability Number	2	As-Built Dwg. File	1912-1995_Broad	way_Br_and_A	App_Misc_Detai	ils.pdf
Vulnerable Component	Expansion Bearing	Seat Width			Drawing #	C4155/3
Description of Vulnerability	Expansion bearing	seats are not sufficient	to prevent supers	structure from	falling off.	
Proposed Retrofit	Add concrete beam	seat on proposed colu	ımn encasing.			
Number of Locations	3	piers			PDF Page #	10
Unit Cost of Retrofit	\$56,000	each			Figure Ref. #	BW002

Vulnerability Number	3	As-Built Dwg. File			
Vulnerable Component	Footings			Drawing #	
Description of Vulnerability	Additional strength	of columns will require	e additional strength to footings.		
Proposed Retrofit	No retrofit required	for 100 year			
Number of Locations	20	footings		PDF Page #	
Unit Cost of Retrofit	\$0	each		Figure Ref. #	

Vulnerability Number	4	As-Built Dwg. File			
Vulnerable Component	Footings			Drawing #	
Description of Vulnerability	Spread footings are	e on soil prone to liquif	action.		
Proposed Retrofit	No retrofit required	for 100 year			
Number of Locations	1	bridge site		PDF Page #	
Unit Cost of Retrofit	\$0	each		Figure Ref. #	

Bridge Complex	Broadway			Compiled by:	CSK	Date:	3/26/2014
Bridge Name	Willamette River, Broadway St [Broadway]			Checked by:	kpbu	Date:	5/1/2014
Bridge Number	06757	06757					
Bridge Location	Fixed River Spans						
Seismic Event	1000 Yr	Desirea	d Performance Level	No Coll	lapse (NC)		
Vulnerability Number	1	As-Built Dwg. File	1911-12-12_Broadway_Main_B	ridge.pdf			
Vulnerable Component	Pier 2 Columns			Drawing #	AH001-01	8	
Description of	Steel columns have	e limited lateral capabi	ility. Additionally, connection det	ails are prone to	prematur	e failure.	
Description of Vulnerability	Steel columns have	e limited lateral capabi	ility. Additionally, connection det	ails are prone to	o prematur	e failure.	
,	Install reinforced co	oncrete encasing arou	ility. Additionally, connection det Ind columns. Additionally, install e Isolation Bearings at piers 3, 4,	additional steel	cross bra	cing bet	ween
Vulnerability	Install reinforced co	oncrete encasing arou	Ind columns. Additionally, install	additional steel	cross bra	cing bet	ween

Vulnerability Number	2	As-Built Dwg. File	1911-12-12_Broadway_Main_Br	idge.pdf	
Vulnerable Component	Pier 1, 3, 4 & 7 Jack	eted Column		Drawing #	AJ002-002
Description of Vulnerability		nd steel columns have lements is insufficient.	limited lateral displacement capa	acity and streng	th. Connection to below
Proposed Retrofit			ng, add concrete infill walls, and at piers 3, 4, and 7 to reduce ove		
Number of Locations	8	Columns		PDF Page #	189
Unit Cost of Retrofit	\$500,000	each		Figure Ref. #	NA

Vulnerability Number	3	As-Built Dwg. File	1911-12-12_Broadway_Ma	ain_Bridge.pdf		
Vulnerable Component	Pier 2, 3, 4, & 7 and	E. Abutment Bearings		Drawing #	AH001-037	
Description of Vulnerability						
Proposed Retrofit	Install longitudinal	Install longitudinal restrainers and catcher blocks. System Retrofit - Provide Base Isolation Bearings				
Number of Locations	20	bearings		PDF Page #	71	
Unit Cost of Retrofit	\$500,000	each		Figure Ref. #	BW004	

Vulnerability Number	4	As-Built Dwg. File	1927-1995_Broadway_Br_R	epairs_Misc_Works	s.pdf	
Vulnerable Component	Pier 2, 3, 4, & 7 Con	crete Piers		Drawing #	AG022-002	
Description of Concrete Piers are unreinforced and prone to brittle failure. Connections to Columns and Caisson are likely not sufficient.						
-	Proposed Retrofit Install reinforced concrete shells to strength pier walls and footings. System Retrofit - Provide Base Isolation System to reduce loads to piers.					
Number of Locations	4	piers		PDF Page #	46	
Unit Cost of Retrofit	\$2,500,000	each		Figure Ref. #	BW040	

Bridge Complex	Broadway			Compiled by:	CSK	Date:	3/26/2014
Bridge Name	Willamette River, Broadway St [Broadway]			Checked by:	kpbu	Date:	5/1/2014
Bridge Number	06757						
Bridge Location	Fixed River Spans						
Seismic Event	1000 Yr	Desire	ed Performance Level	No Col	apse (NC)		
Vulnerability Number	5	As-Built Dwg. File	2002-09-01_Broadway_Rehab_	Ph_4_7_Signed	.pdf		
Vulnerable Component	Staircases to Naito	Parkway		Drawing #	61442		
Description of Vulnerability		,	s vulnerable to failure due to move				
Proposed Retrofit	Inotall avnancian d						
· · · · ·	mstan expansion u	evice between stairs	and main bridge to allow moveme	nt between stru	ctures.		
Number of Locations	2	evice between stairs	and main bridge to allow moveme	nt between stru	ctures. 80		

Vulnerability Number	6	As-Built Dwg. File	1996 Seismic Report - Geotec	n Appendix	
Vulnerable Component	Geotechnical Haza	ards - Piers,1, 2, and 3		Drawing #	NA
Description of Vulnerability	Concrete Pile sup foundation and po		t side are prone to liquifaction.	This will lead to	uneven soil pressures on the
Proposed Retrofit	Provide soil densi	fication around piers			
Number of Locations	1	bridge site		PDF Page #	NA
Unit Cost of Retrofit	\$7,000,000	each		Figure Ref. #	NA

Vulnerability Number	7	As-Built Dwg. File	1996 Seismic Report - Geotech	Appendix	
Vulnerable Component	Geotechnical Hazar	ds - Pier 4		Drawing #	NA
Description of Some of the soil around pier 4 is succeptible to liquifaction. Due to the sloped ground and potential for lateral vulnerability spreading, large lateral forces on the Pier 4 substructure may occur.					
Proposed Retrofit	Provide soil densifi	cation around pier.			
Number of Locations	1	bridge site		PDF Page #	NA
Unit Cost of Retrofit	\$7,000,000	each		Figure Ref. #	NA

Bridge Complex	Broadway			Com	piled by:	CSK	Date:	3/26/2014
Bridge Name	Willamette River, B	roadway St [Broadway]]	Che	cked by:	kpbu	Date:	5/19/2014
Bridge Number	06757							
Bridge Location	Fixed River Spans							
Seismic Event	500 Yr	Desired	Performance Level		No Coll	apse (NC)	
Vulnerability Number	1	As-Built Dwg. File	1911-12-12_Broadway_M	Main_Bridge.pd	lf			
Vulnerable Component	Pier 2 Columns			Drawin	g #	AH001-0	18	
Description of	Steel columns have	e limited lateral capabil	ity. Additionally, connect	ion details are	prone to	prematu	re failure	
Description of Vulnerability	Steel columns have	e limited lateral capabil	ity. Additionally, connect	ion details are	prone to	prematu	re failure	
•	Install reinforced co	oncrete encasing arour	ity. Additionally, connect nd columns. Additionally, Isolation Bearings at pie	install additio	nal steel	cross bra	acing bet	ween
Vulnerability	Install reinforced co	oncrete encasing arour	nd columns. Additionally,	install additio	nal steel o reduce	cross bra	acing bet	ween

Vulnerability Number	2	As-Built Dwg. File	1911-12-12_Broadway_Main_Br	idge.pdf		
Vulnerable Component	Pier 1, 3, 4 & 7 Jack	eted Column	•	Drawing #	AJ002-002	
Description of Concrete filled round steel columns have limited lateral displacement capacity and strength. Connection to below grade supporting elements is insufficient.						
Proposed Retrofit	Proposed Retrofit Weld steel jackets seams and cross framing, add concrete infill walls, and struts to tie the pedestals together. System Retrofit - Provide Base Isolation Bearings at piers 3, 4, and 7 to reduce overall load into columns.					
Number of Locations	8	Columns		PDF Page #	189	
Unit Cost of Retrofit	\$475,000	each		Figure Ref. #	NA	

Vulnerability Number	3	As-Built Dwg. File	1911-12-12_Broadway_Mai	in_Bridge.pdf		
Vulnerable Component	Pier 2, 3, 4, & 7 and	E. Abutment Bearings		Drawing #	AH001-037	
Description of Bearings are very tall and may become unstable under relatively small movements. Anchorage of bearings to Pier cap Vulnerability is likely insufficient. Insufficient seat width at top of piers.						
Proposed Retrofit	Install longitudinal	Install longitudinal restrainers and catcher blocks. System Retrofit - Provide Base Isolation Bearings				
Number of Locations	20	bearings		PDF Page #	71	
Unit Cost of Retrofit	\$475,000	each		Figure Ref. #	BW004	

Vulnerability Number	4	As-Built Dwg. File	1927-1995_Broadway_Br_Repa	airs_Misc_Works	.pdf	
Vulnerable Component	Pier 2, 3, 4, & 7 Con	crete Piers		Drawing #	AG022-002	
Description of Vulnerability	······································					
Proposed Retrofit	Proposed Retrofit Install reinforced concrete shells to strength pier walls and footings. System Retrofit - Provide Base Isolation System to reduce loads to piers.					
Number of Locations	4	piers		PDF Page #	46	
Unit Cost of Retrofit	\$2,375,000	each		Figure Ref. #	BW040	

Bridge Complex	Broadway			Compiled by:	CSK	Date:	3/26/2014
Bridge Name	Willamette River, Broadway St [Broadway]			Checked by:	kpbu	Date:	5/19/2014
Bridge Number	06757						
Bridge Location	Fixed River Spans						
Seismic Event	500 Yr	Desire	ed Performance Level	No Coll	apse (NC)		
Vulnerability Number	5	As-Built Dwg. File	2002-09-01_Broadway_Rehab_	Ph_4_7_Signed.	pdf		
Vulnerable Component	Staircases to Naito	Parkway		Drawing #	61442		
Description of Vulnerability			s vulnerable to failure due to mov		ne stans o	r the ma	n onage.
Proposed Retrofit	Install expansion d	levice between stairs	and main bridge to allow moveme	ent between stru	ctures.		
Number of Locations	2	bent		PDF Page #	80		

Vulnerability Number	6	As-Built Dwg. File	1996 Seismic Report - Geotecl	n Appendix	
Vulnerable Component	Geotechnical Haza	ds - Piers,1, 2, and 3		Drawing #	NA
Description of Vulnerability	Concrete Pile supp foundation and pot		t side are prone to liquifaction.	This will lead to	uneven soil pressures on the
Proposed Retrofit	Provide soil densif	cation around piers			
Number of Locations	1	bridge site		PDF Page #	NA
Unit Cost of Retrofit	\$6,650,000	each		Figure Ref. #	NA

Vulnerability Number	7	As-Built Dwg. File	1996 Seismic Report - Geotech	Appendix	
Vulnerable Component	Geotechnical Hazar	Drawing #	NA		
Description of Some of the soil around pier 4 is succeptible to liquifaction. Due to the sloped ground and potential for lateral vulnerability spreading, large lateral forces on the Pier 4 substructure may occur.					
Proposed Retrofit	Provide soil densifi	cation around piers			
Number of Locations	1	bridge site		PDF Page #	NA
Unit Cost of Retrofit	\$6,650,000	each		Figure Ref. #	NA

Bridge Complex	Broadway			Compiled by	CSK	Date:	3/26/2014
Bridge Name	Willamette River, B	Broadway St [Broadw	ay]	Checked by	KPBU	Date:	5/19/2014
Bridge Number	06757						
Bridge Location	Fixed River Spans						
Seismic Event	100 Yr	Desir	ed Performance Level	No Co	llapse (NC)		
Vulnerability Number	1	As-Built Dwg. File	1911-12-12_Broadway_Main	_Bridge.pdf			
Vulnerable Component	Pier 2 Columns			Drawing #	AH001-01	8	
Description of Vulnerability	Steel columns hav	e limited lateral capa	bility. Additionally, connection	details are prone t	o premature	tanure.	
Proposed Retrofit	Install reinforced c columns.	oncrete encasing arc	ound columns. Additionally, ins	tall additional stee	l cross brac	ing bet	veen
Number of Locations	2	columns		PDF Page #	52		
Unit Cost of Retrofit	\$56,000	each		Figure Ref. #	BW003		

Vulnerability Number	2	As-Built Dwg. File	1911-12-12_Broadway_Main_Br	idge.pdf	
Vulnerable Component	Pier 1, 3, 4 & 7 Jack	eted Column		Drawing #	AJ002-002
Description of Vulnerability		nd steel columns have lements is insufficient.	limited lateral displacement capa	acity and streng	th. Connection to below
Proposed Retrofit	No retrofit required	for 100 year			
Number of Locations	8	Columns		PDF Page #	189
Unit Cost of Retrofit	\$0	each		Figure Ref. #	NA

Vulnerability Number	3	As-Built Dwg. File	1911-12-12_Broadway_	Main_Bri	dge.pdf	
Vulnerable Component	Pier 2, 3, 4, & 7 and	E. Abutment Bearings	•		Drawing #	AH001-037
Description of Vulnerability		all and may become un . Insufficient seat widt		small mov	vements. Anch	orage of bearings to Pier cap
Proposed Retrofit	Install longitudinal	restrainers and catche	r blocks.			
Number of Locations	20	bearings			PDF Page #	71
Unit Cost of Retrofit	\$56,000	each			Figure Ref. #	BW004

Vulnerability Number	4	As-Built Dwg. File	1927-1995_Broadway_Br_Repai	irs_Misc_Works	.pdf
Vulnerable Component	Pier 2, 3, 4, & 7 Cor	crete Piers		Drawing #	AG022-002
Description of Vulnerability	Concrete Piers are sufficient.	unreinforced and pron	e to brittle failure. Connections t	to Columns and	Caisson are likely not
Proposed Retrofit	No retrofit required	for 100 year			
Number of Locations	4	piers		PDF Page #	46
Unit Cost of Retrofit	\$0	each		Figure Ref. #	BW040

Bridge Complex	Broadway			Compiled by:	CSK	Date:	3/26/2014
Bridge Name	Willamette River, E	Broadway St [Broadw	ay]	Checked by:	KPBU	Date:	5/19/2014
Bridge Number	06757						
Bridge Location	Fixed River Spans						
Seismic Event	100 Yr	Desir	ed Performance Level	No Coll	lapse (NC)		
Vulnerability Number	5	As-Built Dwg. File	2002-09-01_Broadway_Reh	nab_Ph_4_7_Signed.	pdf		
				Drowing #	C4 4 4 0		
Vulnerable Component Description of Vulnerability	Staircases to Naito	3	is vulnerable to failure due to r	Drawing #	61442 he stairs c	or the ma	in bridge.
Description of		3	is vulnerable to failure due to r		-	or the ma	in bridge.
		tairway to structure i	is vulnerable to failure due to r		-	or the ma	in bridge.
Description of Vulnerability	Support of top of s	tairway to structure i	is vulnerable to failure due to r		-	or the ma	in bridge.

Vulnerability Number	6	As-Built Dwg. File	1996 Seismic Report - Geotech	n Appendix	
Vulnerable Component	Geotechnical Haza	rds - Piers,1, 2, and 3		Drawing #	NA
Description of Vulnerability	Concrete Pile supp foundation and po		t side are prone to liquifaction.	This will lead to	uneven soil pressures on the
Proposed Retrofit	No retrofit required	l for 100 year			
Number of Locations	1	bridge site		PDF Page #	NA
Unit Cost of Retrofit	\$0	each		Figure Ref. #	NA

Vulnerability Number	7	As-Built Dwg. File	1996 Seismic Report - Geotech	Appendix	
Vulnerable Component	Geotechnical Hazar	ds - Pier 4		Drawing #	NA
Description of Vulnerability			ible to liquifaction. Due to the slo 4 substructure may occur.	ped ground an	d potential for lateral
Proposed Retrofit	No retrofit required	for 100 year			
Number of Locations	1	bridge site		PDF Page #	NA
Unit Cost of Retrofit	\$0	each		Figure Ref. #	NA

Bridge Complex	Broadway			Compiled by:	CSK	Date:	3/26/2014
Bridge Name	Willamette Rive	r, Broadway St [Broadw	/ay]	Checked by:	KPBU	Date:	4/29/2014
Bridge Number	06757						
Bridge Location	Moveable Span						
Seismic Event	1000 Yr	Desir	ed Performance Level	No Col	lapse (NC)		
Vulnerability Number	1	As-Built Dwg. File	1927-1995 Broadway Br	Repairs Misc Works	s.pdf		
				Drawinart		<u> </u>	
Vulnerable Component Description of Vulnerability		alls have limited lateral	load capability and slenderne			gitudina	al direction.
	Concrete pier w	alls have limited lateral	load capability and slenderne s and unreinforced. Exhibitin	ess concerns primari	ly in the long	gitudina	al direction.
Description of	Concrete pier w Piers are 120' ta	alls have limited lateral all above the foundation: Walls with concrete jac		ess concerns primari g non-ductile or britt	ly in the long le response	gitudina es.	
Description of Vulnerability	Concrete pier w Piers are 120' ta Strengthen Pier	alls have limited lateral all above the foundation: Walls with concrete jac	s and unreinforced. Exhibitin	ess concerns primari g non-ductile or britt	ly in the long le response	gitudina es.	

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Vulnerability Number	2	As-Built Dwg. File	1911-12-12_Broadway_Main_Br	idge.pdf	
Vulnerable Component	Pier 5 & 6 Bearings			Drawing #	AJ001-047
Description of Vulnerability		d may become unstabl Insufficient seat width a	le under relatively small moveme at top of piers.	ents. Anchorag	e of bearings to Pier cap is
Proposed Retrofit		nd improve anchorage vith isolation bearing.	, provide stops for transverse ar	nd longitudinal i	novement. System Retrofit -
Number of Locations	4	Bearings		PDF Page #	163
Unit Cost of Retrofit	\$500,000	each		Figure Ref. #	BW050

Vulnerability Number	3	As-Built Dwg. File	1911-12-12_Broadway_Main_Br	ridge.pdf	
Vulnerable Component	Pier 5 & 6 Footings			Drawing #	AH001-016
Description of Vulnerability			einforced. Lateral load and displa exhibit non-ductile behavior	acement capaci	ty particularly in the
Proposed Retrofit			ditions around footing. System R ing unneeded or greatly reduced.		olation will reduce demands
Number of Locations	2	piers		PDF Page #	50
Unit Cost of Retrofit	\$2,000,000	each		Figure Ref. #	NA

Vulnerability Number	4	As-Built Dwg. File	1927-1995_Broadway_Br_Repai	rs_Misc_Works	.pdf
Vulnerable Component	Anchor Struts			Drawing #	AG008-001
Description of Vulnerability	The anchor struts n	nay see very high forc	es in a seismic event and are key	stability compo	onents of the bascule span.
Proposed Retrofit	Strengthen or repla	ce anchor struts and o	connections		
Number of Locations	4			PDF Page #	13
Unit Cost of Retrofit	\$500,000	each		Figure Ref. #	BW0051

Bridge Complex	Broadway			Compiled by:	CSK	Date:	3/26/2014
Bridge Name	Willamette River, B	roadway St [Broadw	ay]	Checked by:	KPBU	Date:	4/29/2014
Bridge Number	06757						
Bridge Location	Moveable Span						
Seismic Event	1000 Yr	Desir	ed Performance Level	No Col	lapse (NC)		
Vulnerability Number	5	As-Built Dwg. File	1911-12-12_Broadway_Mai	n_Bridge.pdf			
	Dell Miles el Tres els				41/004.00		
Vulnerable Component	Rall Wheel Track	k lacks lateral suppo	orts or buffers to keep the whe	Drawing #	AK001-02		naed
Vulnerable Component Description of Vulnerability		k lacks lateral suppo	orts or buffers to keep the whe				nged
Description of	The Rall wheel trac		orts or buffers to keep the whe				nged
Description of Vulnerability	The Rall wheel trac. seismic event.		orts or buffers to keep the whe				nged

Vulnerability Number	6	As-Built Dwg. File	1911-12-12_Broadway_Main_B	idge.pdf	
Vulnerable Component	Truss Frame at Cou	Interweight		Drawing #	AK001-003
Description of Vulnerability	The truss frame tha	t transfers lateral load	I from the counterweight to the R	all Wheels is ins	sufficient
Proposed Retrofit			tudinal frame members to provide demands significantly.	e adequate stren	ngth. <mark>System Retrofit -</mark> Base
Number of Locations	2			PDF Page #	199
Unit Cost of Retrofit	\$2,000,000	each		Figure Ref. #	BW053

Vulnerability Number	7	As-Built Dwg. File	1911-12-12_Broadway_Main_Br	idge.pdf	
Vulnerable Component	Truss Frame at Ral	Wheel		Drawing #	AK001-003
Description of Vulnerability	The truss frame sup large mass they sup		el likely have insufficient lateral s	trength in a sei:	smic event given the very
Proposed Retrofit			tudinal frame members to provide demands significantly.	e adequate strer	ngth. <mark>System Retrofit - Ba</mark> se
Number of Locations	2			PDF Page #	199
Unit Cost of Retrofit	\$2,000,000	each		Figure Ref. #	BW053

Vulnerability Number	8	As-Built Dwg. File	1911-12-12_Broadway_	Main_Bridge.pdf	
Vulnerable Component	Bascule Leaf Latera	al Movement		Drawing #	AK001-003
Description of Vulnerability	The bascule leaves	have little restraint	from rotation about a vertic	al axis or lateral move	ment.
Proposed Retrofit	Provide lateral stop	es at heel and toe of	bascule leaves to engage ir	n seismic event.	
Number of Locations	4			PDF Page #	199
Unit Cost of Retrofit	\$200,000	each		Figure Ref. #	

Bridge Complex	Broadway			Compiled by:	CSK	Date:	3/26/2014
Bridge Name	Willamette River, E	Broadway St [Broadwa	ay]	Checked by:	KPBU	Date:	4/29/2014
Bridge Number	06757						
Bridge Location	Moveable Span						
Seismic Event	1000 Yr	Desire	ed Performance Level	No Coll	apse (NC)	
Vulnerability Number	9	As-Built Dwg. File	2009-08-01_Broadway_Port	tland_Streetcar_Loo	р		
Vulnerable Component	Live Load Shoes			Drawing #	S061		
Description of	The live load shoe	s mav see verv high t	transverse forces as well as lor	naitudinal forces in a	a forward	direction	that they
Description of Vulnerability	The live load shoe are not detailed to		transverse forces as well as lor	ngitudinal forces in a	a forward	direction	that they
· ·	are not detailed to	contain.	transverse forces as well as lor ad shoes to limit movement at		a forward	direction	that they
Vulnerability	are not detailed to	contain.			a forward	direction	that they

Bridge Complex	Broadway			Compiled by:	CSK	Date:	3/26/2014
Bridge Name	Willamette Rive	er, Broadway St [Broadwa	ay]	Checked by:	kpbu	Date:	5/14/2014
Bridge Number	06757						
Bridge Location	Moveable Span						
Seismic Event	500 Yr	Desire	ed Performance Level	No Col	lapse (NC)		
		•					
Vulnerability Number	1	As-Built Dwg. File	1927-1995_Broadway_Br_F	Repairs_Misc_Works	s.pdf		
				Durautina	A COOO 000	~	
Vulnerable Component Description of		walls have limited lateral	load capability and slendernes			gitudina	al direction.
,	Concrete pier v	walls have limited lateral	load capability and slendernes s and unreinforced. Exhibiting	ss concerns primari	ly in the lon	gitudina	al direction.
Description of	Concrete pier v Piers are 120' t	walls have limited lateral all above the foundations or Walls with concrete jac		ss concerns primari non-ductile or britt	ly in the lon le response	gitudina es.	
Description of Vulnerability	Concrete pier v Piers are 120' t Strengthen Pie	walls have limited lateral all above the foundations or Walls with concrete jac	s and unreinforced. Exhibiting	ss concerns primari non-ductile or britt	ly in the lon le response	gitudina es.	

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Vulnerability Number	2	As-Built Dwg. File	1911-12-12_Broadway_Main_Br	idge.pdf	
Vulnerable Component	Pier 5 & 6 Bearings			Drawing #	AJ001-047
Description of Vulnerability		d may become unstabl Insufficient seat width a	le under relatively small moveme at top of piers.	ents. Anchorag	e of bearings to Pier cap is
Proposed Retrofit		nd improve anchorage vith isolation bearing.	, provide stops for transverse ar	nd longitudinal ı	novement. System Retrofit -
Number of Locations	4	Bearings		PDF Page #	163
Unit Cost of Retrofit	\$475,000	each		Figure Ref. #	BW050

Vulnerability Number	3	As-Built Dwg. File	1911-12-12_Broadway_Main_Br	idge.pdf	
Vulnerable Component	Pier 5 & 6 Footings			Drawing #	AH001-016
Description of Pier Footings are approx. 80' tall and unreinforced. Lateral load and displacement capacity particularly in the Vulnerability Iongitudinal direction is insufficient. Will exhibit non-ductile behavior					
Proposed Retrofit			ditions around footing. System R ing unneeded or greatly reduced.		olation will reduce demands
Number of Locations	2	piers		PDF Page #	50
Unit Cost of Retrofit	\$1,900,000	each		Figure Ref. #	NA

Vulnerability Number	4	As-Built Dwg. File	1927-1995_Broadway_Br_Repai	rs_Misc_Works	.pdf	
Vulnerable Component	Anchor Struts			Drawing #	AG008-001	
Description of Vulnerability						
Proposed Retrofit	Strengthen or repla	ce anchor struts and o	connections			
Number of Locations	4			PDF Page #	13	
Unit Cost of Retrofit	\$475,000	each		Figure Ref. #	BW0051	

Bridge Complex	Broadway			Compiled by:	CSK	Date:	3/26/2014
Bridge Name	Willamette River, I	Broadway St [Broadwa	ay]	Checked by:	kpbu	Date:	5/14/2014
Bridge Number	06757						
Bridge Location	Moveable Span						
Seismic Event	500 Yr	Desire	ed Performance Level	No Col	lapse (NC)		
Vulnerability Number	5	As-Built Dwg. File	1911-12-12_Broadway_Main	Bridge.pdf			
Vulnerable Commonset	Dell Missel Treels			Drawing #	A 1/004 00	`	
Vulnerable Component	Rall Wheel Track	ck lacks latoral suppo	orte or huffors to koon the wheel		AK001-02		naod
Vulnerable Component Description of Vulnerability		ck lacks lateral suppo	orts or buffers to keep the wheel				nged
Description of	The Rall wheel tra		orts or buffers to keep the wheel				nged
Description of Vulnerability	The Rall wheel tra seismic event.		orts or buffers to keep the wheel				nged

Vulnerability Number	6	As-Built Dwg. File	1911-12-12_Broadway_Main_Br	idge.pdf	
Vulnerable Component	Truss Frame at Co	unterweight		Drawing #	AK001-003
Description of Vulnerability	The truss frame the	at transfers lateral loa	d from the counterweight to the R	all Wheels is in:	sufficient
Proposed Retrofit			itudinal frame members to provide demands significantly.	e adequate strer	ngth. <mark>System Retrofit - Ba</mark> se
Number of Locations	2			PDF Page #	199
Unit Cost of Retrofit	\$1,900,000	each		Figure Ref. #	BW053

Vulnerability Number	7	As-Built Dwg. File	1911-12-12_Broadway_Main_Br	idge.pdf	
Vulnerable Component	Truss Frame at Rall	Wheel		Drawing #	AK001-003
Description of Vulnerability	The truss frame sup large mass they sup		l likely have insufficient lateral s	trength in a seis	smic event given the very
Proposed Retrofit		transverse and longit Il reduce lateral load d	udinal frame members to provide emands significantly.	adequate stren	gth. System Retrofit - Base
Number of Locations	2			PDF Page #	199
Unit Cost of Retrofit	\$1,900,000	each		Figure Ref. #	BW053

Vulnerability Number	8	As-Built Dwg. File	1911-12-12_Broadway_N	lain_Bridge.pdf	
Vulnerable Component	Bascule Leaf Latera	al Movement		Drawing #	AK001-003
Description of Vulnerability	The bascule leaves	have little restraint	from rotation about a vertica	al axis or lateral move	ment.
Proposed Retrofit	Provide lateral stop	es at heel and toe of	bascule leaves to engage in	seismic event.	
Number of Locations	4			PDF Page #	199
Unit Cost of Retrofit	\$190,000	each		Figure Ref. #	

Bridge Complex	Broadway			Compiled by:	CSK	Date:	3/26/2014
Bridge Name	Willamette River, Broadway St [Broadway]			Checked by:	kpbu	Date:	5/14/2014
Bridge Number	06757						
Bridge Location	Moveable Span						
Seismic Event	500 Yr	Desir	red Performance Level	No Coll	apse (NC)		
Vulnerability Number	9	As-Built Dwg. File	2009-08-01_Broadway_Por	tland_Streetcar_Loo	р		
Mada ana bia Oana ana ant	Lines Land Observe	Drawing #	S061				
Vulnerable Component Description of Vulnerability		oes may see very high t	transverse forces as well as lo			direction	that they
Description of		oes may see very high t	transverse forces as well as lo			direction	that they
-	The live load sho are not detailed t	bes may see very high t to contain.	transverse forces as well as lo ad shoes to limit movement at	ngitudinal forces in a		direction	that they
Description of Vulnerability	The live load sho are not detailed t	bes may see very high t to contain.		ngitudinal forces in a		direction	that they

Bridge Complex	Broadway			Compiled by	CSK	Date:	3/26/2014
Bridge Name	Willamette River, Broadway St [Broadway]			Checked by	kpbu	Date:	5/14/2014
Bridge Number	06757						
Bridge Location	Moveable Span						
Seismic Event	100 Yr	Desir	red Performance Level	No Col	lapse (NC))	
Vulnerability Number	1	As-Built Dwg. File	1927-1995_Broadway_Br_Re	pairs_Misc_Work	s.pdf		
		<u> </u>					
Vulnerable Component Description of		lls have limited lateral	l load capability and slenderness			ongitudina	al direction.
	Concrete pier wa	lls have limited lateral	l load capability and slenderness is and unreinforced. Exhibiting i	concerns primari	ly in the lo	ongitudina	al direction.
Description of	Concrete pier wa	lls have limited lateral above the foundation		concerns primari	ly in the lo	ongitudina	al direction.
Description of Vulnerability	Concrete pier wa Piers are 120' tall	lls have limited lateral above the foundation		concerns primari	ly in the lo	ongitudina	al direction.

Vulnerability Number	2	As-Built Dwg. File	1911-12-12_Broadway_Main_Br	idge.pdf	
Vulnerable Component	Pier 5 & 6 Bearings	•		Drawing #	AJ001-047
Description of Vulnerability		nd may become unsta Insufficient seat widti	ble under relatively small moveme h at top of piers.	ents. Anchorag	e of bearings to Pier cap is
Proposed Retrofit	No retrofit required	l for 100 year			
Number of Locations	4	Bearings		PDF Page #	163
Unit Cost of Retrofit	\$0	each		Figure Ref. #	BW050

Vulnerability Number	3	As-Built Dwg. File	1911-12-12_Broadway_Main_Br	idge.pdf			
Vulnerable Component	Pier 5 & 6 Footings			Drawing #	AH001-016		
Description of Vulnerability	Description of Pier Footings are approx. 80' tall and unreinforced. Lateral load and displacement capacity particularly in the						
Proposed Retrofit	No retrofit required	for 100 year					
Number of Locations	2	piers		PDF Page #	50		
Unit Cost of Retrofit	\$0	each		Figure Ref. #	NA		

Vulnerability Number	4	As-Built Dwg. File	1927-1995_Broadway_Br_Rep	airs_Misc_Works	s.pdf
Vulnerable Component	Anchor Struts			Drawing #	AG008-001
Description of Vulnerability	The anchor struts n	nay see very high force	es in a seismic event and are ke	y stability comp	onents of the bascule span.
Proposed Retrofit	Strengthen or repla	ce anchor struts and c	onnections		
Number of Locations	4			PDF Page #	13
Unit Cost of Retrofit	\$375,000	each		Figure Ref. #	BW0051

Bridge Complex	Broadway	Compiled by:	CSK	Date:	3/26/2014		
Bridge Name	Willamette River, Broadway St [Broadway]			Checked by:	kpbu	Date:	5/14/2014
Bridge Number	06757						
Bridge Location	Moveable Span						
Seismic Event	100 Yr	Desire	ed Performance Level	No Col	lapse (NC)		
Vulnerability Number	5	As-Built Dwg. File	1911-12-12_Broadway_Main	Bridge.pdf			
Vulnerable Component	Rall Wheel Track	•		Drawing #	AK001-02	22	
		ak laaka lataral suppo	orte or huffore to keep the wheel				ngod
Description of Vulnerability		ck lacks lateral suppo	orts or buffers to keep the wheel				nged
Description of	The Rall wheel tra		orts or buffers to keep the wheel				nged
Description of Vulnerability	The Rall wheel trac seismic event.		orts or buffers to keep the wheel				nged

Vulnerability Number	6	As-Built Dwg. File	1911-12-12_Broadway_Main_B	ridge.pdf	
Vulnerable Component	Truss Frame at Cou	unterweight		Drawing #	AK001-003
Description of Vulnerability	The truss frame tha	at transfers lateral loa	d from the counterweight to the F	Rall Wheels is in	sufficient
Proposed Retrofit	Strength or replace	e transverse and long	itudinal frame members to provid	e adequate stre	ngth.
Number of Locations	2			PDF Page #	199
Unit Cost of Retrofit	\$1,500,000	each		Figure Ref. #	BW053

Vulnerability Number	7	As-Built Dwg. File	1911-12-12_Broadway_Main_Br	idge.pdf		
Vulnerable Component	Truss Frame at Rall	Wheel		Drawing #	AK001-003	
Description of Vulnerability The truss frame supports at the Rall wheel likely have insufficient lateral strength in a seismic event given the very large mass they support.						
Proposed Retrofit	Strength or replace	transverse and longitu	idinal frame members to provide	e adequate stren	ngth.	
Number of Locations	2			PDF Page #	199	
Unit Cost of Retrofit	\$1,500,000	each		Figure Ref. #	BW053	

Vulnerability Number	8	As-Built Dwg. File	1911-12-12_Broadway_	_Main_Bridge.pdf	
Vulnerable Component	Bascule Leaf Latera	al Movement	•	Drawing #	AK001-003
Description of Vulnerability	The bascule leaves	have little restraint fr	om rotation about a verti	cal axis or lateral move	ment.
Proposed Retrofit	Provide lateral stop	s at heel and toe of b	ascule leaves to engage	in seismic event.	
Number of Locations	4			PDF Page #	199
Unit Cost of Retrofit	\$150,000	each		Figure Ref. #	

Bridge Complex	Broadway					Date:	3/26/2014
Bridge Name	Willamette River, Broadway St [Broadway]			Checked by:	kpbu	Date:	5/14/2014
Bridge Number	06757						
Bridge Location	Moveable Span						
Seismic Event	100 Yr	Desir	ed Performance Level	No Col	lapse (NC))	
Vulnerability Number	9	As-Built Dwg. File	2009-08-01_Broadway_Por	rtland_Streetcar_Loc	р		
Vulnerable Component	Live Load Shoes	3	· ·	Drawing #	S061		
Description of			transverse forces as well as lo	ngitudinal forces in	a forward	direction	that they
,	The live load sho are not detailed t		transverse forces as well as lo	ngitudinal forces in	a forward	direction	that they
Description of Vulnerability Proposed Retrofit	are not detailed t	to contain.	transverse forces as well as lo ad shoes to limit movement at		a forward	direction	that they
Vulnerability	are not detailed t	to contain.			a forward	direction	that they

Bridge Complex	Broadway			Compiled by:	KPBU	Date:	3/26/2014
Bridge Name	N Broadway St ove	Checked by:	CSK	Date:	5/13/2014		
Bridge Number	06757C						
Bridge Location	East Approaches						
Seismic Event	1000 Yr	Desire	ed Performance Level	No Col	lapse (NC)		
Vulnerability Number	1	As-Built Dwg. File	1949_Interstate Ave Bridge Dra	awings_Broadwa	ay East App	oroach	
Vulnerable Component	Abutments			Drawing #	9139		
Description of		nt transfer mechanisn					
Vulnerability	loading.						<i>cyclic</i>
Vulnerability Proposed Retrofit	loading.		at joints to provide additional stre				
	loading.				8		

Vulnerability Number	2	As-Built Dwg. File	1949_Interstate Ave Bridge Drav	wings_Broadwa	ay East Approach
Vulnerable Component	Interior Pier Wall			Drawing #	9139
Description of Vulnerability	Inadequate momen Ioading.	t transfer mechanism a	at joints with superstructure and	footing. Likely	deterioration under cyclic
Proposed Retrofit	Provide built up co	ncrete connections at j	joints to provide additional streng	gth	
Number of Locations	1			PDF Page #	8
Unit Cost of Retrofit	\$100,000	each		Figure Ref. #	BW93

Bridge Complex	Broadway			Compiled by	KPBU	Date:	3/26/2014
Bridge Name	N Broadway St ove	er N Interstate Ave [B	roadway]	Checked by	CSK	Date:	5/13/2014
Bridge Number	06757C						
Bridge Location	East Approaches						
Seismic Event	500 Yr	Desire	ed Performance Level	No Col	lapse (NC)		
Vulnerability Number	1	As-Built Dwg. File	1949_Interstate Ave Bridge I	Drawings_Broadw	ay East Ap	proach	
Vulnerable Component				Drawing #	9139		
		nt transfer mechanism	n at joints with superstructure a	¥		ion unde	r cyclic
Description of Vulnerability		nt transfer mechanisn	n at joints with superstructure a	¥		ion unde	r cyclic
Description of	Inadequate momer loading.		n at joints with superstructure a at joints to provide additional st	nd footing. Likely		ion unde	r cyclic
Description of Vulnerability	Inadequate momer loading.			nd footing. Likely		ion unde	r cyclic

Vulnerability Number	2	As-Built Dwg.	File	1949_Interstate Ave Bridge Drav	vings_Broadwa	y East Approach
Vulnerable Component	Interior Pier Wall				Drawing #	9139
Description of Vulnerability	Inadequate momen Ioading.	t transfer mec	chanism a	t joints with superstructure and f	ooting. Likely	deterioration under cyclic
Proposed Retrofit	Provide built up col	ncrete connec	ctions at j	oints to provide additional streng	ηth	
Number of Locations	1				PDF Page #	8
Unit Cost of Retrofit	\$95,000	each			Figure Ref. #	BW93

Bridge Complex	Broadway			Compiled by:	KPBU Date:	3/26/2014
Bridge Name	N Broadway St ove	er N Interstate Ave [Bi	roadway]	Checked by:	CSK Date:	5/13/2014
Bridge Number	06757C					
Bridge Location	East Approaches					_
Seismic Event	100 Yr	Desire	ed Performance Level	No Col	lapse (NC)	
						_
Vulnerability Number	1	As-Built Dwg. File	1949_Interstate Ave Bridge	Drawings_Broadwa	ay East Approach	ו
Vulnerable Component	Abutments			Drawing #	9139	
Description of Vulnerability	Inadequate momer loading.	nt transfer mechanisn	n at joints with superstructure	and footing. Likely	deterioration un	der cyclic
Proposed Retrofit	No retrofit required	d for 100 year				
Number of Locations	2			PDF Page #	8	

Vulnerability Number	2	As-Built Dwg. File	1949_Interstate Ave Bridge Drav	wings_Broadwa	y East Approach
Vulnerable Component	Interior Pier Wall			Drawing #	9139
Description of Vulnerability	Inadequate momen loading.	t transfer mechanism	at joints with superstructure and	footing. Likely	deterioration under cyclic
Proposed Retrofit	No retrofit required	for 100 year			
Number of Locations	1			PDF Page #	8
Unit Cost of Retrofit	\$0	each		Figure Ref. #	BW93

Bridge Complex	Burnside			Compiled by	/: AJCA/AXL Date	e: 4/11/2014
Bridge Name	Burnside St West	Burnside St West Approach over Hwy 1 [Burnside]			/: kpbu Date	e: 5/20/2014
Bridge Number	00511A					
Bridge Location	West Approaches					
Seismic Event	1000 Yr	Desired Performance Level		Limited (Operation (LO)	
Vulnerability Number	1	As-Built Dwg. File	1924-02-21 Burnside As-Builts.	. <u>pdf</u>		
Vulnerable Component	Columns			Drawing #	AB001-008	
Description of Vulnerability	Bents 2-19 Columr	is are minimally reinf	orced and not detailed for hing	ing at top and bot	tom of columns.	
Proposed Retrofit	-	-	column flexural and shear capa grade slab/pavement/concrete.	•	13, the bottom of	columns have
Number of Locations	72			PDF Page #	1	
Unit Cost of Retrofit	\$130,000	each		Figure Ref. #	BU301	

Vulnerability Number	2	As-Built Dwg. File	1924-02-21 Burnside As-Builts.pdf		
Vulnerable Component	Footings	•		Drawing #	AB001-008
Description of Vulnerability Bents 2-19 footings assumed to be unreinforced (no reinforcing details). If columns are strengthened, footings will like need strengthening as well.					
Proposed Retrofit	Footing enlargemen	nt and strengthening w	vith possible addition of micropile	es.	
Number of Locations	72			PDF Page #	1
Unit Cost of Retrofit	\$880,000	each		Figure Ref. #	BU301

Vulnerability Number	3	As-Built Dwg. File	1924-02-21 Burnside As-Builts.pdf			
Vulnerable Component	Superstructure Sea	ating on Expansion Be	nt	Drawing #	AB001-0021, 25, 26, 27	
Description of Vulnerability Bents 1, 5, 8, 11, 14, 16, 17, 18, 19 have expansion joints where superstructure could pull off.						
Proposed Retrofit	bosed Retrofit Longitudinal restrainers or Steel/Concrete seat extension or catcher blocks.					
Number of Locations	9			PDF Page #	2	
Unit Cost of Retrofit	\$180,000	each		Figure Ref. #	BU302	

Vulnerability Number	4	As-Built Dwg. File	1924-02-21 Burnside As-Builts.pdf		
Vulnerable Component	Pier Caps/Floor Bea	ams		Drawing #	AB001-0021, 22
Description of Vulnerability	Integral pier caps a are strengthened.	t Bents 2-16 may requir	e strengthening to take seismic	forces from gir	ders or columns after columns
Proposed Retrofit	Section enlargemen	nt.			
Number of Locations	15			PDF Page #	3
Unit Cost of Retrofit	\$260,000	each		Figure Ref. #	BU303

Bridge Complex	Burnside			Compiled by	AJCA/AXL Date:	4/11/2014
Bridge Name	Burnside St West A	Burnside St West Approach over Hwy 1 [Burnside]			kpbu Date:	5/20/2014
Bridge Number	00511A					
Bridge Location	West Approaches					
Seismic Event	500 Yr	Desire	Desired Performance Level		eration (FO)	
Vulnerability Number	1	As-Built Dwg. File	1924-02-21 Burnside As-Builts.pd	<u>f</u>		
Vulnerable Component	Columns			Drawing #	AB001-008	
Description of Vulnerability	Bents 2-19 Column	ns are minimally reinf	orced and not detailed for hingin	g at top and bott	om of columns.	
Proposed Retrofit			column flexural and shear capaci grade slab/pavement/concrete.	ty. For Bents 2-1	3, the bottom of co	lumns have
Number of Locations	72			PDF Page #	1	
Unit Cost of Retrofit	\$124,000	each		Figure Ref. #	BU301	

Vulnerability Number	2	As-Built Dwg. File	1924-02-21 Burnside As-Builts.pdf		
Vulnerable Component	Footings			Drawing #	AB001-008
Description of Vulnerability	Bents 2-19 footings need strengthening		forced (no reinforcing details). If	columns are st	rengthened, footings will likely
Proposed Retrofit					
Number of Locations	72			PDF Page #	1
Unit Cost of Retrofit	\$836,000	each		Figure Ref. #	BU301

Vulnerability Number	3	As-Built Dwg. File	1924-02-21 Burnside As-Builts.pdf		
Vulnerable Component	Superstructure Sea	ting on Expansion Be	nt	Drawing #	AB001-0021, 25, 26, 27
Description of Vulnerability	Bents 1, 5, 8, 11, 14	l, 16, 17, 18, 19 have e.	xpansion joints where superstruc	ture could pull	off.
Proposed Retrofit	Longitudinal restra	iners or Steel/Concret	e seat extension or catcher block	s.	
Number of Locations	9			PDF Page #	2
Unit Cost of Retrofit	\$171,000	each		Figure Ref. #	BU302

Vulnerability Number	4	As-Built Dwg. File	1924-02-21 Burnside As-Builts.pdf		
Vulnerable Component	Pier Caps/Floor Bea	ams		Drawing #	AB001-0021, 22
Description of Vulnerability	Integral pier caps a are strengthened.	t Bents 2-16 may requir	re strengthening to take seismic	forces from gird	ders or columns after columns
Proposed Retrofit	Section enlargemen	nt.			
Number of Locations	15			PDF Page #	3
Unit Cost of Retrofit	\$247,000	each		Figure Ref. #	BU303

Bridge Complex	Burnside			Compiled by	AJCA/AX	L Date:	4/11/2014
Bridge Name	Burnside St West Approach over Hwy 1 [Burnside]			Checked by	kpbu	Date:	5/20/2014
Bridge Number	00511A						
Bridge Location	West Approaches						
Seismic Event	100 Yr	Desir	red Performance Level	No Co	llapse (NC)		
Vulnerability Number	1	As-Built Dwg. File	1924-02-21 Burnside As-Builts.p	<u>df</u>			
Vulnerable Component	Columns			Drawing #	AB001-00	08	
Description of		s are minimally rein	forced and not detailed for hingi	, v			
		as are minimally rein	forced and not detailed for hingin	, v			
Description of	Bents 2-19 Column		forced and not detailed for hingin uperstructure to substructure co	ng at top and bott	om of colui		
Description of Vulnerability	Bents 2-19 Column			ng at top and bott	om of colui		

Vulnerability Number	2	As-Built Dwg. File	1924-02-21 Burnside As-Builts.pdf		
Vulnerable Component	Superstructure Sea	ting on Expansion Ber	nt	Drawing #	AB001-0021, 25, 26, 27
Description of Vulnerability	Bents 1, 5, 8, 11, 14	, 16, 17, 18, 19 have ex	ansion joints where superstructu	ire could pull of	ff.
Proposed Retrofit	Longitudinal restra	iners or Steel/Concrete	e seat extension or catcher block	s.	
Number of Locations	9			PDF Page #	2
Unit Cost of Retrofit	\$135,000	each		Figure Ref. #	BU302

Bridge Complex	Burnside			Compiled by	AXLI	Date:	4/11/2014
Bridge Name	Willamette River, Burnside St (Burnside) [Burnside]			Checked by	ː kpbu	Date:	5/20/2014
Bridge Number	00511						
Bridge Location	Fixed River Spans						
Seismic Event	1000 Yr	Desir	red Performance Level	Limited 0	Operation (LO)	
		•					
Vulnerability Number	1	As-Built Dwg. File	1995-11-01 Burnside Seis	mic Evaluation Report.pd	f		
Vulnerable Component	Liquefaction			Drawing #	Appendi	ix D page	8
Description of			fy (occur in small, disconti				
Vulnerability			ty (occur in small, disconti ope sides of the Piers 1 an				
	unbalanced earth the upper 15ft.		ope sides of the Piers 1 an				
Vulnerability	unbalanced earth the upper 15ft.	pressure on the upsl	ope sides of the Piers 1 an				

Vulnerability Number	2	As-Built Dwg. File	1995-11-01 Burnside Seismic Eval	uation Report.pdf	
Vulnerable Component	Slope Stability / Lat	eral Spreading		Drawing #	Appendix D page 8
Description of Vulnerability	2 or more feet of di	splacements of the rive	er banks will apply pressure on a	the upslope side	of the Piers 1 and 4 caps.
Proposed Retrofit	Provide soil densifi	cation around Piers 1 8	4. Note: cost of vulernability	1 accounts for th	his.
Number of Locations	1	bridge site		PDF Page #	1
Unit Cost of Retrofit	\$0	each		Figure Ref. #	BU201

Vulnerability Number	3	As-Built Dwg. File	1924-02-21 Burnside As-Builts.pdf		
Vulnerable Component	Piers 1 & 4 Founda	tion Timber Piles		Drawing #	AB001-009 & 017
Description of Vulnerability		However, if the footin	ige longitudinal direction due to ti g is allowed to rock, the uplift in _l		
Proposed Retrofit	No proposed retrof	it, allow footing to roc	k.		
Number of Locations	2			PDF Page #	2
Unit Cost of Retrofit	\$0	each		Figure Ref. #	BU202

Vulnerability Number	4	As-Built Dwg. File	1924-02-21_Burnside_As-Builts.pdf		
Vulnerable Component	Piers 1 & 4 Column	s		Drawing #	AB001-009 & 017
Description of Lightly reinforced (without proper seismic reinforcing details) columns could crack and loose of axial/vertical load Vulnerability carrying capacity.					
Proposed Retrofit	Steel shell retrofit f	or vertical capacity pre	servation.		
Number of Locations	4	columns		PDF Page #	3
Unit Cost of Retrofit	\$130,000	each		Figure Ref. #	BU203

Bridge Complex	Burnside			Compiled by:	AXLI	Date:	4/11/2014
Bridge Name	Willamette River, B	Willamette River, Burnside St (Burnside) [Burnside]			kpbu	Date:	5/20/2014
Bridge Number	00511						
Bridge Location	Fixed River Spans						
Seismic Event	1000 Yr	Desir	red Performance Level	Limited O	peration ((LO)	
Vulnerability Number	5	As-Built Dwg. File	1924-02-21 Burnside As-Builts.pd	f			
Vulnerable Component	Connections - supe	er to sub., Fixed Bea	rings and Seat Width	Drawing #	AB001-0)12	
	Substructure to su	perstructure connec	tions at Piers 2 & 3. fixed bearing:	s anchor bolts an	d limited	seat widt	hs.
Description of Vulnerability	Substructure to su	perstructure connec	tions at Piers 2 & 3, fixed bearing	s anchor bolts an	d limited	seat widtl	hs.
			tions at Piers 2 & 3, fixed bearing dowels and concrete.	s anchor bolts an	d limited	seat widtl	hs.
Vulnerability				s anchor bolts an	d limited	seat widtl	hs.

Vulnerability Number	6	As-Built Dwg. File	1924-02-21 Burnside As-Builts.pdf		
Vulnerable Component	Connections - supe	er to sub., Expansion E	Bearings and Seat Width	Drawing #	AB001-040
Description of Vulnerability	Substructure to su	perstructure connectio	ons at Piers 1 & 4, expansion bea	rings and limite	d seat widths.
Proposed Retrofit	Install longitudinal	restrainers and catche	er blocks. Note modification of be	earings in 2001.	
Number of Locations	2	bents		PDF Page #	5
Unit Cost of Retrofit	\$130,000	each		Figure Ref. #	BU205

Vulnerability Number	7	As-Built Dwg. File	1924-02-21 Burnside As-Builts.pdf		
Vulnerable Component	Joint in the Deck S	system	•	Drawing #	AB001-070
Description of Vulnerability	Separating of the f	īxed spans to approa	ch spans joint in the deck system.		
Proposed Retrofit	Strengthen the fixe	ed span connection to	o the pier wall.		
Number of Locations	2			PDF Page #	6
Unit Cost of Retrofit	\$180,000	each		Figure Ref. #	BU206

Vulnerability Number	8	As-Built Dwg. File	1924-02-21 Burnside As-Builts.pdf		
Vulnerable Component	Approach Deck Fix	ed Connection to Pie	rs 1 & 4	Drawing #	AB001-010
Description of Vulnerability	Separating of the a	pproach fixed span d	eck to Piers 1 and 4.		
Proposed Retrofit	None. Longitudinal	restraints installed in	n 2001.		
Number of Locations	2			PDF Page #	7
Unit Cost of Retrofit	\$0	each		Figure Ref. #	BU207

Bridge Complex	Burnside			Compiled by:	AXLI	Date:	4/11/2014
Bridge Name	Willamette River, Burnside St (Burnside) [Burnside]			Checked by:	kpbu	Date:	5/20/2014
Bridge Number	00511						
Bridge Location	Fixed River Spans						
Seismic Event	1000 Yr	Desire	d Performance Level	Limited O	peration (LO)	
Vulnerability Number	9	As-Built Dwg. File	1924-02-21 Burnside As-Builts.pdf				
Vulnerable Component	Truss System - Cor	nections of Primary	Members	Drawing #	AB001-0	31	
Vulnerability							
	None but will reas	iro analysis to confire	n members are safe for limited op	aration and life!	ino routo		
Proposed Retrofit	None, but will requ	ne analysis to comm	n members are sare for minited op	eration and men	ne route.		
Proposed Retrofit Number of Locations	72		n members are sare for minited op	PDF Page #	8		

Vulnerability Number	10 As-B	uilt Dwg. File	-		
Vulnerable Component	Overhead Sign Structure	s		Drawing #	-
Description of Vulnerability	Collapse of overhead sig	n structures ont	o bridge, obstacle to	use the bridge for limited o	peration.
Proposed Retrofit	None, will require clean i	ıp if collapse on	to bridge during seisr	nic event.	
Number of Locations	2			PDF Page #	9
Unit Cost of Retrofit	\$0 each			Figure Ref. #	BU209

Vulnerability Number	11	As-Built Dwg. File	-		
Vulnerable Component	Lightings			Drawing #	-
Description of Vulnerability	Collapse of overhea	nd sign structures onto	bridge, obstacle to use the bridg	ge for limited op	peration.
Proposed Retrofit	None, will require c	lean up if collapse ont	o bridge during seismic event.		
Number of Locations	7			PDF Page #	9
Unit Cost of Retrofit	\$0	each		Figure Ref. #	BU209

Bridge Complex	Burnside			Compiled by	AXLI	Date:	4/11/2014
Bridge Name	Willamette River, B	Willamette River, Burnside St (Burnside) [Burnside]			: kpbu	Date:	5/20/2014
Bridge Number	00511						
Bridge Location	Fixed River Spans						
Seismic Event	500 Yr	Desir	red Performance Level	Full Op	eration (FO)		
Vulnerability Number	1	As-Built Dwg. File	1995-11-01 Burnside Seismic E	valuation Report.pdf			
Vulnerable Component Description of	• •		fy (occur in small, discontinuous		•••	ily in incl	reased,
Description of	15ft of upper 15 to		fy (occur in small, discontinuous ope sides of the Piers 1 and 4 ca	zones) and resu	ting primari	ily in incl	reased,
	15ft of upper 15 to unbalanced earth p the upper 15ft.		ope sides of the Piers 1 and 4 ca	zones) and resu	ting primari	ily in incl	reased,
Description of Vulnerability	15ft of upper 15 to unbalanced earth p the upper 15ft.	pressure on the upsl	ope sides of the Piers 1 and 4 ca	zones) and resu	ting primari	ily in incl	reased,

Vulnerability Number	2	As-Built Dwg. File	1995-11-01 Burnside Seismic Evalu	ation Report.pdf	
Vulnerable Component	Slope Stability / Lat	teral Spreading		Drawing #	Appendix D page 8
Description of Vulnerability	2 or more feet of di	splacements of the rive	r banks will apply pressure on t	he upslope side	of the Piers 1 and 4 caps.
Proposed Retrofit	Provide soil densifi	ication around Piers 1 &	& 4. Note: cost of vulernability 1	l accounts for th	nis.
Number of Locations	1	bridge site		PDF Page #	1
Unit Cost of Retrofit	\$0	each		Figure Ref. #	BU201

Vulnerability Number	3	As-Built Dwg. File	1924-02-21 Burnside As-Builts.pdf		
Vulnerable Component	Piers 1 & 4 Foundat	tion Timber Piles		Drawing #	AB001-009 & 017
Description of Vulnerability		However, if the footing	dge longitudinal direction due to t ng is allowed to rock, the uplift in		
Proposed Retrofit	No proposed retrof	it, allow footing to roo	:к.		
Number of Locations	2			PDF Page #	2
Unit Cost of Retrofit	\$0	each		Figure Ref. #	BU202

Vulnerability Number	4	As-Built Dwg. File	1924-02-21_Burnside_As-Builts.pdf		
Vulnerable Component	Piers 1 & 4 Column	S		Drawing #	AB001-009 & 017
Vulnerability	Lightly reinforced (carrying capacity.	without proper seismic	reinforcing details) columns co	ould crack and lo	oose of axial/vertical load
Proposed Retrofit	Steel shell retrofit f	or vertical capacity pre	servation.		
Number of Locations	4	columns		PDF Page #	3
Unit Cost of Retrofit	\$124,000	each		Figure Ref. #	BU203

Bridge Complex	Burnside	Burnside			AXLI	Date:	4/11/2014
Bridge Name	Willamette River, E	Willamette River, Burnside St (Burnside) [Burnside]			kpbu	Date:	5/20/2014
Bridge Number	00511						
Bridge Location	Fixed River Spans						
Seismic Event	500 Yr	Desir	red Performance Level	Full Ope	eration (FO)	
Vulnerability Number	5	As-Built Dwg. File	1924-02-21 Burnside As-Builts.pdf				
	Connections - super to sub., Fixed Bearings and Seat Width			Dura unita au #	4 0 0 0 4 0 4	-	
Vulnerable Component Description of	•		rings and Seat Width tions at Piers 2 & 3, fixed bearings	Drawing # anchor bolts an	AB001-01		hs.
	•		0	, v			hs.
Description of	Substructure to su	perstructure connec	0	, v			hs.
Description of Vulnerability	Substructure to su	perstructure connec	tions at Piers 2 & 3, fixed bearings	, v			hs.

Vulnerability Number	6	As-Built Dwg. File	1924-02-21 Burnside As-Builts.pdf		
Vulnerable Component	Connections - supe	r to sub., Expansion B	earings and Seat Width	Drawing #	AB001-040
Description of Vulnerability	Substructure to su	perstructure connectio	ns at Piers 1 & 4, expansion bear	rings and limited	d seat widths.
Proposed Retrofit	Install longitudinal	restrainers and catche	r blocks. Note modification of be	arings in 2001.	
Number of Locations	2	bents		PDF Page #	5
Unit Cost of Retrofit	\$124,000	each		Figure Ref. #	BU205

Vulnerability Number	7	As-Built Dwg. File	1924-02-21 Burnside As-Builts.pdf		
Vulnerable Component	Joint in the Deck S	ystem	·	Drawing #	AB001-070
Description of	Separating of the fi	xed spans to approach	spans joint in the deck system.		
Vulnerability					
Proposed Retrofit	Strengthen the fixe	d span connection to t	he pier wall.		
Number of Locations	2			PDF Page #	6
		aaah			
Unit Cost of Retrofit	\$171,000	each		Figure Ref. #	BU206

Vulnerability Number	8	As-Built Dwg. File	1924-02-21 Burnside As-Builts.pdf		
Vulnerable Component	Approach Deck Fix	ed Connection to Pie	rs 1 & 4	Drawing #	AB001-010
Description of Vulnerability	Separating of the a	pproach fixed span d	eck to Piers 1 and 4.		
Proposed Retrofit	None. Longitudinal	restraints installed in	n 2001.		
Number of Locations	2			PDF Page #	7
Unit Cost of Retrofit	\$0	each		Figure Ref. #	BU207

Bridge Complex	Burnside	Burnside			C AXLI	Date:	4/11/2014
Bridge Name	Willamette River, B	Willamette River, Burnside St (Burnside) [Burnside]			ː kpbu	Date:	5/20/2014
Bridge Number	00511						
Bridge Location	Fixed River Spans						
Seismic Event	500 Yr	Desire	ed Performance Level	Full Op	eration (FO))	
	-	•		•			
Vulnerability Number	9	As-Built Dwg. File	1924-02-21 Burnside As-Builts.	<u>pdf</u>			
Vulnerable Component	Truss System - Co	nnections of Primary	Members	Drawing #	AB001-03	31	
Description of Vulnerability			on points along top/bottom cho				
Proposed Retrofit	None, but will requ	ire analysis to confir	m members are safe for limited	l operation and life	line route.		
Number of Locations	72			PDF Page #	8		

Vulnerability Number	10 As-B	uilt Dwg. File	-		
Vulnerable Component	Overhead Sign Structure	S		Drawing #	-
Description of Vulnerability	Collapse of overhead sig	n structures ont	o bridge, obstacle to use	e the bridge for full opera	ntion.
Proposed Retrofit	None, will require clean	up if collapse on	to bridge during seismic	event.	
Number of Locations	2			PDF Page #	9
Unit Cost of Retrofit	\$0 each			Figure Ref. #	BU209

Vulnerability Number	11	As-Built Dwg. File	-		
Vulnerable Component	Lightings			Drawing #	-
Description of Collapse of overhead sign structures onto bridge, obstacle to use the bridge for full operation. Vulnerability					tion.
Proposed Retrofit	None, will require c	lean up if collapse ont	o bridge during seismic event.		
Number of Locations	7			PDF Page #	9
Unit Cost of Retrofit	\$0	each		Figure Ref. #	BU209

Bridge Complex	Burnside			Compiled by:	AXLI	Date:	4/11/2014
Bridge Name	Willamette River, B	Willamette River, Burnside St (Burnside) [Burnside]			kpbu	Date:	5/20/2014
Bridge Number	00511						
Bridge Location	Fixed River Spans						
Seismic Event	100 Yr	Desire	ed Performance Level	No Col	lapse (NC)	
Vulnerability Number	1	As-Built Dwg. File	1924-02-21 Burnside As-Builts.pd	f			
Vulnerable Component	Connections - super to sub., Fixed Bearings and Seat Width			Drawing #	AB001-0	12	
Description of			tions at Piers 2 & 3, fixed bearing		d limited		hs.
Description of					d limited		ns.
	Substructure to su		tions at Piers 2 & 3, fixed bearing		d limited		ns.
Description of Vulnerability	Substructure to su	perstructure connect	tions at Piers 2 & 3, fixed bearing		d limited		15.

Vulnerability Number	2	As-Built Dwg. File	1924-02-21 Burnside As-Builts.pdf	:	
Vulnerable Component	Connections - supe	er to sub., Expansion E	Bearings and Seat Width	Drawing #	AB001-040
Description of Vulnerability	Substructure to su	perstructure connectio	ons at Piers 1 & 4, expansion be	arings and limited	d seat widths.
Proposed Retrofit	Proposed Retrofit Provide soil densification around Piers 1 & 4. Note: cost of vulernability 1 accounts for this.				
Number of Locations	1	bridge site		PDF Page #	5
Unit Cost of Retrofit	\$98,000	each		Figure Ref. #	BU205

Vulnerability Number	3	As-Built Dwg. File	1924-02-21 Burnside As-Builts.pdf		
Vulnerable Component	Joint in the Deck S	ystem		Drawing #	AB001-070
Description of Vulnerability	Separating of the fi	xed spans to approach	n spans joint in the deck system.		
Proposed Retrofit	Strengthen the fixe	d span connection to t	he pier wall.		
Number of Locations	2			PDF Page #	6
Unit Cost of Retrofit	\$135,000	each		Figure Ref. #	BU206

Vulnerability Number	4	As-Built Dwg. File	1924-02-21 Burnside As-Builts.pdf		
Vulnerable Component	Approach Deck Fixe	ed Connection to Piers	1&4	Drawing #	AB001-010
Description of Vulnerability	Separating of the a	pproach fixed span deo	k to Piers 1 and 4.		
Proposed Retrofit	None. Longitudinal	restraints installed in 2	2001.		
Number of Locations	2	columns		PDF Page #	7
Unit Cost of Retrofit	\$0	each		Figure Ref. #	BU207

Bridge Complex	Burnside			Compiled by:	AXLI	Date:	4/11/2014
Bridge Name	Willamette River, Burnside St (Burnside) [Burnside]			Checked by:	kpbu	Date:	5/20/2014
Bridge Number	00511			•			
Bridge Location	Moveable Span						
Seismic Event	1000 Yr	Desire	ed Performance Level	Limited O	peration (LO)	
Vulnerability Number	1	As-Built Dwg. File	1924-02-21 Burnside As-Builts.pdf				
Vulnerable Component	Piers 2 & 3 Founda	tion Timber Piles		Drawing #	AB001-0	11	
Description of Vulnerability	Timber piles could	fail in both compres	sion and uplift.				
Proposed Retrofit	Add steel piling to	the pier footings.					
Number of Locations	2	piers		PDF Page #	1		
Unit Cost of Retrofit	\$3,500,000	each		Figure Ref. #	BU101		

Vulnerability Number	2	As-Built Dwg. File	1924-02-21 Burnside As-Builts.pdf		
Vulnerable Component	Piers 2 & 3 Bascule	Pier Wall below Truss	Seats	Drawing #	AB001-012
Description of Vulnerability	Pier wall under trus event.	s seats without proper	r seismic reinforcing details, pote	ential lost of axi	al support capacity in seismic
Proposed Retrofit	Steel shell retrofit f	or vertical capacity pre	servation.		
Number of Locations	2	piers		PDF Page #	2
Unit Cost of Retrofit	\$4,380,000	each		Figure Ref. #	BU102

Vulnerability Number	3	As-Built Dwg. File	1924-1994 Burnside Bascule Span	and MiscRepairs.	<u>odf</u>
Vulnerable Component	Connections - supe	r to sub., Trunnion Su	pport Vertical Post	Drawing #	AC001-002 & 005
Description of The bottom 15ft of the trunnion support vertical post is unbraced and could be subject to high bending forces.					
Proposed Retrofit	Add transverse bra	cing at the trunnion su	upport posts. System Retrofit - b	ase Isolation wi	ill affect this retrofit
Number of Locations	4			PDF Page #	3
Unit Cost of Retrofit	\$1,750,000	each		Figure Ref. #	BU103

Vulnerability Number	4	As-Built Dwg. File	1924-1994 Burnside Bascule Spa	in and MiscRepairs.	pdf
Vulnerable Component	Connections - supe	r to sub., Anchorage of	of Trunnion to Bascule Piers	Drawing #	AC001-003 & 004
Description of Vulnerability	At the top of the tru and the frame diago		ne bolts which connect the the	trunnion bearing	to the vertical support post
Proposed Retrofit		ichor bolts at the bear ase Isolation will affec	ings of the trunnion frame diag t this retrofit	onals. Strengther	the trunnion bearing bolts.
Number of Locations	4			PDF Page #	4
Unit Cost of Retrofit	\$880,000	each		Figure Ref. #	BU104

Bridge Complex	Burnside			Compiled by:	AXLI	Date:	4/11/2014
Bridge Name	Willamette River, Burnside St (Burnside) [Burnside]			Checked by:	kpbu	Date:	5/20/2014
Bridge Number	00511						
Bridge Location	Moveable Span						
Seismic Event	1000 Yr	Yr Desired Performance Level		Limited O	peration (LO)	
Vulnerability Number	5	As-Built Dwg. File	1924-1994 Burnside Bascule Span	and MiscRepairs.	<u>pdf</u>		
Vulnerable Component	Joint in the Deck S	System at Piers 2 and	3	Drawing #	AC002-0	04	
Description of Vulnerability	Separating of both	the fixed and expans	ion joint system at Piers 2 and 3	oit deck.			
Proposed Retrofit	Strengthen the fixe	ed span connection a	nd install longitudinal restraints.	System Retrofit	- base lso	olation wil	
	retrofit		Ū				ι απесτ this
Number of Locations	, and the second s			PDF Page #	5		i affect this

Vulnerability Number	6	As-Built Dwg. File	1924-1994 Burnside Bascule Span	and MiscRepairs.	pdf
Vulnerable Component	Bascule Leaf Trans	verse Restraint		Drawing #	AC001-011
Description of Vulnerability	A transverse restra between the live loa		bottom bracing of the leaf floorbo	eam at point 14	and the top of new bracing
Proposed Retrofit	Add bascule leaf re Isolation will affect	•	ransverse direction consists of s	steel weldments	s. System Retrofit - base
Number of Locations	4			PDF Page #	6
Unit Cost of Retrofit	\$350,000	each		Figure Ref. #	BU106

Vulnerability Number	7	As-Built Dwg. File	1924-1994 Burnside Bascule Span	and MiscRepairs.	<u>pdf</u>
Vulnerable Component	Bascule Leaf Trans	verse Bracing		Drawing #	AC001-015
Description of Vulnerability	Lateral bracing of t	he bascule leaf will be i	nadequate to resist the higher fo	orce due to the i	retrofit above.
Proposed Retrofit	Strengthen the bas retrofit	cule leaf bracing in the	Bridge's transverse direction. S	ystem Retrofit	- base Isolation will affect this
Number of Locations	2			PDF Page #	7
Unit Cost of Retrofit	\$3,500,000	each		Figure Ref. #	BU107

Vulnerability Number	8	As-Built Dwg. File	1924-1994 Burnside Bascule Span	and MiscRepairs.	<u>pdf</u>
Vulnerable Component	Counterweight Res	trainers	•	Drawing #	AC038-003
Description of Vulnerability	Add restrainers to t the pier.	he rear face of the cou	nterweight to resist transverse i	movement, and	transfer seismic forces into
Proposed Retrofit	Mount two steel bra affect this retrofit	ickets low on the pit w	alls to restrain the transverse m	ovement. <mark>Syste</mark>	m Retrofit - base Isolation will
Number of Locations	2			PDF Page #	8
Unit Cost of Retrofit	\$350,000	each		Figure Ref. #	BU108

Bridge Complex	Burnside			Compiled by	AXLI	Date:	4/11/2014
Bridge Name	Willamette River, B	urnside St (Burnside)) [Burnside]	Checked by	kpbu	Date:	5/20/2014
Bridge Number	00511						
Bridge Location	Moveable Span						
Seismic Event	1000 Yr	Desire	ed Performance Level	Limited O	peration (L	0)	
		•					
Vulnerability Number	9	As-Built Dwg. File	1924-1994 Burnside Bascule S	pan and MiscRepairs	.pdf		
				D : "		-	
Vulnerable Component Description of			he links to alleviate excessive :	Drawing # force transfer into t	AC038-003		ng of the
	, v		he links to alleviate excessive				ng of the
Description of	Develop a repairab machinery room.	le structural fuse in th to restrain the longitu	he links to alleviate excessive udinal movement and weaken trofit - base Isolation will affect	force transfer into t the connection of th	the light floo	or framii	•
Description of Vulnerability	Develop a repairab machinery room.	le structural fuse in th to restrain the longitu	udinal movement and weaken	force transfer into t the connection of th	the light floo	or framii	•

Mada and Althe Manada an	40				
Vulnerability Number	10	As-Built Dwg. File	-		
Vulnerable Component	Mechanical Equipm	ent / Working Parts		Drawing #	-
Description of Vulnerability	Mechanical equipm	ent to close the bascu	ıle spans for bridge operation will	need to be fund	ctional during seismic event.
Proposed Retrofit		rovide Base Isolation arts if there is damage	System to protect mechanical con	mponents. Prov	vide guideline to repair the
Number of Locations	2			PDF Page #	-
Unit Cost of Retrofit	\$880,000	each		Figure Ref. #	-

Vulnerability Number	11	As-Built Dwg. File	-		
Vulnerable Component	Pier Houses			Drawing #	-
Description of Vulnerability	Collapse of pier ho	Collapse of pier houses onto bridge, obstacle to use the bridge for limited operation.			
Proposed Retrofit	None, will require clean up if collapse onto bridge during seismic event.				
Number of Locations	2			PDF Page #	-
Unit Cost of Retrofit	\$0	each		Figure Ref. #	-

Vulnerability Number	12	As-Built Dwg. File	-		
Vulnerable Component	Lightings			Drawing #	-
Description of Collapse of lightings onto bridge, obstacle to use the bridge for limited operation .					
Proposed Retrofit	Proposed Retrofit None, will require clean up if collapse onto bridge during seismic event.				
Number of Locations	3			PDF Page #	-
Unit Cost of Retrofit	\$0	each		Figure Ref. #	-

Bridge Complex	Burnside			Compiled by:	AXLI	Date:	4/11/2014
Bridge Name	Willamette River,	Willamette River, Burnside St (Burnside) [Burnside]			kpbu	Date:	5/20/2014
Bridge Number	00511						
Bridge Location	Moveable Span						
Seismic Event	500 Yr	Desire	ed Performance Level	Full Ope	eration (FO	C)	
Vulnerability Number	1	As-Built Dwg. File	1924-02-21 Burnside As-Builts.pd	f			
Vulnerable Component	Piers 2 & 3 Found	ation Timber Piles		Drawing #	AB001-0	11	
Description of Vulnerability	l imber piles coul	d fail in both compress	sion and uplift.				
Proposed Retrofit	Add steel piling to	o the pier footings.					
Number of Locations	2	piers		PDF Page #	1		
Unit Cost of Retrofit	\$3,325,000	each		Figure Ref. #	BU101		

Vulnerability Number	2	As-Built Dwg. File	1924-02-21 Burnside As-Builts.pdf		
Vulnerable Component	Piers 2 & 3 Bascule	Pier Wall below Truss	Seats	Drawing #	AB001-012
Description of Vulnerability	Pier wall under trus event.	s seats without proper	seismic reinforcing details, pote	ential lost of axi	al support capacity in seismic
Proposed Retrofit	Steel shell retrofit f	or vertical capacity pre	servation.		
Number of Locations	2	piers		PDF Page #	2
Unit Cost of Retrofit	\$4,161,000	each		Figure Ref. #	BU102

Vulnerability Number	3	As-Built Dwg. File	1924-1994 Burnside Bascule Span	and MiscRepairs.	<u>pdf</u>
Vulnerable Component	Connections - supe	er to sub., Trunnion S	upport Vertical Post	Drawing #	AC001-002 & 005
Description of Vulnerability The bottom 15ft of the trunnion supoprt vertical post is unbraced and could be subject to high bending forces.					
Proposed Retrofit	Add transverse bracing at the trunnion support posts. System Retrofit - base Isolation will affect this retrofit				
Number of Locations	4			PDF Page #	3
Unit Cost of Retrofit	\$1,663,000	each		Figure Ref. #	BU103

Vulnerability Number	4	As-Built Dwg. File	1924-1994 Burnside Bascule Span	and MiscRepairs.	<u>pdf</u>	
Vulnerable Component	Connections - supe	r to sub., Anchorage o	f Trunnion to Bascule Piers	Drawing #	AC001-003 & 004	
Description of At the top of the trunnion support post, the bolts which connect the the trunnion bearing to the vertical support post vulnerability and the frame diagonal are deficient.						
Proposed Retrofit	Proposed Retrofit Install additional anchor bolts at the bearings of the trunnion frame diagonals. Strengthen the trunnion bearing bolts. System Retrofit - base Isolation will affect this retrofit					
Number of Locations	4			PDF Page #	4	
Unit Cost of Retrofit	\$836,000	each		Figure Ref. #	BU104	

Bridge Complex	Burnside			Compiled by:	AXLI	Date:	4/11/2014
Bridge Name	Willamette River, Burnside St (Burnside) [Burnside]			Checked by:	kpbu	Date:	5/20/2014
Bridge Number	00511						
Bridge Location	Moveable Span						
Seismic Event	500 Yr	Desir	ed Performance Level	Full Ope	eration (FO)		
Vulnerability Number	5	As-Built Dwg. File	1924-1994 Burnside Bascule Spa	in and MiscRepairs.	<u>pdf</u>		
Vulnerable Component	Joint in the Deck	System at Piers 2 and	3	Drawing #	AC002-004	4	
Description of Vulnerability	Separating of both	h the fixed and expans	sion joint system at Piers 2 and 3	pit deck.			
Proposed Retrofit	Strengthen the fix retrofit	red span connection a	nd install longitudinal restraints.	System Retrofit	- base Isol	ation wi	ll affect this
	•	red span connection a	nd install longitudinal restraints.	System Retrofit	- base Isol	ation wi	ll affect this

Vulnerability Number	6	As-Built Dwg. File	1924-1994 Burnside Bascule Span	and MiscRepairs.	pdf
Vulnerable Component	Bascule Leaf Trans	verse Restraint	•	Drawing #	AC001-011
Description of Vulnerability	A transverse restra between the live loa		bottom bracing of the leaf floorbo	eam at point 14	and the top of new bracing
Proposed Retrofit	Add bascule leaf re Isolation will affect		transverse direction consists of s	steel weldments	5. System Retrofit - base
Number of Locations	4			PDF Page #	6
Unit Cost of Retrofit	\$333,000	each		Figure Ref. #	BU106

Vulnerability Number	7	As-Built Dwg. File	1924-1994 Burnside Bascule Span	and MiscRepairs.	<u>pdf</u>
Vulnerable Component	Bascule Leaf Trans	verse Bracing		Drawing #	AC001-015
Description of Vulnerability	Lateral bracing of t	he bascule leaf will be i	nadequate to resist the higher fo	orce due to the i	retrofit above.
Proposed Retrofit	Strengthen the bas retrofit	cule leaf bracing in the	Bridge's transverse direction. S	system Retrofit	- base Isolation will affect this
Number of Locations	2			PDF Page #	7
Unit Cost of Retrofit	\$3,325,000	each		Figure Ref. #	BU107

Vulnerability Number	8	As-Built Dwg. File	1924-1994 Burnside Bascule S	pan and MiscRepairs.	pdf
Vulnerable Component	Counterweight Res	trainers	•	Drawing #	AC038-003
Description of Vulnerability	Add restrainers to t the pier.	he rear face of the cou	nterweight to resist transver	se movement, and t	transfer seismic forces into
Proposed Retrofit	Mount two steel bra affect this retrofit	eckets low on the pit wa	alls to restrain the transverse	e movement. Syste	m Retrofit - base Isolation will
Number of Locations	2			PDF Page #	8
Unit Cost of Retrofit	\$333,000	each		Figure Ref. #	BU108

Bridge Complex	Burnside			Compiled by	AXLI	Date:	4/11/2014
Bridge Name	Willamette River, Burnside St (Burnside) [Burnside]			Checked by	kpbu	Date:	5/20/2014
Bridge Number	00511						
Bridge Location	Moveable Span						
Seismic Event	500 Yr	Desir	red Performance Level	Full Op	eration (FO)		
	-			·			
Vulnerability Number	9	As-Built Dwg. File	1924-1994 Burnside Bascule Sp	oan and MiscRepairs	.pdf		
	Counterweight Link Fuse					_	
Vulnerable Component Description of			the links to alleviate excessive f	Drawing #	AC038-003	-	ng of the
,			the links to alleviate excessive f	, v		-	ng of the
Description of	Develop a repairab machinery room. Install a steel strut	le structural fuse in t to restrain the longit	the links to alleviate excessive f tudinal movement and weaken t tetrofit - base Isolation will affec	iorce transfer into the connection of t	the light floo	or framii	•
Description of Vulnerability	Develop a repairab machinery room. Install a steel strut	le structural fuse in t to restrain the longit	tudinal movement and weaken t	iorce transfer into the connection of t	the light floo	or framii	•

Vulnerability Number	10	As-Built Dwg. File	-		
Vulnerable Component	Mechanical Equipm	ent / Working Parts		Drawing #	-
Decemination of			la anna fam bridera annaític a sill		- 4
Description of	wecnanical equipm	ent to close the bascu	le spans for bridge operation will	need to be fund	ctional during seismic event.
Vulnerability					
Proposed Retrofit	System Retrofit - P	rovide Base Isolation	System to protect mechanical con	nponents. Prov	vide guideline to repair the
	mechanical work pa	arts if there is damage.			. ,
		Ŭ			
Number of Locations	2			PDF Page #	-
Unit Cost of Retrofit	-	each		Figure Ref. #	
Unit Cost of Retront	3030,000	each		rigule Rel. #	

Vulnerability Number	11	As-Built Dwg. File	-		
Vulnerable Component	Pier Houses		·	Drawing #	-
Description of Vulnerability	Collapse of pier ho	ouses onto bridge, obs	tacle to use the bridge for full ope	eration.	
Proposed Retrofit	None, will require o	clean up if collapse on	to bridge during seismic event.		
Number of Locations	2			PDF Page #	-
Unit Cost of Retrofit	\$0	each		Figure Ref. #	-

Vulnerability Number	12	As-Built Dwg. File	-		
Vulnerable Component	Lightings			Drawing #	-
Description of Vulnerability	Collapse of lighting	s onto bridge, obstacl	e to use the bridge for full operati	ion.	
Proposed Retrofit	None, will require c	lean up if collapse ont	o bridge during seismic event.		
Number of Locations	3			PDF Page #	-
Unit Cost of Retrofit	\$0	each		Figure Ref. #	-

Bridge Complex	Burnside			Compiled by:	AXLI	Date:	4/11/2014
Bridge Name	Willamette River, Burnside St (Burnside) [Burnside]			Checked by:	kpbu	Date:	5/20/2014
Bridge Number	00511						
Bridge Location	Moveable Span						
Seismic Event	100 Yr	Desir	red Performance Level	No Col	lapse (NC)		
Vulnerability Number	1	As-Built Dwg. File	1924-1994 Burnside Bascule Sp	an and MiscRepairs.	.pdf		
Vulnerable Component	Connections - super to sub., Trunnion Support Vertical Post			Drawing #	AC001-00	12 8 005	
-		•	•••	, v			es.
Description of Vulnerability		•	t vertical post is unbraced and c	, v			?S.
Description of	The bottom 15ft of t	•	t vertical post is unbraced and c	, v			25.
Description of Vulnerability	The bottom 15ft of t	the trunnion supopr	t vertical post is unbraced and c	,			25.

Vulnerability Number	2	As-Built Dwg. File	1924-1994 Burnside Bascule Span	and MiscRepairs.	odf
Vulnerable Component	Joint in the Deck Sy	stem at Piers 2 and 3		Drawing #	AC002-004
Description of Vulnerability	Separating of both	the fixed and expansio	n joint system at Piers 2 and 3 pi	it deck.	
Proposed Retrofit	Strengthen the fixe	d span connection and	install longitudinal restraints.		
Number of Locations	4	piers		PDF Page #	5
Unit Cost of Retrofit	\$135,000	each		Figure Ref. #	BU105

Vulnerability Number	3	As-Built Dwg. File	1924-1994 Burnside Bascule Span	and MiscRepairs.	<u>pdf</u>
Vulnerable Component	Bascule Leaf Trans	verse Restraint		Drawing #	AC001-011
Description of Vulnerability	A transverse restra between the live loa		bottom bracing of the leaf floorb	eam at point 14	and the top of new bracing
Proposed Retrofit	Add bascule leaf re	straint in the Bridge's	transverse direction consists of s	steel weldments	s.
Number of Locations	4			PDF Page #	6
Unit Cost of Retrofit	\$263,000	each		Figure Ref. #	BU106

Vulnerability Number	4	As-Built Dwg. File	1924-1994 Bui	nside Bascule Span	and MiscRepairs.	<u>pdf</u>
Vulnerable Component	Counterweight Res	trainers			Drawing #	AC038-003
Description of Vulnerability	Add restrainers to t the pier.	he rear face of the co	unterweight to	resist transverse n	novement, and t	transfer seismic forces into
Proposed Retrofit	Mount two steel bra	nckets low on the pit	walls to restrain	the transverse mo	ovement.	
Number of Locations	2				PDF Page #	8
Unit Cost of Retrofit	\$263,000	each			Figure Ref. #	BU108

Bridge Complex	Burnside			Compiled by:	AXLI	Date:	4/11/2014
Bridge Name	Willamette River, F	Burnside St (Burnside) [Burnsic	de]	Checked by:	kpbu	Date:	5/20/2014
Bridge Number	00511						
Bridge Location	Moveable Span						
Seismic Event	100 Yr	Desired Perform	nance Level	No Coll	apse (NC)		
	•	•					
Vulnerability Number	5	As-Built Dwg. File 1924-19	994 Burnside Bascule Span	and MiscRepairs.	pdf		
	Counterweight Link Fuse						
Vulnerable Component Description of Vulnerability	Develop a repairat	k Fuse le structural fuse in the links to	o alleviate excessive forc	Drawing # e transfer into ti	AC038-00	-	ng of the
1	, , , , , , , , , , , , , , , , , , ,		o alleviate excessive forc			-	ng of the
Description of Vulnerability	Develop a repairat machinery room.	le structural fuse in the links to to restrain the longitudinal mo		e transfer into ti	he light flo	or framir	
Description of	Develop a repairat machinery room. Install a steel strut	le structural fuse in the links to to restrain the longitudinal mo	evement and weaken the o	e transfer into th	he light flo	or framir	

Bridge Complex	Burnside			Compiled by:	AXLI	Date:	3/26/2014
Bridge Name	Burnside St (East A	Approach) over Hwy	1 & Conns [Burnside]	Checked by:	kpbu	Date:	5/20/2014
Bridge Number	00511B						
Bridge Location	East Approaches						
Seismic Event	1000 Yr	Desire	ed Performance Level	Limited O	peration (l	-0)	
Vulnerability Number	1	As-Built Dwg. File	1924-02-21 Burnside As-Builts.pd				
Vulnerable Component Description of	Pile Caps Bents 21-27, Low ri	isk as footing is large	e compared to column, column w	Drawing #	AB001-01		s 24 to 27
			e compared to column, column w	, v			s 24 to 27
Description of	Bents 21-27, Low ri are 20ft below grou	ind.	e compared to column, column wi	Il not able to roci	k the footi	ng; Bents	
Description of Vulnerability	Bents 21-27, Low ri are 20ft below grou	ind.		Il not able to roci	k the footi	ng; Bents	

Vulnerability Number	2	As-Built Dwg. File	1924-02-21 Burnside As-Builts.pdf		
Vulnerable Component	Spread footing			Drawing #	AB001-049
Description of Vulnerability	Bent 28, low risk, w	all (from skate park) b	etween columns, spread footing i	buried in groun	d
Proposed Retrofit	None, but confirm o	columns is structurally	connect to wall.		
Number of Locations	3			PDF Page #	2, 3
Unit Cost of Retrofit	\$0	each		Figure Ref. #	BU402

Vulnerability Number	3	As-Built Dwg. File	1924-02-21 Burnside As-Builts.pdf		
Vulnerable Component	Spread footing			Drawing #	AB001-008
Description of Vulnerability	Bents 29-34, low ris	sk, footing buried in g	ground, pavement or 6-10ft embed.	ment will "fix" c	olumn at ground level
Proposed Retrofit	None.				
Number of Locations	24			PDF Page #	4
Unit Cost of Retrofit	\$0	each		Figure Ref. #	BU403

Vulnerability Number	4	As-Built Dwg. File	1924-02-21 Burnside As-Builts.pdf		
Vulnerable Component	Superstructure sea	ting on Abutment		Drawing #	AB001-083
Description of Vulnerability	East Approach Abu support (out to out	• • •	forced abutment, crack and mov	ement will lead	to lost of superstructure seat
Proposed Retrofit	Seat Extender. Ste	el wall plate with shear	studs attached to abutment wal	I.	
Number of Locations	1			PDF Page #	5
Unit Cost of Retrofit	\$130,000	each		Figure Ref. #	BU404

Bridge Complex	Burnside	Burnside			AXLI	Date:	3/26/2014
Bridge Name	Burnside St (East Approach) over Hwy 1 & Conns [Burnside]			Checked by:	kpbu	Date:	5/20/2014
Bridge Number	00511B			-			
Bridge Location	East Approaches						
Seismic Event	1000 Yr	Desire	d Performance Level	Limited O	peration (LO	C)	
Vulnerability Number	5	As-Built Dwg. File	1924-02-21 Burnside As-Builts.p	<u>df</u>			
Vulnerable Component Description of	Shear/bending failu		include Bent 28 columns, as c	Drawing # olumn has 56-1in c	AB001-019		
,	Shear/bending failu		include Bent 28 columns, as c	,			
Description of	Shear/bending failu possibly wall betwe	ire of anchor rod; not een columns (from sk	include Bent 28 columns, as c	,			
Description of Vulnerability	Shear/bending failu possibly wall betwe	ire of anchor rod; not een columns (from sk	include Bent 28 columns, as c ate park)	,			

Vulnerability Number	6	As-Built Dwg. File	1924-02-21 Burnside As-Builts.pdf		
Vulnerable Component	Bent Column (conc	rete encased steel colu	imn pairs with bracing)	Drawing #	AB001-047, 054, 059
Description of Vulnerability	Steel columns have	limited lateral load ca	bability and slenderness concer	ns.	
Proposed Retrofit	Concrete jacketing	to increase column sh	ear capacity.		
Number of Locations	15			PDF Page #	7
Unit Cost of Retrofit	\$130,000	each		Figure Ref. #	BU406

Vulnerability Number	7	As-Built Dwg. File	1924-02-21_Burnside_As-Builts	<u>s.pdf</u>	
Vulnerable Component	Bent Column (cond	crete column)		Drawing #	AB001-008
Description of Vulnerability			ixity from pavement or concre een columns (from skate park)		e Bent 28 columns, as column one side
Proposed Retrofit	In-fill wall above gr	ound to prevent flexu	re failure and increase shear	capacity.	
Number of Locations	24			PDF Page #	8
Unit Cost of Retrofit	\$130,000	each		Figure Ref. #	BU407

Bridge Complex	Burnside	Burnside			AXLI	Date:	3/26/2014
Bridge Name	Burnside St (East Approach) over Hwy 1 & Conns [Burnside]			Checked by:	kpbu	Date:	5/20/2014
Bridge Number	00511B						
Bridge Location	East Approaches						
Seismic Event	500 Yr	Desir	ed Performance Level	Full Ope	ration (FO)	
Vulnerability Number	1	As-Built Dwg. File	1924-02-21 Burnside As-Builts.pdf				
						-	
Vulnerable Component Description of	Pile Caps Bents 21-27, Low r	isk as footing is large	e compared to column, column wi	Drawing #	AB001-01	-	s 24 to 27
	•		e compared to column, column wi	, v		-	s 24 to 27
Description of	Bents 21-27, Low r are 20ft below grou	und.	e compared to column, column wi g dowels if strengthening from oth	Il not able to roci	k the footir	ng; Bents	
Description of Vulnerability	Bents 21-27, Low r are 20ft below grou	und.		Il not able to roci	k the footir	ng; Bents	

Vulnerability Number	2	As-Built Dwg. File	1924-02-21 Burnside As-Builts.pdf		
Vulnerable Component	Spread footing			Drawing #	AB001-049
Description of Vulnerability	Bent 28, low risk, w	all (from skate park) b	etween columns, spread footing i	buried in groun	d
Proposed Retrofit	None, but confirm o	columns is structurally	connect to wall.		
Number of Locations	3			PDF Page #	2, 3
Unit Cost of Retrofit	\$0	each		Figure Ref. #	BU402

Vulnerability Number	3	As-Built Dwg. File	1924-02-21 Burnside As-Builts.pdf		
Vulnerable Component	Spread footing			Drawing #	AB001-008
Description of Vulnerability	Bents 29-34, low ris	sk, footing buried in gi	round, pavement or 6-10ft embedi	nent will "fix" c	olumn at ground level
Proposed Retrofit	None.				
Number of Locations	24			PDF Page #	4
Unit Cost of Retrofit	\$0	each		Figure Ref. #	BU403

Vulnerability Number	4	As-Built Dwg. File	1924-02-21 Burnside As-Builts.pdf		
Vulnerable Component	Superstructure sea	ting on Abutment		Drawing #	AB001-083
Description of Vulnerability	East Approach Abu support (out to out	• • • •	forced abutment, crack and mov	ement will lead	to lost of superstructure seat
Proposed Retrofit	Steel wall plate with	h shear studs attached	to abutment wall.		
Number of Locations	1			PDF Page #	5
Unit Cost of Retrofit	\$124,000	each		Figure Ref. #	BU404

Bridge Complex	Burnside	3urnside			Date:	3/26/2014
Bridge Name	Burnside St (East A	Burnside St (East Approach) over Hwy 1 & Conns [Burnside]			Date:	5/20/2014
Bridge Number	00511B					
Bridge Location	East Approaches					
Seismic Event	500 Yr	Desired Performance Level	Full Ope	eration (FO)		
Vulnerability Number	5	As-Built Dwg. File 1924-02-21 Burnside As-Builts.pdf				
Vulnerable Component	Connections Bont	a to Delaw Crewed Foundations	Dura visia av #	A D004 040	047 054	
•		s to Below Ground Foundations	Drawing #	AB001-019,		
Description of Vulnerability	Shear/bending failu	is to Below Ground Foundations are of anchor rod; not include Bent 28 columns, as colu aren columns (from skate park)	, v			
Description of	Shear/bending failu possibly wall betwe	rre of anchor rod; not include Bent 28 columns, as colu	, v			

Number of Locations	15		PDF Page #	6
Unit Cost of Retrofit	\$124,000	each	Figure Ref. #	BU405

Vulnerability Number	6	As-Built Dwg. File	1924-02-21 Burnside As-Builts.pdf		
Vulnerable Component	Bent Column (conc	rete encased steel colu	umn pairs with bracing)	Drawing #	AB001-047, 054, 059
Description of Vulnerability	Steel columns have	limited lateral load ca	pability and slenderness concer	ns.	
Proposed Retrofit	Concrete jacketing	to increase column sh	ear capacity		
Number of Locations	15			PDF Page #	7
Unit Cost of Retrofit	\$124,000	each		Figure Ref. #	BU406

Vulnerability Number	7	As-Built Dwg. File	1924-02-21_Burnside_As-Builts.pc	<u>If</u>	
Vulnerable Component	Bent Column (conc	rete column)		Drawing #	AB001-008
Description of Vulnerability			xity from pavement or concrete en columns (from skate park) al		
Proposed Retrofit	In-fill wall above gr	ound to prevent flexu	re failure and increase shear ca	pacity.	
Number of Locations	24			PDF Page #	8
Unit Cost of Retrofit	\$124,000	each		Figure Ref. #	BU407

Bridge Complex	Burnside		Compiled by	AXLI	Date:	3/26/2014
Bridge Name	Burnside St (East A	Approach) over Hwy 1 & Conns [Burnside]	Checked by	kpbu l	Date:	5/20/2014
Bridge Number	00511B					
Bridge Location	East Approaches					
Seismic Event	100 Yr	Desired Performance Level	No Col	lapse (NC)		
Vulnerability Number	1	As-Built Dwg. File 1924-02-21 Burnside As-Builts.p	<u>odf</u>			
Vulnerable Component Description of		ts to Below Ground Foundations ure of anchor rod; not include Bent 28 columns, as c	Drawing #	AB001-019		
	Shear/bending failu		- v			
Description of	Shear/bending failu possibly wall betwe	rre of anchor rod; not include Bent 28 columns, as c	- v			
Description of Vulnerability	Shear/bending failu possibly wall betwe	ure of anchor rod; not include Bent 28 columns, as c een columns (from skate park)	- v			

Vulnerability Number	2	As-Built Dwg. File	1924-02-21 Burnside As-Builts.pdf		
Vulnerable Component	Bent Column (conc	· · · ·		Drawing #	AB001-008
Description of Vulnerability			ity from pavement or concrete flo n columns (from skate park) and		
Proposed Retrofit	In-fill wall above gro	ound to prevent flexure	failure and increase shear capa	city.	
Number of Locations	24			PDF Page #	8
Unit Cost of Retrofit	\$98,000	each		Figure Ref. #	BU407

Vulnerability Number	3	As-Built Dwg. File	1924-02-21 Burnside As-Builts.pdf		
Vulnerable Component	Rocker bearing			Drawing #	AB001-048, 049, 050, 054
Description of Vulnerability	Rocker bearing & a	anchor rod to column			
Proposed Retrofit	1. Provide restrain 2. Replace bearing	ers to bearing to prev s	ent collapse		
Number of Locations	11			PDF Page #	
Unit Cost of Retrofit	\$98,000	each		Figure Ref. #	

Vulnerability Number	4	As-Built Dwg. File	1924-02-21 Burnside As-Builts.pdf		
Vulnerable Component	Seat Width (Expans	sion)		Drawing #	AB001-053, 055
Description of Vulnerability	Inadequate seat wi	dth at Bents 31, 33 an	d 34		
Proposed Retrofit	Steel or Concrete s	eat extension or catc	her blocks.		
Number of Locations	54			PDF Page #	10
Unit Cost of Retrofit	\$98,000	each		Figure Ref. #	BU409

Bridge Complex	Burnside			Compiled by:	AXLI Da	ate: 3/26/2014
Bridge Name	Burnside St (East A	pproach) over Hwy 1	& Conns [Burnside]	Checked by:	kpbu Da	ate: 5/20/2014
Bridge Number	00511B					
Bridge Location	East Approaches					
Seismic Event	100 Yr	Desire	ed Performance Level	No Col	lapse (NC)	
Vulnerability Number	5	As-Built Dwg. File	1924-02-21 Burnside As-Builts.pdf			
Vulnerable Component	Connection - Subst	Connection - Substructure to Superstructure				
Description of Vulnerability	RCDG to column co	onnection with dowel	s only			
Proposed Retrofit	Concrete jacketing	at connection.				
Number of Locations	24			PDF Page #	11	
Unit Cost of Retrofit	\$98,000	each		Figure Ref. #	BU410	

Bridge Complex	Morrison			Compiled by	TCA	Date:	4/2/2014
Bridge Name	W Morrison Br Cor	n over Hwy 1W (Fron	Checked by	KPBU	Date:	5/14/2014	
Bridge Number	02758B						
Bridge Location	West Approaches						
Seismic Event	1000 Yr	Desire	d Performance Level	No Co	lapse (NC)		
Vulnerability Number	1	As-Built Dwg. File	1956-1990_Morrison_W_App	proach_Intch_East	bank_Yran	np.pdf	
Vulnerable Component	Footing			Drawing #	D9		
Vulnerability			the foundation. Column to foot nic loads. Vulnerability is foot				
Proposed Retrofit		ooting plan and eleva mplete joint replacem	tion dimensions, drill and bond ent.	new dowels and a	stirrups in a	existing f	ooting,
Proposed Retrofit Number of Locations		•••	-	new dowels and s	stirrups in a	existing f	iooting,

Vulnerability Number	2	As-Built Dwg. File	1956-1990_Morriso	1_W_Approach_Intch_E	astbank_Yrar	np.pdf			
Vulnerable Component	Footing			Drawing #	D9				
Description of Vulnerability									
Proposed Retrofit	Add additional layer of concrete to increase pile head embedment depth to a minimum 24".								
Number of Locations	9	Footings		PDF Page #	10				
Unit Cost of Retrofit	\$0	each		Figure Ref.	# MR008				

Vulnerability Number	3	As-Built Dwg. File	1956-1990	Morrison_V	V_Approa	ch_Intch_Eastb	bank_Yramp.pdf		
Vulnerable Component	Column	Jumn Drawing # D9							
Description of Column flexural and shear strength insufficient for seismic demands. Stirrups are spaced too far apart to provide proper confinement for concrete core. Column to bent cap joint detailing is also poor, and the joint is a common failure mechanism where shear forces tend to concentrate. Vulnerability is low displacement capacity and non-ductile performance.									
Proposed Retrofit	Steel jacketing to p	Steel jacketing to provide confinement.							
Number of Locations	51	Columns				PDF Page #	10		
Unit Cost of Retrofit	\$75,000	each			-	Figure Ref. #	MR009		

Vulnerability Number	4	As-Built Dwg. File	1956-1990_Morrison_W_Appr	oach Intch East	bank Vramp ndf				
		AS-Built Dwy. File	1956-1990_Wornson_w_App						
Vulnerable Component	Bent cap			Drawing #	D9				
Description of	Bent Cap flexural s	Bent Cap flexural strength insufficient for to transfer superstructure forces into the substructure during lateral loading.							
Vulnerability	Vulnerability is the	cap can fail premature	ly before column hinges.						
Proposed Retrofit	Add concrete bols	ters and doweling new	rebar for the entire cap to incre	ease stiffness.					
Number of Locations	19	Bents		PDF Page #	10				
Unit Cost of Retrofit	\$150,000	each		Figure Ref. #	MR009				

Bridge Complex	Morrison			Compiled by:	TCA	Date:	4/2/2014
Bridge Name	W Morrison Br Co	W Morrison Br Conn over Hwy 1W (Front Ave) & Park [Morrison]			KPBU	Date:	5/14/2014
Bridge Number	02758B			-			
Bridge Location	West Approaches						
Seismic Event	1000 Yr	Desire	ed Performance Level	No Coll	apse (NC)		
Vulnerability Number	5	As-Built Dwg. File	1956-1990_Morrison_W_App	proach_Intch_East	oank_Yran	np.pdf	
Vulnerable Component	Girder Restraint			Drawing #	D9		
Description of Vulnerability		seating at the bearing	at the superstructure to substr js.		, and a		
Proposed Retrofit	Reinforced concre	ete shear keys and lo	ngitudinal cable restraints.				
Number of Locations	24	Bents		PDF Page #	10		
Unit Cost of Retrofit	\$100,000	each		Figure Ref. #	MR009		

Vulnerability Number	6	As-Built Dwg. File	1956-1990_Morrison_W_Approa	ch Intch Easth	oank Yramp.pdf
Vulnerable Component	Superstructure bea	rings at bent caps			 D9
Description of Vulnerability			is this bearing type may perform re. Currently, the stringers are c		
Proposed Retrofit	Full bearing replace	ement with elastomeric	pads.		
Number of Locations	24	Bents		PDF Page #	10
Unit Cost of Retrofit	\$75,000	each		Figure Ref. #	MR010

Vulnerability Number	7	As-Built Dwg. File	1956-1990	Morrison	_w_/	Approach	_Intch_E	astban	k_Yramp.pdf
Vulnerable Component	Superstructure diap	iperstructure diaphragms						D1	9
Description of Vulnerability Superstructure cross brace diaphragms insufficient in transferring shear forces to substructure. Brace members are undersized and the vulnerability is shear failure at the girder flange to deck connection during lateral movement.									
Proposed Retrofit	Replace diaphragm	s members to increase	transverse	stiffness.					
Number of Locations	24	Diaphragm Lines				PL)F Page #	£ 20	
Unit Cost of Retrofit	\$75,000	each				Fig	gure Ref. :	# MF	R011

Vulnerability Number	8	As-Built Dwg. File	1956-1990_Morrison_W_Approa	ach Intch East	pank Yramp.pdf
	Expansion joints			Drawing #	D23
Description of Vulnerability	Vulnerability is mov	vement during a seismi	ic event may move beyond the ca	apacity of the h	inge
Proposed Retrofit	Longitudinal cable	restrainers Cost Inclu	uded in vulnerability 5		
Number of Locations	21	Joints		PDF Page #	24
Unit Cost of Retrofit	\$0	each		Figure Ref. #	MR012

Bridge Complex	Morrison			Compiled by	TCA	Date:	4/2/2014			
Bridge Name	W Morrison Br Con	in over Hwy 1W (Front	: Ave) & Park [Morrison]	Checked by	KPBU	Date:	5/14/2014			
Bridge Number	02758B									
Bridge Location	West Approaches									
Seismic Event	500 Yr	Desire	d Performance Level	No Co	llapse (NC)					
Vulnerability Number	1	As-Built Dwg. File 1956-1990_Morrison_W_Approach_Intch_Eastbank_Yramp.pdf								
Vulnerable Component	Footing			Drawing #	D9					
Vulnerability			he foundation. Column to foo nic loads. Vulnerability is foot							
Proposed Retrofit		Increase existing footing plan and elevation dimensions, drill and bond new dowels and stirrups in existing footing, drive new piles, complete joint replacement.								
	51	Footings		PDF Page #	10					
Number of Locations	21	rooungo		i Di i ugo #						

Vulnerability Number	2	As-Built Dwg. File	1956-1990_Morrison_W_Approa	ch_Intch_Easth	bank_Yramp.pdf
Vulnerable Component	Footing			Drawing #	D9
Description of Vulnerability			may not be sufficient enough for out or yielding when moment is tr		
Proposed Retrofit	Add additional laye	r of concrete to increa	se pile head embedment depth to	a minimum 24	<i>.</i>
Number of Locations	9	Footings		PDF Page #	10
Unit Cost of Retrofit	\$0	each		Figure Ref. #	MR008

Vulnerability Number	3	As-Built Dwg. File	1956-1990_Morrison_W_Approa	ch_Intch_Eastb	bank_Yramp.pdf		
Vulnerable Component	Column			Drawing #	D9		
Description of Vulnerability Column flexural and shear strength insufficient for seismic demands. Stirrups are spaced too far apart to provide proper confinement for concrete core. Column to bent cap joint detailing is also poor, and the joint is a common failure mechanism where shear forces tend to concentrate. Vulnerability is low displacement capacity and non-ductile performance.							
Proposed Retrofit	Steel jacketing to p	rovide confinement.					
Number of Locations	51	Columns		PDF Page #	10		
Unit Cost of Retrofit	\$71,000	each		Figure Ref. #	MR009		

Vulnerability Number	4	As-Built Dwg. File	1956-1990_Morri	son_W_Approa	ch_Intch_East	bank_Yramp.pdf			
Vulnerable Component	Bent cap				Drawing #	D9			
	-								
Description of	Bent Cap flexural s	Bent Cap flexural strength insufficient for to transfer superstructure forces into the substructure during lateral loading.							
Vulnerability	Vulnerability is the	cap can fail premature	ly before column	hinges.					
Proposed Retrofit	Add concrete bolst	ters and doweling new l	rebar for the entir	e cap to increas	se stiffness.				
Number of Locations	19	Bents			PDF Page #	10			
Unit Cost of Retrofit	\$143,000	each			Figure Ref. #	MR009			

Bridge Complex	Morrison			Compiled by:	TCA	Date:	4/2/2014
Bridge Name	W Morrison Br Co	nn over Hwy 1W (Fror	nt Ave) & Park [Morrison]	Checked by:	KPBU	Date:	5/14/2014
Bridge Number	02758B						
Bridge Location	West Approaches						
Seismic Event	500 Yr	Desire	ed Performance Level	No Coll	apse (NC)		
Vulnerability Number	5	As-Built Dwg. File	1956-1990_Morrison_W_App	proach_Intch_East	oank_Yran	np.pdf	
Vulnerable Component	Girder Restraint			Drawing #	D9		
Description of Vulnerability		seating at the bearing	at the superstructure to substr s.				
Proposed Retrofit	Reinforced concre	te shear keys and lo	ngitudinal cable restraints.				
Number of Locations	24	Bents		PDF Page #	10		
Unit Cost of Retrofit	\$95,000	each		Figure Ref. #	MR009		

Vulnerability Number	6	As-Built Dwg. File	10E6 1000 Marriagn W Approx	ah Intah Eaath	ank Vromn ndf				
,		, <u>,</u>	1956-1990_Morrison_W_Approa		bank_framp.pu				
Vulnerable Component	Superstructure bea	rings at bent caps		Drawing #	D9				
	Otvinnen obse velopilitation. Valnenskilite is this beginn two may perform a subject so division to two of a								
Description of	Stringer shoe rehat	Stringer shoe rehabilitation. Vulnerability is this bearing type may perform poorly in seismic conditions to transfer							
Vulnerability	loads from superst	ructure into substructu	re. Currently, the stringers are c	onnected by an	chor bolts to the shoes.				
	,								
Proposed Retrofit	Full bearing replace	ement with elastomeric	pads.						
Number of Locations	24	Bents		PDF Page #	10				
Unit Cost of Retrofit	\$71,000	each		Figure Ref. #	MR010				

Vulnerability Number	7	As-Built Dwg. File	1956-1990_Mo	rrison_W_	Approach_Intch_Eas	tbank_Yra	amp.pdf	
Vulnerable Component	Superstructure diap	Superstructure diaphragms Drawing # D19						
Description of Vulnerability Superstructure cross brace diaphragms insufficient in transferring shear forces to substructure. Brace members are undersized and the vulnerability is shear failure at the girder flange to deck connection during lateral movement.								
Proposed Retrofit	Replace diaphragms members to increase transverse stiffness.							
Number of Locations	24	Diaphragm Lines			PDF Page #	20		
Unit Cost of Retrofit	\$71,000	each			Figure Ref. #	MR011		

Vulnerability Number	8	As-Built Dwg. File	1956-1990_Morrison_W_Appro	ach_Intch_Easth	bank_Yramp.pdf
Vulnerable Component	Expansion joints			Drawing #	D23
Description of Vulnerability	Vulnerability is mo	vement during a seismi	c event may move beyond the o	capacity of the hi	inge
Proposed Retrofit	Longitudinal cable	restrainers Cost Inclu	uded in vulnerability 5		
Number of Locations	21	Joints		PDF Page #	24
Unit Cost of Retrofit	\$0	each		Figure Ref. #	MR012

Bridge Complex	Morrison			Compiled by:	TCA	Date:	4/2/2014
Bridge Name	W Morrison Br Cor	nn over Hwy 1W (Fror	nt Ave) & Park [Morrison]	Checked by:	KPBU	Date:	5/14/2014
Bridge Number	02758B						
Bridge Location	West Approaches						
Seismic Event	100 Yr	Desir	ed Performance Level	No Coll	apse (NC	;)	
Vulnerability Number	1	roach_Intch_Easth	oank_Yra	mp.pdf			
Vulnerable Component	As-Built Dwg. File 1956-1990_Morrison_W_Appro			Drawing #	D9		
Description of			at the superstructure to substrue	· J		ilitv is sur	erstructure
	No transverse or lo		at the superstructure to substruc ic event.	· J		ility is sup	erstructure
Description of	No transverse or lo unseating at the be	ongitudinal retraints a earings due to seismi	•	cture connection.	Vulnerabi		
Description of Vulnerability	No transverse or lo unseating at the be	ongitudinal retraints a earings due to seismi	ic event.	cture connection.	Vulnerabi		

Vulnerability Number	2	As-Built Dwg. File	1956-1990	Morrison	W_Appro	ach_Intch_Ea	stbank	_Yramp.pdf
Vulnerable Component	Superstructure bea	rings at bent caps				Drawing #	D9	
Description of Vulnerability		bilitation. Vulnerability ructure into substructu						
Proposed Retrofit	Full bearing replac	ement with elastomeric	: pads.					
Number of Locations	24	Bents				PDF Page #	10	
Unit Cost of Retrofit	\$56,000	each				Figure Ref. #	e MR	010

Vulnerability Number	3	As-Built Dwg. File	1956-1990_	Morrison_	W_Approa	ch_Intch_East	bank_Yramp.pdf
Vulnerable Component	Superstructure dia	ohragms				Drawing #	D19
Description of Vulnerability Superstructure cross brace diaphragms insufficient in transferring shear forces to substructure. Brace members are undersized and the vulnerability is shear failure at the girder flange to deck connection during lateral movement.							
Proposed Retrofit	No retrofit needed f	for 100 yr event					
Number of Locations	55	Diaphragm Lines				PDF Page #	20
Unit Cost of Retrofit	\$0	each				Figure Ref. #	MR011

Vulnerability Number	4	As-Built Dwg. File	1956-1990_Morrison_W_Approa	ch_Intch_Easth	oank_Yramp.pdf
Vulnerable Component	Expansion joints			Drawing #	D23
Description of Vulnerability	Vulnerability is mo	vement during a seism	ic event may move beyond the ca	apacity of the hi	inge
Proposed Retrofit	Longitudinal cable	restrainers			
Number of Locations	21	Joints		PDF Page #	24
Unit Cost of Retrofit	\$75,000	each		Figure Ref. #	MR012

			rksheet			
Bridge Complex	Morrison		Compiled by	TCA	Date:	4/2/2014
Bridge Name	W Morrison Br Con	n over Hwy 1W (Front Ave) & Park [Morrison]	Checked by	KPBU	Date:	5/14/2014
Bridge Number	02758B					
Bridge Location	Fixed River Spans					
Seismic Event	1000 Yr	Desired Performance Level	No Col	llapse (NC)		
Vulnerability Number	1	As-Built Dwg. File 1956-03-30_Morrison_Bridge	_AsBuilts.pdf			
Vulnerable Component	Footing		Drawing #	A5 of 26		
Description of	Footing shear and	flexural rebar detailing look insufficient. There are no	flexural bars at	the top of t	the footin	ng and no
Vulnerability	stirrups to transfer	the shear loads into the foundation. Column to footi cchanism during seismic loads. Vulnerability is footi	ng joint is also po	oorly detai	led, and t	the joint is a
			.g			J
Proposed Retrofit	drive new piles, co	ooting plan and elevation dimensions, drill and bond mplete joint replacement. System Retrofit - Base iso dation, making the footing retrofit less of a priority a	lating the structu	Ire would r	educe the	
		1-				
Number of Locations	4	Footings	PDF Page #	4		
Unit Cost of Retrofit	\$2,000,000	each	Figure Ref. #	MR014		
Vulnorobility Number	0	As Built Durg Eile 1056 02 20 Marrison Bridge	A o Duilto ndf			
Vulnerability Number Vulnerable Component	2 Column	As-Built Dwg. File 1956-03-30_Morrison_Bridge	Drawing #	AC -6 00		
			. v	A6 of 26		
Description of Vulnerability	Column flexural an proper confinemen	d shear strength insufficient for seismic demands. S t for concrete core. Column to bent cap joint detailin shear forces tend to concentrate. Vulnerability is low	tirrups are space g is also poor, an	d too far a nd the joint	is a com	mon failure
Description of	Column flexural an proper confinemen mechanism where performance. Steel jacketing to p	t for concrete core. Column to bent cap joint detailin	tirrups are space g is also poor, an displacement ca g the structure wo	d too far a nd the joint apacity and ould reduc	is a com I non-duc	mon failure ctile
Description of Vulnerability Proposed Retrofit	Column flexural an proper confinemen mechanism where performance. Steel jacketing to p into the substructu	t for concrete core. Column to bent cap joint detailin shear forces tend to concentrate. Vulnerability is low provide confinement. System Retrofit - Base isolating re, making the column jacketing less of a priority and	tirrups are space g is also poor, an v displacement ca g the structure wo potentially unne	d too far a nd the joint apacity and pould reduc cessary.	is a com I non-duc	mon failure ctile
Description of Vulnerability Proposed Retrofit Number of Locations	Column flexural an proper confinemen mechanism where performance. Steel jacketing to p	t for concrete core. Column to bent cap joint detailin shear forces tend to concentrate. Vulnerability is low provide confinement. System Retrofit - Base isolating	tirrups are space g is also poor, an v displacement ca g the structure wo potentially unne PDF Page #	d too far a nd the joint apacity and ould reduc	is a com I non-duc	mon failure ctile
Description of Vulnerability Proposed Retrofit	Column flexural an proper confinemen mechanism where performance. Steel jacketing to p into the substructu	t for concrete core. Column to bent cap joint detailin shear forces tend to concentrate. Vulnerability is low provide confinement. System Retrofit - Base isolating re, making the column jacketing less of a priority and Columns	tirrups are space g is also poor, an v displacement ca g the structure wo potentially unne	d too far a nd the joint apacity and puld reduc cessary.	is a com I non-duc	mon failure ctile
Description of Vulnerability Proposed Retrofit Number of Locations	Column flexural an proper confinemen mechanism where performance. Steel jacketing to p into the substructu	t for concrete core. Column to bent cap joint detailin shear forces tend to concentrate. Vulnerability is low provide confinement. System Retrofit - Base isolating re, making the column jacketing less of a priority and Columns	tirrups are space g is also poor, an o displacement ca g the structure wo potentially unne <u>PDF Page #</u> Figure Ref. #	d too far a nd the joint apacity and puld reduc cessary.	is a com I non-duc	mon failure ctile
Description of Vulnerability Proposed Retrofit Number of Locations Unit Cost of Retrofit	Column flexural an proper confinemen mechanism where performance. Steel jacketing to p into the substructu 8 \$75,000	t for concrete core. Column to bent cap joint detailin shear forces tend to concentrate. Vulnerability is low provide confinement. System Retrofit - Base isolating re, making the column jacketing less of a priority and Columns each	tirrups are space g is also poor, an o displacement ca g the structure wo potentially unne <u>PDF Page #</u> Figure Ref. #	d too far a nd the joint apacity and puld reduc cessary.	is a com I non-duc	mon failure ctile
Description of Vulnerability Proposed Retrofit Number of Locations Unit Cost of Retrofit Vulnerability Number Vulnerabile Component	Column flexural an proper confinemen mechanism where performance. Steel jacketing to p into the substructu 8 \$75,000 3 Bent cap	t for concrete core. Column to bent cap joint detailin shear forces tend to concentrate. Vulnerability is low provide confinement. System Retrofit - Base isolating re, making the column jacketing less of a priority and Columns each As-Built Dwg. File 1956-03-30_Morrison_Bridge	tirrups are space g is also poor, an displacement ca the structure wo potentially unne PDF Page # Figure Ref. # AsBuilts.pdf Drawing #	d too far a od the joint apacity and ould reduc ccessary. 5 MR015 A6 of 26	is a com I non-duc e the den	nmon failure ctile nands going
Description of Vulnerability Proposed Retrofit Number of Locations Unit Cost of Retrofit Vulnerability Number	Column flexural an proper confinemen mechanism where performance. Steel jacketing to p into the substructu 8 \$75,000 3 Bent cap Bent cap at Piers 1	t for concrete core. Column to bent cap joint detailin shear forces tend to concentrate. Vulnerability is low provide confinement. System Retrofit - Base isolating re, making the column jacketing less of a priority and Columns each	tirrups are space g is also poor, an displacement ca g the structure wo potentially unne PDF Page # Figure Ref. # AsBuilts.pdf Drawing # poerstructure force	d too far a od the joint apacity and ould reduc ccessary. 5 MR015 A6 of 26	is a com I non-duc e the den	nmon failure ctile nands going
Description of Vulnerability Proposed Retrofit Number of Locations Unit Cost of Retrofit Vulnerability Number Vulnerable Component Description of	Column flexural an proper confinemen mechanism where performance. Steel jacketing to p into the substructu 8 8 \$75,000 3 Bent cap Bent cap at Piers 1 lateral loading. Vu	t for concrete core. Column to bent cap joint detailin shear forces tend to concentrate. Vulnerability is low provide confinement. System Retrofit - Base isolating re, making the column jacketing less of a priority and Columns each As-Built Dwg. File 1956-03-30_Morrison_Bridge. and 4 flexural strength insufficient for to transfer sup Inerability is the cap can fail prematurely before column ters and doweling new rebar for the entire cap to increa d reduce the demands going into the substructure, ma	tirrups are space g is also poor, an o displacement ca g the structure wo potentially unne <u>PDF Page #</u> Figure Ref. # <u>AsBuilts.pdf</u> Drawing # perstructure force nn hinges.	d too far a ad the joint apacity and ould reduc ceessary. 5 MR015 A6 of 26 es into the ystem Reti	is a com I non-duc e the den substruc	mon failure ctile nands going cture during se isolating
Description of Vulnerability Proposed Retrofit Number of Locations Unit Cost of Retrofit Vulnerability Number Vulnerability Number Vulnerability Number Vulnerability	Column flexural an proper confinemen mechanism where performance. Steel jacketing to p into the substructu 8 8 \$75,000 3 Bent cap Bent cap at Piers 1 lateral loading. Vu Add concrete bolst the structure would	t for concrete core. Column to bent cap joint detailin shear forces tend to concentrate. Vulnerability is low provide confinement. System Retrofit - Base isolating re, making the column jacketing less of a priority and Columns each As-Built Dwg. File 1956-03-30_Morrison_Bridge. and 4 flexural strength insufficient for to transfer sup Inerability is the cap can fail prematurely before column ters and doweling new rebar for the entire cap to increa d reduce the demands going into the substructure, ma	tirrups are space g is also poor, an o displacement ca g the structure wo potentially unne <u>PDF Page #</u> Figure Ref. # <u>AsBuilts.pdf</u> Drawing # perstructure force nn hinges.	d too far a ad the joint apacity and ould reduc ceessary. 5 MR015 A6 of 26 es into the ystem Reti	is a com I non-duc e the den substruc	nmon failure ctile nands going cture during se isolating

Vulnerability Number	4	As-Built Dwg. File	1956-03-30_Morrison_Bridge_A	sBuilts.pdf			
Vulnerable Component	Trunnion Support F	rame	· <u> </u>	Drawing #	A12 of 26		
Description of Embedment of vertical bars at Section E-E insufficient. Vulnerability is flexural reinforcement may not develop full							
Vulnerability	Embedment of vertical bars at Section E-E insufficient. Vulnerability is flexural reinforcement may not develop full strength and pulls out. Trunnion beam may see high torsion and out of plane forces.						
Proposed Retrofit	Add additional vert	ical bars. And build up	o overall frame				
Number of Locations	2	leaf		PDF Page #	11		
Unit Cost of Retrofit	\$1,500,000	each		Figure Ref. #	MR016		

Bridge Complex	Morrison			Compiled by:	TCA	Date:	4/2/2014
Bridge Name	W Morrison Br Conn over Hwy 1W (Front Ave) & Park [Morrison]			Checked by:	KPBU	Date:	5/14/2014
Bridge Number	02758B						
Bridge Location	Fixed River Spans						
Seismic Event	1000 Yr	Desire	ed Performance Level	No Coll	apse (NC)		
Vulnerability Number	5	As-Built Dwg. File	1956-03-30_Morrison_Bridge	AsBuilts.pdf			
Vulnerable Component	Superstructure bea	arings at bent caps		Drawing #	C9 of 72		
Description of Vulnerability		bearing shoe mounte	ient in transferring seismic forc	es in ough the un	nor bong	10 50050	ucture.
Proposed Retrofit	Full bearing replac	ement. System Retro	ofit - Replace existing bearings	with isolalation be	arings.		
Proposed Retrofit Number of Locations	Full bearing replac	ement. System Retro	ofit - Replace existing bearings		arings. 27		

Vulnerability Number	6	As-Built Dwg. File	1956-03-30_Morrison_Bridge_A	sBuilts.pdf	
Vulnerable Component	Superstructure dia	ohragms	•	Drawing #	C5 of 72
Description of Vulnerability			nsufficient in transferring shear fo ng or yielding during lateral move		ucture. Brace members are
Proposed Retrofit		luce the demands goin	transverse stiffness and strengt g into the superstructure, making		
Number of Locations	18	Diaphragm Lines		PDF Page #	23
Unit Cost of Retrofit	\$500,000	each		Figure Ref. #	MR018

Vulnerability Number	7	As-Built Dwg. File	1956-03-30_Morrison_	Bridge_As	sBuilts.pdf	
Vulnerable Component	Truss laterals				Drawing #	C5 of 72
Description of Vulnerability		erals may need streng erability is swaying o	thening to transfer tran f the truss frames.	sverse sei	smic forces fro	m superstructure to
Proposed Retrofit		s going into the supe				isolating the structure would acement less of a priority and
Number of Locations	16	Bays			PDF Page #	23
Unit Cost of Retrofit	\$500,000	each			Figure Ref. #	MR019

Vulnerability Number	8	As-Built Dwg. File	1956-03-30_Morrison_	Bridge_AsBuilts.pdf	
Vulnerable Component	Pit span bearing se	ats		Drawing #	C28 of 72
Description of Vulnerability	The fixed span over	r the bascule piers doe	s not have sufficient b	earing width.	
Proposed Retrofit	Concrete seat exter increased section w		d into trunnion suppor	rt beam or complete supp	ort frame retrofit with
Number of Locations	2	Pier Lines		PDF Page #	46
Unit Cost of Retrofit	\$75,000	each		Figure Ref. #	MR30

Bridge Complex	Morrison			Compiled by	TCA	Date:	4/2/2014
Bridge Name	W Morrison Br Conn over Hwy 1W (Front Ave) & Park [Morrison]			Checked by	KPBU	Date:	5/14/2014
Bridge Number	02758B						
Bridge Location	Fixed River Spans						
Seismic Event	1000 Yr	Desire	ed Performance Level	No Col	lapse (NC)		
Vulnerability Number	9	As-Built Dwg. File	1956-03-30_Morrison_Bridge	_AsBuilts.pdf			
Vulnerable Component	Deck Support Colu	mns at Pit Span		Drawing #	C28 of 72		
Description of		•••	deck span and resting on the tr	unnon beam are	intery denicit		ingituamai
Vulnerability		••••	arily connection to floorbeam		intery denote		ngituumai
'	seismic force trans	sfer mechanism, prim			-		mgnuumar
Vulnerability	seismic force trans	sfer mechanism, prim	narily connection to floorbeam		-		

	Seis						
Bridge Complex	Morrison			Compiled by	TCA	Date:	4/2/2014
Bridge Name	W Morrison Br Con	n over Hwy 1W (Front	Ave) & Park [Morrison]	Checked by		Date:	5/14/2014
Bridge Number	02758B		· · ·				
Bridge Location	Fixed River Spans						
Seismic Event	500 Yr	Desired	d Performance Level	No Col	llapse (NC)		
Vulnerability Number	1	As-Built Dwg. File	1956-03-30_Morrison_Bridg	e_AsBuilts.pdf			
Vulnerable Component	Footing			Drawing #	A5 of 26		
Description of Vulnerability Proposed Retrofit	stirrups to transfer common failure me	the shear loads into t chanism during seisn	g look insufficient. There are i he foundation. Column to foo nic loads. Vulnerability is foo ion dimensions, drill and bond	ting joint is also po ting fails premature	oorly detail ely before d	led, and t column h	he joint is a inges.
			ent. System Retrofit - Base is oting retrofit less of a priority	•		educe the	e demands
Number of Locations	4	Footings		PDF Page #	4		
Unit Cost of Retrofit	\$1,900,000	each		Figure Ref. #	MR014		
Vulnerability Number	2	As-Built Dwg. File	1956-03-30_Morrison_Bridg		-		
Vulnerable Component	Column			Drawing #	A6 of 26		
	Column Column flexural and proper confinemen	d shear strength insu t for concrete core. C	1956-03-30_Morrison_Bridg fficient for seismic demands. column to bent cap joint detail oncentrate. Vulnerability is lo	Drawing # Stirrups are space ing is also poor, an	d too far aj nd the joint	is a com	mon failure
Vulnerable Component Description of	Column Column flexural and proper confinemen mechanism where s performance. Steel jacketing to p	d shear strength insur t for concrete core. C shear forces tend to c rovide confinement.	fficient for seismic demands. olumn to bent cap joint detail	Drawing # Stirrups are space ing is also poor, an w displacement ca ng the structure wo	d too far aj nd the joint apacity and ould reduce	is a com I non-duc	mon failure tile
Vulnerable Component Description of Vulnerability	Column Column flexural and proper confinemen mechanism where s performance. Steel jacketing to p	d shear strength insur t for concrete core. C shear forces tend to c rovide confinement.	fficient for seismic demands. olumn to bent cap joint detail oncentrate. Vulnerability is lo System Retrofit - Base isolati	Drawing # Stirrups are space ing is also poor, an w displacement ca ng the structure wo	d too far aj nd the joint apacity and ould reduce	is a com I non-duc	mon failure tile
Vulnerable Component Description of Vulnerability Proposed Retrofit	Column Column flexural an proper confinemen mechanism where s performance. Steel jacketing to p into the substructu	d shear strength insur t for concrete core. C shear forces tend to c rovide confinement. re, making the column	fficient for seismic demands. olumn to bent cap joint detail oncentrate. Vulnerability is lo System Retrofit - Base isolati	Drawing # Stirrups are space ing is also poor, an ow displacement ca ng the structure wo nd potentially unne	d too far aj ad the joint apacity and ould reduce cessary.	is a com I non-duc	mon failure tile
Vulnerable Component Description of Vulnerability Proposed Retrofit Number of Locations	Column Column flexural an proper confinemen mechanism where s performance. Steel jacketing to p into the substructu	d shear strength insur t for concrete core. C shear forces tend to c rovide confinement. re, making the column Columns	fficient for seismic demands. olumn to bent cap joint detail oncentrate. Vulnerability is lo System Retrofit - Base isolati	Drawing # Stirrups are space ing is also poor, an ow displacement ca ng the structure wo nd potentially unne PDF Page #	d too far aj ad the joint apacity and bould reduce cessary.	is a com I non-duc	mon failure tile
Vulnerable Component Description of Vulnerability Proposed Retrofit Number of Locations	Column Column flexural an proper confinemen mechanism where s performance. Steel jacketing to p into the substructu	d shear strength insur t for concrete core. C shear forces tend to c rovide confinement. re, making the column Columns	fficient for seismic demands. olumn to bent cap joint detail oncentrate. Vulnerability is lo System Retrofit - Base isolati	Drawing # Stirrups are space ing is also poor, an w displacement ca ng the structure wo nd potentially unne PDF Page # Figure Ref. #	d too far aj ad the joint apacity and bould reduce cessary.	is a com I non-duc	mon failure tile
Vulnerable Component Description of Vulnerability Proposed Retrofit Number of Locations Unit Cost of Retrofit	Column Column flexural an proper confinemen mechanism where s performance. Steel jacketing to p into the substructu 8 8 \$71,000	d shear strength insur t for concrete core. C shear forces tend to c rovide confinement. re, making the column Columns each	fficient for seismic demands. olumn to bent cap joint detail oncentrate. Vulnerability is lo System Retrofit - Base isolati n jacketing less of a priority ar	Drawing # Stirrups are space ing is also poor, an w displacement ca ng the structure wo nd potentially unne PDF Page # Figure Ref. #	d too far aj ad the joint apacity and bould reduce cessary.	is a com I non-duc	mon failure tile
Vulnerable Component Description of Vulnerability Proposed Retrofit Number of Locations Unit Cost of Retrofit Vulnerability Number	Column Column flexural an proper confinemen mechanism where s performance. Steel jacketing to p into the substructu 8 8 \$71,000 3 Bent cap Bent Cap flexural s	d shear strength insur t for concrete core. C shear forces tend to c rovide confinement. re, making the column Columns each As-Built Dwg. File	fficient for seismic demands. olumn to bent cap joint detail oncentrate. Vulnerability is lo System Retrofit - Base isolati n jacketing less of a priority ar	Drawing # Stirrups are space ing is also poor, an ow displacement ca ng the structure wo nd potentially unne PDF Page # Figure Ref. # e_AsBuilts.pdf Drawing #	d too far a ad the joint apacity and ould reduce ccessary. 5 MR015 A6 of 26	is a com I non-duc e the den	mon failure tile nands going
Vulnerable Component Description of Vulnerability Proposed Retrofit Number of Locations Unit Cost of Retrofit Vulnerability Number Vulnerable Component Description of	Column Column flexural and proper confinement mechanism where a performance. Steel jacketing to p into the substructure 8 \$71,000 3 Bent cap Bent Cap flexural s Vulnerability is the Add concrete bolst	d shear strength insur t for concrete core. C shear forces tend to c rovide confinement. re, making the column Columns each As-Built Dwg. File trength insufficient fo cap can fail prematur ers and doweling new I reduce the demands	fficient for seismic demands. olumn to bent cap joint detail oncentrate. Vulnerability is lo System Retrofit - Base isolati n jacketing less of a priority ar [1956-03-30_Morrison_Bridg r to transfer superstructure fo	Drawing # Stirrups are space ing is also poor, and ow displacement can ng the structure work ng the structure work PDF Page # Figure Ref. # e_AsBuilts.pdf Drawing # prces into the substances strease stiffness.	d too far a ad the joint apacity and build reduce cessary. 5 MR015 A6 of 26 tructure du	is a com I non-duc e the den rring later	mon failure tile nands going ral loading. se isolating
Vulnerable Component Description of Vulnerability Proposed Retrofit Number of Locations Unit Cost of Retrofit Vulnerability Number Vulnerability Number Vulnerability Description of Vulnerability	Column Column flexural and proper confinement mechanism where a performance. Steel jacketing to p into the substructure 8 \$71,000 3 Bent cap Bent Cap flexural s Vulnerability is the structure would	d shear strength insur t for concrete core. C shear forces tend to c rovide confinement. re, making the column Columns each As-Built Dwg. File trength insufficient fo cap can fail prematur ers and doweling new I reduce the demands	fficient for seismic demands. olumn to bent cap joint detail oncentrate. Vulnerability is lo System Retrofit - Base isolati n jacketing less of a priority ar [1956-03-30_Morrison_Bridg [1956-03-30_Morrison_Bridg] r to transfer superstructure fo ely before column hinges.	Drawing # Stirrups are space ing is also poor, and ow displacement can ng the structure work ng the structure work PDF Page # Figure Ref. # e_AsBuilts.pdf Drawing # prces into the substances strease stiffness.	d too far a ad the joint apacity and build reduce cessary. 5 MR015 A6 of 26 tructure du	is a com I non-duc e the den rring later	mon failure tile nands going ral loading. se isolating

Vulnerability Number	4	As-Built Dwg. File	1956-03-30	Morrison_Bridge_A	sBuilts.pdf			
Vulnerable Component	Trunnion Support F	rame			Drawing #	A12 of 26		
Description of	Embedment of vertical bars at Section E-E insufficient. Vulnerability is flexural reinforcement may not develop full							
Vulnerability	strength and pulls of	out. Trunnion beam n	nay see high t	orsion and out of pla	ane forces.			
Proposed Retrofit	Add additional vert	ical bars.						
Number of Locations	2	leaf			PDF Page #	11		
Unit Cost of Retrofit	\$1,425,000	each				MR016		

Bridge Complex	Morrison			Compiled by:	TCA	Date:	4/2/2014
Bridge Name	W Morrison Br Conn over Hwy 1W (Front Ave) & Park [Morrison]			Checked by:	KPBU	Date:	5/14/2014
Bridge Number	02758B						
Bridge Location	Fixed River Spans						
Seismic Event	500 Yr	Desir	ed Performance Level	No Coll	lapse (NC)		
Vulnerability Number	5	As-Built Dwg. File	1956-03-30_Morrison_Bridge	AsBuilts.pdf			
Vulnerable Component	Superstructure bea	arings at bent caps		Drawing #	C9 of 72		
Description of	"Fixed" and "Exp"	' bearing shoe insuffic	cient in transferring seismic ford	es through the and	chor bolts	to subst	ructure.
Description of Vulnerability	"Fixed" and "Exp"	bearing shoe insuffic	cient in transferring seismic forc	ces through the and	chor bolts	to substi	ructure.
		_	cient in transferring seismic forc r <mark>ofit</mark> - Replace existing bearings	-		to substi	ructure.
Vulnerability		_		-		to substi	ructure.

Vulnerability Number	6	As-Built Dwg. File	1956-03-30_Morrison_Bridge_A	sBuilts.pdf	
Vulnerable Component	Superstructure dia	ohragms		Drawing #	C5 of 72
Description of Vulnerability	undersized and the	vulnerability is bucklir	sufficient in transferring shear f Ig or yielding during lateral move	ement.	
Proposed Retrofit		s going into the supers	transverse stiffness. System R tructure, making the diaphragm		
Number of Locations	18	Diaphragm Lines		PDF Page #	23
Unit Cost of Retrofit	\$475,000	each		Figure Ref. #	MR018

Vulnerability Number	7	As-Built Dwg. File	1956-03-30_Morrison	_Bridge_A	sBuilts.pdf	
Vulnerable Component	Truss laterals				Drawing #	C5 of 72
Description of Vulnerability		erals may need strengt erability is swaying of t		isverse sei	ismic forces fro	m superstructure to
						structure would reduce the ss of a priority and potentially
Number of Locations	16	Bays			PDF Page #	23
Unit Cost of Retrofit	\$475,000	each			Figure Ref. #	MR019

Vulnerability Number	8	As-Built Dwg. File	1956-03-30_Morrison_	Bridge_AsBuilts.pdf	
Vulnerable Component	Pit span bearing se	ats		Drawing #	C28 of 72
Description of Vulnerability			es not have sufficient be	-	
Proposed Retrofit	Concrete seat exter increased section v		ea into trunnion suppor	t beam or complete supp	port frame retrofit with
Number of Locations	2	Pier Lines		PDF Page #	46
Unit Cost of Retrofit	\$71,000	each		Figure Ref. #	MR30

Bridge Complex	Morrison			Compiled by:	TCA	Date:	4/2/2014
Bridge Name	W Morrison Br Conn over Hwy 1W (Front Ave) & Park [Morrison]			Checked by:	KPBU	Date:	5/14/2014
Bridge Number	02758B						
Bridge Location	Fixed River Spans						
Seismic Event	500 Yr	Desir	ed Performance Level	No Col	lapse (NC))	
Vulnerability Number	9	As-Built Dwg. File	1956-03-30_Morrison_Bridge	e_AsBuilts.pdf			
Viulaanahla Camananant	Deck Support Columns at Pit Span			Drawing #	C28 of 72	>	
Vulnerable Component Description of	The short steel col	umns supporting the	e deck span and resting on the t	, v			ongitudinal
	The short steel col	umns supporting the	e deck span and resting on the t narily connection to floorbeam.	, v			ongitudinal
Description of Vulnerability	The short steel coll seismic force trans	umns supporting the fer mechanism, prim	, .	runnion beam are l	likely defic	ient in Io	ongitudinal
Description of	The short steel coll seismic force trans	umns supporting the fer mechanism, prim	narily connection to floorbeam.	runnion beam are l	likely defic	ient in Io	ongitudinal

Bridge Complex	Morrison			Compiled by:	TCA	Date:	4/2/2014
Bridge Name	W Morrison Br Conn over Hwy 1W (Front Ave) & Park [Morrison]			Checked by:	KPBU	Date:	5/14/2014
Bridge Number	02758B						
Bridge Location	Fixed River Spans						
Seismic Event	100 Yr	Desire	ed Performance Level	No Col	lapse (NC)		
Vulnerability Number	1	As-Built Dwg. File	1956-03-30_Morrison_Bridge_	AsBuilts.pdf			
Vulnerable Component	Trunnion Support	Frame		Drawing #	A12 of 26	i	
Description of Vulnerability			E-E insufficient. Vulnerability is fi				
-	su engui and puils	out. munnon beam	may see high torsion and out of J	biane forces.			
Proposed Retrofit	Add additional ver		may see mgn torsion and out of j				
Proposed Retrofit Number of Locations			may see mgn torsion and out of j	PDF Page #	11		

Martin and hill to Alamaka an	0	A - Built Burn File	4050 00 00 14-	unia e a Duisia a	- Duality and		
Vulnerability Number	2	As-Built Dwg. File	1956-03-30_MO	rrison_Bridge_A	sBuilts.pdf		
Vulnerable Component	Superstructure bea	rings at bent caps			Drawing #	C9 of 72	
Description of "Fixed" and "Exp" bearing shoe insufficient in transferring seismic forces through the anchor bolts to substructure.							
Description of	"Fixed" and "Exp"	bearing shoe insufficie	nt in transferrin	g seismic forces	through the and	chor bolts to substructure.	
Vulnerability							
Proposed Retrofit	Full bearing replace	ement.					
Number of Locations	8	Bearings			PDF Page #	27	
Unit Cost of Retrofit	\$75,000	each			Figure Ref. #	MR017	

Vulnerability Number	3	As-Built Dwg. File	1956-03-30_N	Norrison_	Bridge_	AsBuilts.pdf	
Vulnerable Component	Superstructure diap	ohragms				Drawing #	C5 of 72
Description of Vulnerability		ss brace diaphragms ir vulnerability is bucklir					ucture. Brace members are
Proposed Retrofit	No retrofit Needed 1	for 100 yr event					
Number of Locations	18	Diaphragm Lines				PDF Page #	23
Unit Cost of Retrofit	\$0	each				Figure Ref. #	MR018

Vulnerability Number	4	As-Built Dwg. File	1956-03-30_Morrison_Br	ridge_AsBuilts.pdf		
Vulnerable Component	Truss laterals		•	Drawing #	C5 of 72	
Description of Vulnerability Top and bottom laterals may need strengthening to transfer transverse seismic forces from superstructure to substructure. Vulnerability is swaying of the truss frames.						
Proposed Retrofit	No Retrofit needed	for 100 yr event				
Number of Locations	16	leaf		PDF Page #	23	
Unit Cost of Retrofit	\$0	each		Figure Ref. #	MR019	

Bridge Complex	Morrison			Compiled by	TCA	Date:	4/2/2014
Bridge Name	W Morrison Br Conn over Hwy 1W (Front Ave) & Park [Morrison]			Checked by	KPBU	Date:	5/14/2014
Bridge Number	02758B						
Bridge Location	Fixed River Spans						
Seismic Event	100 Yr	Desir	ed Performance Level	No Col	llapse (NC)		
Vulnerability Number	5	As-Built Dwg. File	1956-03-30_Morrison_Bridge	e_AsBuilts.pdf			
Vulnerable Component	Pit span bearing s	eats		Drawing #	C28 of 72	2	
Description of Vulnerability	The fixed span ov	er the bascule piers d	loes not have sufficient bearing	width.			
	Concrete seat exte	enders with bars dow	oes not nave suπicient bearing eled into trunnion support beam		oort frame i	retrofit w	ith
Vulnerability Proposed Retrofit Number of Locations	Concrete seat extr increased section	enders with bars down width. Pier Lines		n or complete supp PDF Page #	46	retrofit w	ith
Vulnerability Proposed Retrofit	Concrete seat exto	enders with bars down		n or complete supp	_	retrofit w	ith
Vulnerability Proposed Retrofit Number of Locations	Concrete seat extr increased section	enders with bars down width. Pier Lines		n or complete supp PDF Page # Figure Ref. #	46	retrofit w	ith

Vulnerable Component	Deck Support Colur	mns at Pit Span		Drawing #	C28 of 72
Description of Vulnerability			ck span and resting on the trun y connection to floorbeam.	nion beam are li	kely deficient in longitudinal
Proposed Retrofit	Full column replace	ement or retrofitted floor	r beam to column connection to	allow rotation a	it the top.
Number of Locations	8	Pier Lines		PDF Page #	46
Unit Cost of Retrofit	\$56,000	each		Figure Ref. #	MR31

Bridge Complex	Morrison			Compiled by:	TCA	Date:	4/2/2014
Bridge Name	W Morrison Br Conn over Hwy 1W (Front Ave) & Park [Morrison]			Checked by:	KPBU	Date:	5/14/2014
Bridge Number	02758B			-			
Bridge Location	Moveable Span						
Seismic Event	1000 Yr	Desire	ed Performance Level	No Col	lapse (NC)		
Vulnerability Number	1	As-Built Dwg. File	1956-03-30_Morrison_Bridge_A	AsBuilts.pdf			
Vulnerable Component	Superstructure bea	rings		Drawing #	C28 of 72		
Vulnerability	poorly under seism	ic loading.					
Proposed Retrofit	Replace bearings, µ	provide sufficient gap	o to allow for increased movemen isolation bearing, but still able to				
	Replace bearings, µ	provide sufficient gap					

Vulnerability Number	2	As-Built Dwg. File	1956-03-30_Morrison_Bridge_A	sBuilts.pdf	
Vulnerable Component	Truss diaphragms			Drawing #	C28 of 72
Description of Vulnerability			nsufficient in transferring shear f of the vertical members support		
Proposed Retrofit		ill reduce demands go	gonal members to increase trans ing into the superstructure, maki		
Number of Locations	8	Diaphragm lines		PDF Page #	46
Unit Cost of Retrofit	\$2,000,000	each		Figure Ref. #	MR020

Vulnerability Number	3	As-Built Dwg. File	1956-03-30 Morrison Bridge A	sBuilts.pdf	
Vulnerable Component	Bascule Truss Late	, v			C15 of 72
Description of Vulnerability		y need strengthening t lying of the truss frame	o transfer transverse seismic for es.	rces from super:	structure to substructure.
Proposed Retrofit			stiffness. System Retrofit - Ba ss top and bottom lateral brace s		
Number of Locations	8	Diaphragm lines		PDF Page #	33
Unit Cost of Retrofit	\$500,000	each		Figure Ref. #	MR021

Vulnerability Number	4	As-Built Dwg. File	1956-03-30_Morrison	_Bridge_As	sBuilts.pdf	
Vulnerable Component	Trunnion Bearing A	Inchor Bolts			Drawing #	A12 of 26
Description of Vulnerability	Trunnion bearing a	nchor bolts are likely ir	nsufficient to transfer s	seismic Ioa	nds into the trun	nion frame
Proposed Retrofit	Replace with high s	trength bolts or drill ar	nd bond additional and	chor bolts a	around the exis	ting bearing base plate.
Number of Locations	4	Bearings			PDF Page #	11
Unit Cost of Retrofit	\$75,000	each			Figure Ref. #	MR022

Bridge Complex	Morrison			Compiled by:	TCA	Date:	4/2/2014
Bridge Name	W Morrison Br Co	onn over Hwy 1W (Fron	t Ave) & Park [Morrison]	Checked by:	KPBU	Date:	5/14/2014
Bridge Number	02758B						
Bridge Location	Moveable Span						
Seismic Event	1000 Yr	Desire	d Performance Level	No Col	lapse (NC)		
Vulnerability Number	5	As-Built Dwg. File	1956-03-30_Morrison_Bridg	e_AsBuilts.pdf			
Vulnerable Component	Counterweight Br	races		Drawing #	C21 of 72	2	
Description of Vulnerability	Bottom lateral bra	aces are likely insuffici	ent to transfer lateral inertial fo	orces from the cour	nterweight	to the tru	innion
-							
Proposed Retrofit	Base isolated trui	•••	rs between truss bays, replace nds going into the superstruct sary.	••			
•	Base isolated trui	nnion will reduce dema	nds going into the superstruct	ure, making counte			
Proposed Retrofit Number of Locations Unit Cost of Retrofit	Base isolated trui less of a priority a	nnion will reduce dema	nds going into the superstruct	••	erweight b		
Number of Locations Unit Cost of Retrofit	Base isolated true less of a priority a	nnion will reduce dema and potentially unnces	nds going into the superstruct	PDF Page #	erweight b		
Number of Locations	Base isolated true less of a priority a	nnion will reduce dema and potentially unnces	nds going into the superstruct	PDF Page # Figure Ref. #	erweight b		
Number of Locations Unit Cost of Retrofit	Base isolated trun less of a priority a 2 \$2,000,000	nnion will reduce dema and potentially unncess each As-Built Dwg. File	nds going into the superstruct sary.	PDF Page # Figure Ref. #	erweight b	race stre	

	Base isolated trunn	eral support members between truss bays, replace sup ion will reduce demands going into the superstructure, d potentially unncessary.	•	· · · · · · · · · · · · · · · · · · ·
Number of Locations	2		PDF Page #	28
Unit Cost of Retrofit	\$500,000	each	Figure Ref. #	none

Vulnerability Number	7	As-Built Dwg. File	1956-03-30_Morrison_Bridge	_AsBuilts.pdf	
Vulnerable Component	Piers 2 and 3			Drawing #	A8
Description of Vulnerability	Piers 2 and 3 are vu	Inerable to longitudir	al seismic shaking and deterio	ration	
Proposed Retrofit		l strength, particularly reduce strength dem		ion. System Retr	ofit - Base Isolation of bascule
Number of Locations	2			PDF Page #	7
Unit Cost of Retrofit	\$2,500,000	each		Figure Ref. #	NA

Bridge Complex	Morrison			Compiled by:	TCA	Date:	4/2/2014
Bridge Name	W Morrison Br Con	W Morrison Br Conn over Hwy 1W (Front Ave) & Park [Morrison]			KPBU	Date:	5/14/2014
Bridge Number	02758B						
Bridge Location	Moveable Span						
Seismic Event	500 Yr	Desire	d Performance Level	No Col	lapse (NC)		
Vulnerability Number	1	As-Built Dwg. File	1956-03-30_Morrison_Bridge_A	sBuilts.pdf			
Vulnerable Component	Superstructure bea	rings		Drawing #	C28 of 72	2	
Vulnerability	poorly under seism	nic loading.					
		-					
Proposed Retrofit			to allow for increased movement isolation bearing, but still able to				
Proposed Retrofit Number of Locations							

Vulnerability Number	2	As-Built Dwg. File	1956-03-30_Morrison_Bridge_A	sBuilts.pdf	
Vulnerable Component	Truss diaphragms		Drawing #	C28 of 72	
Description of Vulnerability			nsufficient in transferring shear f of the vertical members supporti		
Proposed Retrofit		ill reduce demands go	jonal members to increase trans ing into the superstructure, maki		
Number of Locations	8	Diaphragm lines		PDF Page #	46
Unit Cost of Retrofit	\$1,900,000	each		Figure Ref. #	MR020

Vulnerability Number	3	As-Built Dwg. File	1956-03-30 Morrison Bridge A	sBuilts.pdf	
Vulnerable Component	Bascule Truss Late	, v			C15 of 72
Description of Vulnerability		y need strengthening t lying of the truss frame	o transfer transverse seismic for es.	rces from super:	structure to substructure.
Proposed Retrofit			stiffness. System Retrofit - Ba ss top and bottom lateral brace s		
Number of Locations	8	Diaphragm lines		PDF Page #	33
Unit Cost of Retrofit	\$475,000	each		Figure Ref. #	MR021

Vulnerability Number	4	As-Built Dwg. File	1956-03-30_Morrison_	Bridge_As	sBuilts.pdf	
Vulnerable Component	Trunnion Bearing A	nchor Bolts			Drawing #	A12 of 26
Description of Vulnerability	Trunnion bearing a	nchor bolts are likely ir	nsufficient to transfer s	eismic Ioa	nds into the trun	nion frame
Proposed Retrofit	Replace with high s	trength bolts or drill ar	nd bond additional anc	hor bolts a	around the exis	ting bearing base plate.
Number of Locations	4	Bearings			PDF Page #	11
Unit Cost of Retrofit	\$71,000	each			Figure Ref. #	MR022

Bridge Complex	Morrison	Morrison			TCA	Date:	4/2/2014
Bridge Name	W Morrison Br Conn over Hwy 1W (Front Ave) & Park [Morrison]			Checked by	KPBU	Date:	5/14/2014
Bridge Number	02758B						
Bridge Location	Moveable Span						
Seismic Event	500 Yr	Desir	ed Performance Level	No Co	llapse (NC))	
Vulnerability Number	5	As-Built Dwg. File	1956-03-30_Morrison_Bridge	e_AsBuilts.pdf			
Vulnerable Component	Counterweight B	Braces		Drawing #	C21 of 72	2	
Description of Vulnerability	Bollom lateral br	races are intery insume.	ient to transfer lateral inertial fo	rees nom the cou	inter in engine	. to the tr	minon
•	Add intemediate Base isolated tru	lateral support membe	ers between truss bays, replace ands going into the superstruct	supports with stif	fer section	s. Syste	m Retrofit ·
Vulnerability	Add intemediate Base isolated tru less of a priority 2	lateral support membe	ers between truss bays, replace ands going into the superstruct	supports with stif ure, making count PDF Page #	fer section terweight b	s. Syste	m Retrofit
Vulnerability Proposed Retrofit Number of Locations	Add intemediate Base isolated tru less of a priority	lateral support membe	ers between truss bays, replace ands going into the superstruct	supports with stif ure, making count	fer section terweight b	s. Syste	m Retrofit
Vulnerability Proposed Retrofit Number of Locations Unit Cost of Retrofit	Add internediate Base isolated tru less of a priority 2 \$1,900,000	lateral support membe unnion will reduce demo and potentially unnces each	ers between truss bays, replace ands going into the superstruct ssary.	supports with stif ure, making count PDF Page # Figure Ref. #	fer section terweight b	s. Syste	m Retrofit
Vulnerability Proposed Retrofit	Add intemediate Base isolated tru less of a priority 2	lateral support membe unnion will reduce demo and potentially unnces	ers between truss bays, replace ands going into the superstruct	supports with stif ure, making count PDF Page # Figure Ref. #	fer section terweight b	s. Syste	m Retrofit

Vulnerable Component	Truss Lateral suppo	ort	Drawing #	C10 of 72			
Description of Vulnerability The truss overall lacks lateral support and will see high displacements in a seismic events.							
	Base isolated trunn	eral support members between truss bays, replace sup ion will reduce demands going into the superstructure, d potentially unncessary.	•	2 · · · · · · · · · · · · · · · · · · ·			
Number of Locations	2		PDF Page #	28			
Unit Cost of Retrofit	\$475,000	each	Figure Ref. #	none			

Bridge Complex	Morrison			Compiled by:	TCA	Date:	4/2/2014
Bridge Name	W Morrison Br Conn over Hwy 1W (Front Ave) & Park [Morrison]			Checked by:	KPBU	Date:	5/14/2014
Bridge Number	02758B						
Bridge Location	Moveable Span						
Seismic Event	100 Yr	Desire	ed Performance Level	No Col	lapse (NC)		
Vulnerability Number	1	As-Built Dwg. File	1956-03-30_Morrison_Bridge	e_AsBuilts.pdf			
Vulnerable Component	Superstructure be	earings		Drawing #	C28 of 72		
Description of Vulnerability	poorly under seis	•	k insufficient to transfer seismic	, lorces. Vuinerab	inty is the	bearing	an periorin
Proposed Retrofit	Replace bearings,	provide sufficient ga	p to allow for increased moveme	ent, but overall for	ce demano	ls will red	luce.
Number of Locations	8	Bearings		PDF Page #	46		

Vulnerability Number	2	As-Built Dwg. File	1956-03-30_Morrisor	_Bridge_A	sBuilts.pdf	
Vulnerable Component	Truss diaphragms				Drawing #	C28 of 72
Description of Vulnerability						ucture. Brace members are ams during lateral movement.
Proposed Retrofit	No Retrofit needed	for 100 yr event				
Number of Locations	8	Diaphragm lines			PDF Page #	46
Unit Cost of Retrofit	\$0	each			Figure Ref. #	MR020

Vulnerability Number	3	As-Built Dwg. File	1956-03-30_Morrison_	_Bridge_A	sBuilts.pdf	
Vulnerable Component	Bascule Truss Late	ral Braces			Drawing #	C15 of 72
Description of Vulnerability		y need strengthening to ying of the truss frame		eismic for	ces from supers	structure to substructure.
Proposed Retrofit	No Retrofit needed	for 100 yr event				
Number of Locations	8	Diaphragm lines			PDF Page #	33
Unit Cost of Retrofit	\$0	each			Figure Ref. #	MR021

Vulnerability Number	4	As-Built Dwg. File	1956-03-30_Morri	ison_Bridge_As	sBuilts.pdf	
Vulnerable Component	Counterweight Brac	ces			Drawing #	C21 of 72
Description of Vulnerability	Bottom lateral brac	es are likely insufficier	nt to transfer latera	al inertial forces	from the coun	terweight to the trunnion
Proposed Retrofit	Add intemediate lat	eral support members	between truss bay	ys, replace sup _l	ports with stiffe	er sections.
Number of Locations	2				PDF Page #	39
Unit Cost of Retrofit	\$375,000	each			Figure Ref. #	MR24

Bridge Complex	Morrison			Compiled by:	TCA	Date:	4/2/2014
Bridge Name	W Morrison Br Co	onn over Hwy 1W (Froi	nt Ave) & Park [Morrison]	Checked by:	KPBU	Date:	5/14/2014
Bridge Number	02758B						
Bridge Location	Moveable Span						
Seismic Event	100 Yr	Desir	ed Performance Level	No Coll	apse (NC)		
Vulnerability Number	1	As-Built Dwg. File	1956-03-30_Morrison_Bridge	e_AsBuilts.pdf			
Vulnerable Component	Trunnion Bearing	Anchor Bolts		Drawing #	A12 of 26	3	
Description of	Truinion bearing	anchor bons are likely	y insufficient to transfer seismic		monnan	<i>ie</i>	
,	Trainion bearing				inion nan	le	
Proposed Retrofit			l and bond additional anchor bo				olate.
Vulnerability							olate.

Bridge Complex	Morrison			Compiled by	TCA D	ate: 4/2/2014
Bridge Name	SE Belmont St ove	r Hwy 1 & Conns (Morr	ison Intchg) [Morrison]	Checked by	KPBU D	ate: 5/14/2014
Bridge Number	02758A					
Bridge Location	East Approaches					
Seismic Event	1000 Yr	Desired	Performance Level	No Co	lapse (NC)	
Vulnerability Number	1	As-Built Dwg. File	1956-02-16_Morrison_East_A	pproach.pdf		
Vulnerable Component	Footing		·	Drawing #	B11 of 68	
Vulnerability			ne foundation. Column to footi ic loads. Vulnerability is footir			
Proposed Retrofit	Ŭ	ooting plan and elevati mplete joint replaceme	on dimensions, drill and bond i nt.	new dowels and s	stirrups in exis	ating footing,
Number of Locations	114	Footings		PDF Page #	18	
Number of Locations						

Vulnerability Number	2	As-Built Dwg. File	1956-02-16_Morrison_East_A	Approach.pdf	
Vulnerable Component	Footing			Drawing #	B11 of 68
Description of Vulnerability			may not be sufficient enough ut or yielding when moment i		
Proposed Retrofit	Add additional laye Vulnerability 1	r of concrete to increa	se pile head embedment depti	h to a minimum 24	I" Cost included with
Number of Locations	114	Footings		PDF Page #	18
Unit Cost of Retrofit	\$0	each		Figure Ref. #	MR001

Vulnerability Number	3	As-Built Dwg. File	1956-02-16_Morrison_East_App	proach.pdf	
Vulnerable Component	Column			Drawing #	B16 of 68
Description of Vulnerability	proper confinement	t for concrete core. Co	icient for seismic demands. Stir lumn to bent cap joint detailing i ncentrate. Vulnerability is low d	is also poor, and	d the joint is a common failure
Proposed Retrofit	Steel jacketing to p	rovide confinement.			
Number of Locations	124	Columns		PDF Page #	23
Unit Cost of Retrofit	\$75,000	each		Figure Ref. #	MR002

Vulnerability Number	4	As-Built Dwg. File	1956-02-16 Morrison	East App	roach.pdf	
Vulnerable Component	Bent cap				Drawing #	B16 of 68
	•					
Description of	Bent Cap flexural s	strength insufficient for	to transfer superstruct	ure forces	into the subst	ructure during lateral loading.
Vulnerability	Vulnerability is the	cap can fail premature	ly before column hinge	s.		
Duan a sail Datus fit		(4 - 1		
Proposed Retrofit	Add concrete bols	ters and doweling new	rebar for the entire cap	to increas	se stimness.	
N		Danta			DD5 D+ +++	00
Number of Locations	55	Bents			PDF Page #	23
Unit Cost of Retrofit	\$100,000	each			Figure Ref. #	MR003

Bridge Complex	Morrison			Compiled by:	TCA	Date:	4/2/2014
Bridge Name	SE Belmont St ov	er Hwy 1 & Conns (Mo	orrison Intchg) [Morrison]	Checked by:	KPBU	Date:	5/14/2014
Bridge Number	02758A						
Bridge Location	East Approaches						
Seismic Event	1000 Yr	Desire	ed Performance Level	No Col	lapse (NC)	
Vulnerability Number	5	As-Built Dwg. File	1956-02-16_Morrison_East_Ap	proach.pdf			
Vulnerable Component	Bent cap - Restra	iners		Drawing #	B16 of 6	8	
Description of Vulnerability		nseating at the bearing	at the superstructure to substruc Is.		Vulliciu	onity is	
Proposed Retrofit	Reinforced concr	ete shear keys and lo	ngitudinal cable restraints				
.,			ighta anna i cabic i cottaintei				
Number of Locations	69	Bents		PDF Page #	23		

Vulnerability Number	6	As-Built Dwg. File	1956-02-16_Morrison_East_App	roach.pdf	
Vulnerable Component	Superstructure bea	rings at bent caps		Drawing #	B17 of 68
Description of Vulnerability			v is this bearing type may perform ure. Currently, the stringers are o		
Proposed Retrofit	Full bearing replac	ement with elastomeric	c pads.		
Number of Locations	69	Bents		PDF Page #	24
Unit Cost of Retrofit	\$75,000	each		Figure Ref. #	MR004

Vulnerability Number	7	As-Built Dwg. File	1956-02-16_Morrison	_East_	Approach.pdf	
Vulnerable Component	Superstructure dia	ohragms			Drawing #	B43 of 68
Description of Vulnerability						ucture. Brace members are ıring lateral movement.
Proposed Retrofit	Replace bearing dia	aphragms members to	increase transverse s	tiffness		
Number of Locations	104	Diaphragm Lines			PDF Page #	50
Unit Cost of Retrofit	\$75,000	each			Figure Ref. #	MR005

Vulnerability Number	8	As-Built Dwg. File	1956-02-16_Morriso	n_East_Ap	proach.pdf	
Vulnerable Component	Superstructure gird	lers			Drawing #	B43 of 68
Description of Vulnerability		bearing and in span hi			l buckling during	g transverse loading.
Proposed Retrofit	Add additional shea	ar stiffener plates or do	oubler plates to the w	eb.		
Number of Locations	104	Pier/Bent Lines			PDF Page #	50
Unit Cost of Retrofit	\$75,000	each			Figure Ref. #	MR006

Bridge Complex	Morrison			Compiled by	TCA	Date:	4/2/2014
Bridge Name	SE Belmont St ove	er Hwy 1 & Conns (Mo	orrison Intchg) [Morrison]	Checked by	KPBU	Date:	5/14/2014
Bridge Number	02758A						
Bridge Location	East Approaches						
Seismic Event	1000 Yr	Desir	red Performance Level	No Col	lapse (NC)		
Vulnerability Number	9	As-Built Dwg. File	1956-02-16_Morrison_East_A	Approach.pdf			
Vulnerable Component	In span hinge rest	rainte		Drawing #	B43 of 68		
Description of	No transverse and		ts at in span hinges. Vulnerabili				ting during
,			ts at in span hinges. Vulnerabili				ting during
Description of	No transverse and shaking.	longitudinal restrain	ts at in span hinges. Vulnerabili sverse stopper plate (similar to v	ty is relatively larg	ge gaps and	d unseat	ting during
Description of Vulnerability	No transverse and shaking.	longitudinal restrain		ty is relatively larg	ge gaps and	d unseat	ting during

Bridge Complex	Morrison			Compiled by	TCA [Date:	4/2/2014
Bridge Name	SE Belmont St over Hwy 1 & Conns (Morrison Intchg) [Morrison]			Checked by	KPBU [Date:	5/14/2014
Bridge Number	02758A						
Bridge Location	East Approaches						
Seismic Event	500 Yr	Desired	Performance Level	No Co	lapse (NC)		
Vulnerability Number	1	As-Built Dwg. File	1956-02-16_Morrison_East_A	pproach.pdf			
Vulnerable Component	Footing		÷	Drawing #	B11 of 68		
Vulnerability			he foundation. Column to footin hic loads. Vulnerability is footin				
Proposed Retrofit	•	ooting plan and elevati mplete joint replaceme	on dimensions, drill and bond i nt.	new dowels and s	stirrups in ex	isting f	ooting,
Number of Locations	114	Footings		PDF Page #	18		
	\$475,000	each		Figure Ref. #	MR001		

Vulnerability Number	2	As-Built Dwg. File	1956-02-16_Morrison_East_A	pproach.pdf	
Vulnerable Component	Footing			Drawing #	B11 of 68
Description of Vulnerability			o may not be sufficient enough f I out or yielding when moment is		
Proposed Retrofit	Add additional lay Vulnerability 1	er of concrete to incre	ease pile head embedment depth	n to a minimum 24	4" Cost included with
Number of Locations	114	Footings		PDF Page #	18
Unit Cost of Retrofit	\$0	each		Figure Ref. #	MR001

Vulnerability Number	3	As-Built Dwg. File	1956-02-16_Morrison_East_App	roach.pdf	
Vulnerable Component	Column			Drawing #	B16 of 68
Description of Vulnerability	proper confinement	t for concrete core. Co	icient for seismic demands. Stiri lumn to bent cap joint detailing i ncentrate. Vulnerability is low di	s also poor, and	d the joint is a common failure
Proposed Retrofit	Steel jacketing to p	rovide confinement.			
Number of Locations	124	Columns		PDF Page #	23
Unit Cost of Retrofit	\$71,000	each		Figure Ref. #	MR002

Vulnerability Number	4	As-Built Dwg. File	1956-02-16_Morrison_East_App	proach.pdf		
Vulnerable Component	Bent cap			Drawing #	B16 of 68	
Description of	Bent Cap flexural s	Bent Cap flexural strength insufficient for to transfer superstructure forces into the substructure during lateral loading.				
Vulnerability	Vulnerability is the	/ulnerability is the cap can fail prematurely before column hinges.				
Proposed Retrofit	Add concrete bols	ters and doweling new	rebar for the entire cap to increa	se stiffness.		
Number of Locations	55	Bents		PDF Page #	23	
Unit Cost of Retrofit	\$95,000	each		Figure Ref. #	MR003	

Bridge Complex	Morrison			Compiled by:	TCA	Date:	4/2/2014
Bridge Name	SE Belmont St over Hwy 1 & Conns (Morrison Intchg) [Morrison]			Checked by:	KPBU	Date:	5/14/2014
Bridge Number	02758A						
Bridge Location	East Approaches						
Seismic Event	500 Yr	Desire	ed Performance Level	No Coll	apse (NC)		
Vulnerability Number	5	As-Built Dwg. File	1956-02-16_Morrison_East_A	pproach.pdf			
Vulnerable Component	Bent cap - Restrain	ners		Drawing #	B16 of 68	;	
Description of	NO dansverse or it	Jingituumai resuamus					
Vulnerability	superstructure uns	seating at the bearing	at the superstructure to substru Is.		Vunicius	inty is	
Vulnerability Proposed Retrofit	,	seating at the bearing	•				
	,	seating at the bearing	ıs.	PDF Page #	23		

Vulnerability Number	6	As-Built Dwg. File	1956-02-16_Morrison_East_App	proach.pdf	
Vulnerable Component	Superstructure bea	rings at bent caps		Drawing #	B17 of 68
Description of Vulnerability			v is this bearing type may perforn ure. Currently, the stringers are o		
Proposed Retrofit	Full bearing replac	ement with elastomeric	c pads.		
Number of Locations	69	Bents		PDF Page #	24
Unit Cost of Retrofit	\$71,000	each		Figure Ref. #	MR004

Vulnerability Number	7	As-Built Dwg. File	1956-02-16_Morris	on_East	_Approach.pdf		
Vulnerable Component	Superstructure diap	ohragms			Drawing #	E	B43 of 68
		ss brace diaphragms in vulnerability is shear f					cture. Brace members are ing lateral movement.
Proposed Retrofit	Replace bearing dia	aphragms members to	increase transverse	stiffnes	ss.		
Number of Locations	104	Diaphragm Lines			PDF Page	# 5	50
Unit Cost of Retrofit	\$71,000	each			Figure Ref.	#	MR005

Vulnerability Number	8	As-Built Dwg. File	1956-02-16_M	orrison_East_	Approach.pdf	
Vulnerable Component	Superstructure gird	lers			Drawing #	B43 of 68
Description of Vulnerability		bearing and in span l		•	ocal buckling durin	g transverse loading.
Proposed Retrofit	Add additional shea	ar stiffener plates or o	loubler plates to	the web.		
Number of Locations	104	Pier/Bent Lines			PDF Page #	50
Unit Cost of Retrofit	\$71,000	each			Figure Ref. #	MR006

Bridge Complex	Morrison			Compiled by:	TCA	Date:	4/2/2014
Bridge Name	SE Belmont St over Hwy 1 & Conns (Morrison Intchg) [Morrison]			Checked by:	KPBU	Date:	5/14/2014
Bridge Number	02758A						
Bridge Location	East Approaches						
Seismic Event	500 Yr	Desir	ed Performance Level	No Col	lapse (NC)		
Vulnerability Number	9	As-Built Dwg. File	1956-02-16_Morrison_East_A	pproach.pdf			
Vulnerable Component	In span hinge restra	Drawing #	B43 of 68				
Description of	No transverse and	longitudinal restrain	ts at in span hinges. Vulnerabili	ty is relatively larg	e gaps and	d unseat	ing during
Description of Vulnerability	No transverse and shaking.	longitudinal restrain	ts at in span hinges. Vulnerabili	ty is relatively larg	je gaps and	d unseat	ing during
,	shaking.		ts at in span hinges. Vulnerabili sverse stopper plate (similar to v				ing during
Vulnerability	shaking.						ing during

Bridge Complex	Morrison			Compiled by:	TCA	Date:	4/2/2014
Bridge Name	SE Belmont St over Hwy 1 & Conns (Morrison Intchg) [Morrison]			Checked by:	KPBU	Date:	5/14/2014
Bridge Number	02758A						
Bridge Location	East Approaches						
Seismic Event	100 Yr	Desire	ed Performance Level	No Coll	apse (NC)		
	-						
Vulnerability Number	1	As-Built Dwg. File	1956-02-16_Morrison_East_	Approach.pdf			
Vulnerable Component	Bent cap			Drawing #	B16 of 68	3	
Vulnerability	superstructure un	seating at the bearing	's.			-	
		to also w kova and la					
Proposed Retrofit	Reinforced concre	ete snear keys and lol	ngitudinal cable restraints.				
Proposed Retrofit Number of Locations	Reinforced concre	Bents	ngitudinal cable restraints.	PDF Page #	23		

Vulnerability Number	2	As-Built Dwg. File	1956-02-16 Morrison East App	proach.pdf	
Vulnerable Component	Superstructure bea	· · · ·			B17 of 68
Description of Vulnerability			is this bearing type may perforn re. Currently, the stringers are o		
Proposed Retrofit	Full bearing replace	ement with elastomeric	pads.		
Number of Locations	69	Bents		PDF Page #	24
Unit Cost of Retrofit	\$56,000	each		Figure Ref. #	MR004

Vulnerability Number	3	As-Built Dwg. File	1956-02-16_Morriso	1_East_A	Approach.pdf	
Vulnerable Component	Superstructure diap	ohragms			Drawing #	B43 of 68
Description of Vulnerability						ucture. Brace members are ring lateral movement.
Proposed Retrofit	No Retrofit needed	at 100 yr event				
Number of Locations	252	Diaphragm Lines			PDF Page #	50
Unit Cost of Retrofit	\$0	each			Figure Ref. #	MR005

Vulnerability Number	4	As-Built Dwg. File	1956-02-16_Morrison_E	East_Approach.pdf	
Vulnerable Component	In span hinge restr	aints	·	Drawing #	B43 of 68
				•	•
Description of	No transverse and	longitudinal restraints	at in span hinges. Vuln	erability is relatively lar	ge gaps and unseating during
Vulnerability	shaking.				
Proposed Retrofit	Longitudinal cable	restrainers and transve	erse stopper plate (simil	ar to wind tongues) to l	imit movement.
Number of Locations	32	Hinge Lines		PDF Page #	50
Unit Cost of Retrofit	\$75,000	each		Figure Ref. #	MR007

Bridge Complex	Hawthorne			Compiled by	: AXLI	Date:	3/26/2014
Bridge Name	Willamette River, SW Hawthorne Blvd (Hawthorne Br) [Hawthorne]			Checked by	: KPBU	Date:	5/20/2014
Bridge Number	02757D						
Bridge Location	West Approaches						
Seismic Event	1000 Yr	Desire	ed Performance Level	No Co	llapse (NC)		
Vulnerability Number	1	As-Built Dwg. File	1957-11-29 Hawthorne West Ap	proaches.pdf			
Vulnerable Component	Pile to cap connec	tion		Drawing #	F0001-01	1	
Description of Vulnerability	loading.		igular shaped cap without ancho	r rennerenng, priv	, min panoa	it under t	
	loading.						
Proposed Retrofit		nicropile around exist	ing footing, and tie to existing fo	ooting.			
Proposed Retrofit Number of Locations		nicropile around exist	ting footing, and tie to existing fo	PDF Page #	1		

Vulnerability Number	2	As-Built Dwg. File	1957-11-29 Hawthorne West Appro	oaches.pdf	
Vulnerable Component	Spread footing	•	•	Drawing #	F0001-012 to 015, 017
Description of Vulnerability	Bents 2, 3, 4, 7, 8, 9	, 10, and 11 spread foo	ting, no top layer of reinforcing i	n footings.	
Proposed Retrofit	Footing overlay on	top of footing.			
Number of Locations	24			PDF Page #	2
Unit Cost of Retrofit	\$500,000	each		Figure Ref. #	HA302

Vulnerability Number	3	As-Built Dwg. File	1957-11-29 Hawthorne West Ap	proaches.pdf	
Vulnerable Component	Abutment 3 Electri	cal Vault		Drawing #	F0001-008
Description of Vulnerability		le dowel connected to Hawthorne Bridge.	footings, vault room could col	lapse under seisn	nic loadings and afffect the
Proposed Retrofit	Add additional dov	rels.			
Number of Locations	1			PDF Page #	3
Unit Cost of Retrofit	\$100,000	each		Figure Ref. #	HA303

Vulnerability Number	4	As-Built Dwg. File	1957-11-29 Hawthorn	ne West Appro	oaches.pdf	
Vulnerable Component	Connections - Bent	s columns to spread	d footings		Drawing #	F0001-012 to 015, 017
Description of Vulnerability	Bents 2, 3, 4, 7, 8, 9), 10, and 11 columns	s to spread footings co	onnections, in	adequate reinf	orcing embedment length.
Proposed Retrofit	Column Jacketing,	add rebar doweled i	into footing Cost incl	luded with Vul	Inerability 6	
Number of Locations	24				PDF Page #	4
Unit Cost of Retrofit	\$0	each			Figure Ref. #	HA304

Bridge Complex	Hawthorne		Compiled by:		Date:	3/26/2014
Bridge Name	·	W Hawthorne Blvd (Hawthorne Br) [Hawthorne]	Checked by:	KPBU L	Date:	5/20/2014
Bridge Number	02757D					
Bridge Location	West Approaches					
Seismic Event	1000 Yr	Desired Performance Level	No Col	lapse (NC)		
Vulnerability Number	5	As-Built Dwg. File 1957-11-29 Hawthorne West A	oproaches.pdf			
Vulnerable Component	Connections - Abut	Connections - Abutments to spread footings)08	
1		· · · · · · · · · · · · · · · · · · ·	· 5			
Description of Vulnerability	Abutments 1, 2, and for all three abutme	d 3 to spread footing connections, inadequate reinfo	rcing embedment	length. Total	abutn	nent length

Number of Locations	3		PDF Page #	5
Unit Cost of Retrofit	\$100,000	each	Figure Ref. #	HA305

Vulnerability Number	6	As-Built Dwg. File	1957-11-29 Hawthorne West A	Approaches.pdf	
Vulnerable Component	Bents columns			Drawing #	F0001-011-017
Description of Vulnerability	Inadequate shear c. Bents 3, 4, 7, 8, 9, 1		dia.), 2 (3ft sq.) and 5 (2ft dia	ı.) columns; inadeq	uate flexural capacity for
Proposed Retrofit	Encase Columns or	r add shear walls.			
Number of Locations	35			PDF Page #	6
Unit Cost of Retrofit	\$75,000	each		Figure Ref. #	HA306

Vulnerability Number	7	As-Built Dwg. File	1957-11-29 Hawthorne West Appr	oaches.pdf	
Vulnerable Component	Seat Widths			Drawing #	F0001-019
Description of Vulnerability	Marginal seat width	s, Pier 7, Bents 1 to 5,	Bents 7 to 9, Bents 10 to 11, Abu	itments 1 to 3, to	otal 830ft.
Proposed Retrofit	Concrete seat exter	nsion or steel seat exte	nsion.		
Number of Locations	14			PDF Page #	7
Unit Cost of Retrofit	\$75,000	each		Figure Ref. #	HA307

Vulnerability Number	8	As-Built Dwg. File	1957-11-29 Hawthorne We	est Approaches.pdf	
Vulnerable Component	Cap Beams			Drawing #	F0001-013, 014, 015, 017
Description of Vulnerability		0 and 11 cap beams, ca eam length shown here		otected members if co	lumns fail in flexure. Total
Proposed Retrofit	Enlarge cap beam t	o increase capacity.			
Number of Locations	7			PDF Page #	9
Unit Cost of Retrofit	\$150,000	each		Figure Ref. #	HA309

Bridge Complex	Hawthorne			Compiled by	/: AXLI	Date:	3/26/2014
Bridge Name	Willamette River, SW Hawthorne Blvd (Hawthorne Br) [Hawthorne]			Checked by	KPBU	Date:	5/20/2014
Bridge Number	02757D						
Bridge Location	West Approaches						
Seismic Event	500 Yr	Desire	ed Performance Level	No Co	llapse (NC)	
Vulnerability Number	1	As-Built Dwg. File	1957-11-29 Hawthorne West Ap	proaches.pdf			
Vulnerable Component	Pile to cap connect	tion		Drawing #	F0001-01	11	
Description of	Bent 1: Only 1ft nil	le embedment in trian	ogular shaned can without ancho	r reinforcina: nil	o will nullo	ut under e	soismic
Description of Vulnerability	Bent 1: Only 1ft pil loading.	e embedment in triar	ngular shaped cap without ancho	r reinforcing; pil	e will pullo	ut under s	seismic
	loading.		ngular shaped cap without ancho ting footing, and tie to existing fo		e will pullo	ut under s	seismic
Vulnerability	loading.				e will pullo	ut under s	seismic

Vulnerability Number	2	As-Built Dwg. File	1957-11-29 Hawthorne West Appr	oaches.pdf	
Vulnerable Component	Spread footing			Drawing #	F0001-012 to 015, 017
Description of Vulnerability	Bents 2, 3, 4, 7, 8, 9	, 10, and 11 spread foo	ting, no top layer of reinforcing i	in footings.	·
Proposed Retrofit	Footing overlay on	top of footing.			
Number of Locations	24			PDF Page #	2
Unit Cost of Retrofit	\$475,000	each		Figure Ref. #	HA302

Vulnerability Number	3	As-Built Dwg. File	1957-11-29 Hawthorne West App	roaches.pdf		
Vulnerable Component	Abutment 3 Electric	al Vault		Drawing #	F0001-008	
Description of Vulnerability Thin wall with single dowel connected to footings, vault room could collapse under seismic loadings and afflect the electrical supply to Hawthorne Bridge.						
Proposed Retrofit	Add additional dow	rels.				
Number of Locations	1			PDF Page #	3	
Unit Cost of Retrofit	\$95,000	each		Figure Ref. #	HA303	

Vulnerability Number	4	As-Built Dwg. File	1957-11-29 Hawthorne West Appr	oaches.pdf				
Vulnerable Component	Connections - Bent	Connections - Bents columns to spread footings Drawing # F0001-012 to 015, 017						
Description of Bents 2, 3, 4, 7, 8, 9, 10, and 11 columns to spread footings connections, inadequate reinforcing embedment length.								
Proposed Retrofit	Proposed Retrofit Column Jacketing, add rebar doweled into footing Cost included with Vulnerability 6							
Number of Locations	24			PDF Page #	4			
Unit Cost of Retrofit	\$0	each		Figure Ref. #	HA304			

Bridge Complex	Hawthorne		Compiled by:	AXLI Date	e: 3/26/2014
Bridge Name	Willamette River, S	W Hawthorne Blvd (Hawthorne Br) [Hawthorne]	Checked by:	KPBU Date	e: 5/20/2014
Bridge Number	02757D				
Bridge Location	West Approaches				
Seismic Event	500 Yr	Desired Performance Level	No Col	lapse (NC)	
Vulnerability Number	5	As-Built Dwg. File 1957-11-29 Hawthorne West A	pproaches.pdf		
Vulnerable Component	Connections - Abut	ments to spread footings	Drawing #	F0001-006-008	
		• •			
Description of Vulnerability	Abutments 1, 2, and for all three abutme	<i>3 to spread footing connections, inadequate reinfonts are 201ft.</i>	prcing embedment	length. Total ab	utment length

Number of Locations	3		PDF Page #	5
Unit Cost of Retrofit	\$95,000	each	Figure Ref. #	HA305
				,

Vulnerability Number	6	As-Built Dwg. File	1957-11-29 Hawthorne Wes	t Approaches.pdf			
Vulnerable Component	Bents columns			Drawing #	F0001-011-017		
Description of Inadequate shear capacity for Bents 1 (2ft dia.), 2 (3ft sq.) and 5 (2ft dia.) columns; inadequate flexural capacity for Bents 3, 4, 7, 8, 9, 10 and 11 (3ft sq.).							
Proposed Retrofit	Proposed Retrofit Encase Columns or add shear walls.						
Number of Locations	35			PDF Page #	6		
Unit Cost of Retrofit	\$71,000	each		Figure Ref. #	HA306		

Vulnerability Number	7	As-Built Dwg. File	1957-11-29 Hawthorne West Appro	paches.pdf	
Vulnerable Component	Seat Widths			Drawing #	F0001-019
Description of Vulnerability	Marginal seat width	s, Pier 7, Bents 1 to 5,	Bents 7 to 9, Bents 10 to 11, Abu	tments 1 to 3, to	otal 830ft.
Proposed Retrofit	Concrete seat exter	nsion or steel seat exte	ension.		
Number of Locations	14			PDF Page #	7
Unit Cost of Retrofit	\$71,000	each		Figure Ref. #	HA307

Vulnerability Number	8	As-Built Dwg. File	1957-11-29 Hawthorne We	est Approaches.pdf		
Vulnerable Component	Cap Beams			Drawing #	F0001-013, 014, 015, 017	
Description of Vulnerability		10 and 11 cap beams, c beam length shown her		otected members if co	lumns fail in flexure. Total	
Proposed Retrofit Enlarge cap beam to increase capacity.						
Number of Locations	7			PDF Page #	9	
Unit Cost of Retrofit	\$143,000	each		Figure Ref. #	HA309	

Bridge Complex	Hawthorne			Compiled by:	AXLI	Date:	3/26/2014
Bridge Name	Willamette River, S	W Hawthorne Blvd (H	lawthorne Br) [Hawthorne]	Checked by:	KPBU	Date:	5/20/2014
Bridge Number	02757D						
Bridge Location	West Approaches						
Seismic Event	100 Yr	Desire	ed Performance Level	No Col	lapse (NC)		
Vulnerability Number	1	As-Built Dwg. File	1957-11-29 Hawthorne West App	proaches.pdf			
Vulnerable Component	Pile to cap connect	tion		Drawing #	F0001-011		
Description of Vulnerability	loading.	e embeument in than	ngular shaped cap without anchor	reinforcing, pile	will pullou	t under a	seisiilic
	g.						
Proposed Retrofit	No retrofit needed a	at 100 yr event					
Proposed Retrofit Number of Locations		at 100 yr event		PDF Page #	1		

Vulnerability Number	2	As-Built Dwg. File	1957-11-29 Hawth	orne West Appr	oaches.pdf		
Vulnerable Component	Spread footing		-		Drawing #	F0001-012 to 015, 017	
Description of Bents 2, 3, 4, 7, 8, 9, 10, and 11 spread footing, no top layer of reinforcing in footings. Footing could crack under Vulnerability seismic loading, but should not fail.							
Proposed Retrofit	Proposed Retrofit No retrofit needed at 100 yr event						
Number of Locations	24				PDF Page #	2	
Unit Cost of Retrofit	\$0	each			Figure Ref. #	HA302	

Vulnerability Number	3	As-Built Dwg. File	1957-11-29 Hawthorne	West Appro	paches.pdf	
Vulnerable Component	Bents columns				Drawing #	F0001-011-017
Description of Vulnerability	Inadequate shear ca Bents 3, 4, 7, 8, 9, 10	• • •	t dia.), 2 (3ft sq.) and 5 ((2ft dia.) co	olumns; inadequ	uate flexural capacity for
Proposed Retrofit	No retrofit needed a	it 100 yr event				
Number of Locations	35				PDF Page #	6
Unit Cost of Retrofit	\$0	each			Figure Ref. #	HA306

Vulnerability Number	4	As-Built Dwg. File	1957-11-29 Hawthorne West	Approaches.pdf	
Vulnerable Component	Cap Beams			Drawing #	F0001-013, 014, 015, 017
Description of Vulnerability		0 and 11 cap beams, c eam length shown her	ap beams are capacity prote e).	ected members if co	lumns fail in flexure. Total
Proposed Retrofit	No retrofit needed a	at 100 yr event			
Number of Locations Unit Cost of Retrofit	7 \$0	each		PDF Page # Figure Ref. #	9 HA309

Bridge Complex	Hawthorne			Compiled by	C AXLI	Date:	3/26/2014
Bridge Name	Willamette River, S	Willamette River, SW Hawthorne Blvd (Hawthorne Br) [Hawthorne]			<pre>KPBU</pre>	Date:	5/20/2014
Bridge Number	02757D						
Bridge Location	West Approaches						
Seismic Event	100 Yr	Desire	ed Performance Level	No Co	llapse (NC)		
Vulnerability Number	5	As-Built Dwg. File	1957-11-29 Hawthorne West A	pproaches.pdf			
Vulnerable Component	Seat Widths			Drawing #	F0001-019)	
Description of Vulnerability	marginai seat widti	is, Pier 7, Benis 7 to	5, Bents 7 to 9, Bents 10 to 11, A	Abulments T to 3,	10181 63011.		
Proposed Retrofit	Concrete seat exte	nsion or steel seat ex	xtension.				
Number of Locations	14			PDF Page #	7		
Unit Cost of Retrofit	\$56,000	each		Figure Ref. #	HA307		

Bridge Complex	Hawthorne			Compiled by:	AJCA	Date:	3/26/2014
Bridge Name	Willamette River, Hawthorne Ave [Hawthorne]			Checked by:	kpbu	Date:	5/20/2014
Bridge Number	02757						
Bridge Location	Fixed River Spans						
Seismic Event	1000 Yr	Desired	Performance Level	No Col	lapse (NC)		
Vulnerability Number	1	As-Built Dwg. File	1909_XX_XX_Hawthorne_Br_Ma	ain_Span.pdf			
Vulnerable Component	Bearings for Piers	1-4 7		Drawing #	C0002-01	0	

vuinerable Component					
Description of Vulnerability	Existing bearings a	re vulnerable to topple off their piers during an earthqu	nake.	<u>.</u>	
Proposed Retrofit	System Retrofit - In	stall Base Isolation Bearings			
Number of Locations	10		PDF Page #	10 of 43	
Unit Cost of Retrofit	\$500,000	each	Figure Ref. #	HA101	

Vulnerability Number	2	As-Built Dwg. File	1909_XX_XX_Hawthorne_Br_M	lain_Span.pdf		
Vulnerable Component	Superstructure pull	ing off Piers 1-4, 7		Drawing #	C0002-010	
Description of No transverse restraints at any of the existing piers . Vulnerability						
Proposed Retrofit Insall shear lugs on top of pier walls						
Number of Locations	5			PDF Page #	10 of 43	
Unit Cost of Retrofit	\$75,000	each		Figure Ref. #	HA101	

Vulnerability Number	3	As-Built Dwg. File	1909_XX_XX_	Hawthorne_Br_M	lain_Span.pdf	
Vulnerable Component	Piles at Piers 1 & 7				Drawing #	C0002-002
Description of Vulnerability	Liquifiable soils at	bents 1 & 7			<u> </u>	
Proposed Retrofit	Soil Densificaton					
Number of Locations	2	bridge site			PDF Page #	2 of 43
Unit Cost of Retrofit	\$7,000,000	each			Figure Ref. #	NA

Vulnerability Number	4	As-Built Dwg. File	1909_XX_XX_	Hawthorne_Br_M	lain_Span.pdf	
Vulnerable Component	Bottom Chord later	al bracing spans 1-4, 6			Drawing #	C0002-006
Description of Vulnerability	Lateral bracing ove	rstressed during earth	quake. (3 end	panels of each s _l	oan)	
Proposed Retrofit	Strengthening of bo span members	ottom chord bracing in	cluding conne	ctions. System F	Retrofit - Base Is	olation will reduce forces in lift
Number of Locations	30				PDF Page #	6 of 43
Unit Cost of Retrofit	\$500,000	each			Figure Ref. #	HA102

Bridge Complex	Hawthorne			Compiled by	AJCA	ate: 3/26/201
Bridge Name	Willamette River, Hawthorne Ave [Hawthorne]			Checked by	kpbu D	ate: 5/20/201
Bridge Number	02757					
Bridge Location	Fixed River Spans					
Seismic Event	1000 Yr	Desire	ed Performance Level	No Col	lapse (NC)	
Vulnerability Number	5	As-Built Dwg. File	1909_XX_XX_Hawthorne_	Br_Main_Span.pdf		
Vulnerable Component	Existing Piers			Drawing #	C0002-002	
Vulnerability			not adequate for carrying for			
Proposed Retrofit	Strengthen Piers s	teel confinement jack	tets at base of piers System F	Retrofit - Base Isolat	ion will lesser	the forces into
	une substructure					
Number of Locations	5	1		PDF Page #	2 of 43	

Bridge Complex	Hawthorne		Compiled by: AJCA	Date:	3/26/2014
Bridge Name	Willamette River, H	awthorne Ave [Hawthorne]	Checked by: kpbu	Date:	5/20/2014
Bridge Number	02757				
Bridge Location	Fixed River Spans				
Seismic Event	500 Yr	Desired Performance Level	No Collapse (NC))	
		•			
Vulnerability Number	1	As-Built Dwg File 1909 XX XX Hawthorne Br M	ain. Snan ndf		

Vulnerability Number	1	As-Built Dwg. File	1909_XX_XX_Hawthorne_Br_M	ain_Span.pdf	
Vulnerable Component	Bearings for Piers	1-4, 7		Drawing #	C0002-010
Description of Vulnerability	Existing bearings a	re vulnerable to toppl	e off their piers during an earthqu	iake.	
Proposed Retrofit	System Retrofit - Ir	stall Base Isolation B	learings		
Number of Locations	10			PDF Page #	10 of 43
Unit Cost of Retrofit	\$475,000	each		Figure Ref. #	HA101

Vulnerability Number	2	As-Built Dwg. File	1909_XX_XX_	Hawthorne_	Br_Main_Span.pdf	
Vulnerable Component	Superstructure pull	ing off Piers 1-4, 7			Drawing #	C0002-010
Description of No transverse restraints at any of the existing piers. Vulnerability						
Proposed Retrofit	Insall shear lugs on top of pier walls					
Number of Locations	5				PDF Page #	10 of 43
Unit Cost of Retrofit	\$71,000	each			Figure Ref. #	HA101

Vulnerability Number	3	As-Built Dwg. File	1909_XX_XX_Hawthorne_Br_M	/lain_Span.pdf			
Vulnerable Component	Piles at Piers 1 &	7		Drawing #	C0002-002		
Description of Liquifiable soils at bents 1 & 7 Vulnerability							
Proposed Retrofit	Soil Densificaton						
Number of Locations	2	bridge site		PDF Page #	2 of 43		
Unit Cost of Retrofit	\$6,650,000	each		Figure Ref. #	NA		

Vulnerability Number	4	As-Built Dwg. File	1909 XX XX H	awthorne Br Ma	ain_Span.pdf				
Vulnerable Component	Bottom Chord later	Dattom Chord lateral bracing spans 1-4, 6 Drawing # C0002-006							
Description of Vulnerability	Lateral bracing ove	rstressed during earth	quake. (3 end pa	nels of each spa	an)				
Proposed Retrofit	Strengthening of bo span members	Strengthening of bottom chord bracing including connections. System Retrofit - Base Isolation will reduce forces in lift span members							
Number of Locations	30				PDF Page #	6 of 43			
Unit Cost of Retrofit	\$475,000	each			Figure Ref. #	HA102			

Bridge Complex	Hawthorne				Compiled by:	AJCA	Date:	3/26/2014
Bridge Name	Willamette River, H	Willamette River, Hawthorne Ave [Hawthorne]			Checked by:	kpbu	Date:	5/20/2014
Bridge Number	02757							
Bridge Location	Fixed River Spans							
-	-							
Vulnerability Number	5	As-Built Dwg. File	1909_XX_XX_	Hawthorne_Br_Ma	ain_Span.pdf			
Vulnerable Component	Existing Piers				Drawing #	C0002-0	02	
Vulnerability								
Proposed Retrofit	Strengthen Piers st the substructure	teel confinement jacke	ts at base of pie	rs System Retrof	it - Base Isolati	on will le:	ssen the fe	orces into
	the substructure	eel confinement jacke	ts at base of pie				ssen the fo	orces into
Proposed Retrofit Number of Locations Unit Cost of Retrofit		eel confinement jacke	ets at base of pie		it - Base Isolati PDF Page # Figure Ref. #	on will les 2 of 43 HA104	ssen the fo	orces into

Bridge Complex	Hawthorne	awthorne				Date:	3/26/2014
Bridge Name	Willamette River, H	Willamette River, Hawthorne Ave [Hawthorne]			kpbu	Date:	5/20/2014
Bridge Number	02757						
Bridge Location	Fixed River Spans						
Seismic Event	100 Yr	Desired	Performance Level	No Coll	apse (NC)		
Vulnerability Number	1	As-Built Dwg. File					
Vulnerable Component	Bearings for Piers "	1-4, 7		Drawing #			
Description of Vulnerability	Existing bearings a	re vulnerable to topple	off their piers during an earthqu	ake.			
Proposed Retrofit	Install catcher bloc	ks and restrainers					

Number of Locations	10		PDF Page #	
Unit Cost of Retrofit	\$75,000	each	Figure Ref. #	HA101

Vulnerability Number	2	As-Built Dwg. File						
Vulnerable Component	Superstructure pull	ing off Piers 1-4, 7		Drawing #				
Description of	No transverse restraints at any of the existing piers.							
Vulnerability								
Proposed Retrofit	Insall shear lugs on	top of pier walls						
Number of Locations	5			PDF Page #				
Unit Cost of Retrofit	\$56,000	each		Figure Ref. #	HA101			

Bridge Complex	Hawthorne			Compiled by:	AJCA	Date:	3/26/2014
Bridge Name	Willamette River, Hawthorne Ave [Hawthorne]			Checked by:	kpbu	Date:	5/20/2014
Bridge Number	02757						
Bridge Location	Moveable Span						
Seismic Event	1000 Yr	Desir	ed Performance Level	No Col	lapse (NC	;)	
Vulnerability Number	1	As-Built Dwg. File	1909_XX_XX_Hawthorne_Br	_Main_Span.pdf			
Vulnerable Component	Bearings for Piers	5-6		Drawing #			
Description of Vulnerability			ole off their piers during an earth				
Proposed Retrofit	Install Isolation Be	arings					
Number of Locations	4			PDF Page #			

Vulnerability Number	2	As-Built Dwg. File	1909_XX_XX_Hawthorne_Br_Ma	ain_Span.pdf				
Vulnerable Component	Superstructure pull	ing off Piers 5-6		Drawing #				
				•	·			
Description of	No transverse restr	o transverse restraints at any of the existing piers.						
Vulnerability								
Proposed Retrofit	Insall shear lugs on	top of pier walls						
Number of Locations	2			PDF Page #				
Unit Cost of Retrofit	\$75,000	each		Figure Ref. #	HA101			

Vulnerability Number	3	As-Built Dwg. File	1909_XX_XX_Ha	wthorne_Br_Ma	ain_Span.pdf		
Vulnerable Component	Bottom Chord later	al bracing Span 5			Drawing #	C0002-004	
Description of Lateral bracing overstressed during earthquake. (3 end panels of each span) Vulnerability							
Proposed Retrofit	Strengthening of bottom chord bracing including connections. System Retrofit - Base Isolation will reduce forces in lift span members						
Number of Locations	6				PDF Page #	4 of 43	
Unit Cost of Retrofit	\$500,000	each			Figure Ref. #	HA102	

Vulnerability Number	4	As-Built Dwg. File	1909_XX_XX_Hawthorne_Br_M	ain_Span.pdf	
Vulnerable Component	Towers at Bents 5 &	6	•	Drawing #	C0002-004
Description of Vulnerability	Towers are not ade will require strengtl		rces from counterweights. Both	n front and back	legs and transverse braces
Proposed Retrofit	Replace or strength	en existing members.	System Retrofit - install isolation	on bearings to r	educe forces in tower.
Number of Locations	2			PDF Page #	4 of 43
Unit Cost of Retrofit	\$8,000,000	each		Figure Ref. #	HA103

Bridge Complex	Hawthorne			Compiled by	AJCA Dat	e: 3/26/2014
Bridge Name	Willamette River,	Hawthorne Ave [Hawt	horne]	Checked by	kpbu Dat	e: 5/20/2014
Bridge Number	02757					
Bridge Location	Moveable Span					
Seismic Event	1000 Yr	Desire	ed Performance Level	No Col	lapse (NC)	
Vulnerability Number	5	As-Built Dwg. File	1909_XX_XX_Hawthorne	Br_Main_Span.pdf		
Vulnerable Component	Existing Piers			Drawing #	C0002-003	
Description of Vulnerability	Fiers 5 and 6 are		adequate for carrying forces	nom superstructure	into piles.	
Proposed Retrofit	Strengthen Piers the substructure	steel confinement jack	xets at base of piers System	Retrofit - Base Isolat	ion will lessen t	he forces into
Number of Locations	2			PDF Page #	3 of 43	

Bridge Complex	Hawthorne			Compiled by:	AJCA	Date:	3/26/2014
Bridge Name	Willamette River, H	lawthorne Ave [Hawth	norne]	Checked by:	kpbu	Date:	5/20/2014
Bridge Number	02757						
Bridge Location	Moveable Span						
Seismic Event	500 Yr	Desire	ed Performance Level	No Coll	apse (NC)	
Vulnerability Number	1	As-Built Dwg. File	1909_XX_XX_Hawthorne_Br	_Main_Span.pdf			
Vulnerable Component	Bearings for Piers	5-6		Drawing #			
Description of Vulnerability	Existing bearings a	are vulnerable to topp	ble off their piers during an eart	hquake.			
Proposed Retrofit	Install Isolation Be	arings					

Number of Locations	4		PDF Page #	
Unit Cost of Retrofit	\$475,000	each	Figure Ref. #	HA101

Vulnerability Number	2	As-Built Dwg. File	1909_XX_XX_Hawthorne_Br_Ma	ain_Span.pdf		
Vulnerable Component	Superstructure pull	ing off Piers 5-6		Drawing #		
Description of Vulnerability						
Proposed Retrofit	Insall shear lugs on	top of pier walls				
Number of Locations	2			PDF Page #		
Unit Cost of Retrofit	\$71,000	each		Figure Ref. #	HA101	

Vulnerability Number	3	As-Built Dwg. File	1909_XX_XX_	Hawthorne_Br_Ma	in_Span.pdf		
Vulnerable Component	Bottom Chord later	al bracing Span 5			Drawing #	C0002-004	
Description of Vulnerability							
Proposed Retrofit	Strengthening of bo span members	ottom chord bracing in	cluding conne	ctions. System Re	trofit - Base Ise	plation will reduce forces in lift	
Number of Locations	6				PDF Page #	4 of 43	
Unit Cost of Retrofit	\$475,000	each			Figure Ref. #	HA102	

Vulnerability Number	4	As-Built Dwg. File	1909_XX_XX_Hawthorne_Br_M	ain_Span.pdf	
Vulnerable Component	Towers at Bents 5 &	£ 6		Drawing #	C0002-004
Description of Vulnerability	Towers are not ade will require strengtl	• •	orces from counterweights. Both	h front and back	legs and transverse braces
Proposed Retrofit	Replace or strength	een existing members.	System Retrofit - install isolation	on bearings to r	educe forces in tower.
Number of Locations	2			PDF Page #	4 of 43
Unit Cost of Retrofit	\$7,600,000	each		Figure Ref. #	HA103

Vulnerability Number	5	As-Built Dwg. File	1909_XX_XX_Hawthorne_Br_Ma	ain_Span.pdf	
Vulnerable Component	Existing Piers			Drawing #	C0002-003
Description of	Piers 5 and 6 are ur	nreinforced and not ade	equate for carrying forces from s	uperstructure i	nto piles.
Vulnerability					
Proposed Retrofit	Strengthen Piers st	eel confinement jacket:	s at base of piers System Retrof	it - Base Isolati	on will lessen the forces into
Number of Locations	2			PDF Page #	3 of 43
Unit Cost of Retrofit	\$2,375,000	each		Figure Ref. #	HA104

-							
Bridge Complex	Hawthorne			Compiled by	AJCA	Date:	3/26/2014
Bridge Name	Willamette River, H	awthorne Ave [Hawtho	rne]	Checked by.	kpbu	Date:	5/20/2014
Bridge Number	02757						
Bridge Location	Moveable Span						
Seismic Event	100 Yr	Desired	Performance Level	No Col	lapse (NC))	
Vulnerability Number	1	As-Built Dwg. File					
Vulnerable Component	Bearings for Piers	5-6		Drawing #			
Description of Vulnerability	Existing bearings a	re vulnerable to topple	e off their piers during an eartho	juake.			
Proposed Retrofit	Install catcher bloc	ks and restrainers					
Number of Locations	4			PDF Page #			
Unit Cost of Retrofit	\$113.000	each		Figure Ref. #	HA101		

Vulnerability Number	2	As-Built Dwg. File				
Vulnerable Component	Superstructure pulling off Piers 5-6			Drawing #		
	1				•	
Description of	No transverse restr	aints at any of the exis	ting piers.			
Vulnerability						
Proposed Retrofit	Insall shear lugs on	ton of nier walls				
r roposed Retrom	moan onear rugo on	top of pier wans				
Number of Locations	2			PDF Page #		
Unit Cost of Retrofit	\$56,000	each		Figure Ref. #	HA101	

Bridge Complex	Hawthorne		Compiled by:	AJCA	Date:	3/26/2014
Bridge Name	SE Madison St Ram	p over Hwy 1E SB (SE MLK Blvd) [Hawthorne]	Checked by:	kpbu	Date:	5/20/2014
Bridge Number	02757B					
Bridge Location	East Approaches					
Seismic Event	1000 Yr	Desired Performance Level	No Colla	apse (NC)		

Vulnerability Number	1	As-Built Dwg. File	1956-1991_Hawthorne_E_Appro	oach_1991_E_T	ransition_Str.pdf
Vulnerable Component	Columns			Drawing #	47776
Description of Vulnerability		ו, 5W, 7H. Base of Colu It. Tops frame into ben	ımns frame into pile cap. Detaili t caps.	ng not sufficien	t for hinging. Fairly short
Proposed Retrofit	Existing detail may	require strengthening			
Number of Locations	32			PDF Page #	109
Unit Cost of Retrofit	\$75,000	each		Figure Ref. #	HA401

Vulnerability Number	2	As-Built Dwg. File	1956-1991_Hawthorne_E_Appro	ach 1001 E T	ransition Strndf	
· · · · · · · · · · · · · · · · · · ·		AS-Built Dwy. File				
Vulnerable Component	Pile Cap Footings			Drawing #	47776	
Description of Vulnerability	Footings may need	Footings may need to be strengthened to force hinging in the new retrofitted columns				
Proposed Retrofit	Footing overlay on	Footing overlay on top of footing, some additional micropiles may be necessary				
Number of Locations	32			PDF Page #	109	
Unit Cost of Retrofit	\$500,000	each		Figure Ref. #	HA401	

Vulnerability Number	3	As-Built Dwg. File	1956-1991	_Hawthorne_E_Appro	oach_1991_E_T	ransition_Str.pdf
Vulnerable Component	Superstructure Sea	ating on Pier 1			Drawing #	47774
Description of Vulnerability	Pier 1. Longitudina	l restraint not provided	l.			
Proposed Retrofit	Install seat extende	Install seat extenders				
Number of Locations	1				PDF Page #	107
Unit Cost of Retrofit	\$100,000	each			Figure Ref. #	HA402

Vulnerability Number	4	As-Built Dwg. File	1956-1991_Hawthorne_E_App	oach_1991_E_T	ransition_Str.pdf	
Vulnerable Component	Superstructure Con	nection at Pier 1		Drawing #	47774	
Description of Vulnerability						
Proposed Retrofit	fit Install restrainers and lateral shear lugs					
Number of Locations	1			PDF Page #	107	
Unit Cost of Retrofit	\$75,000	each		Figure Ref. #	HA403	

Bridge Complex	Hawthorne			Compiled by:	AJCA	Date:	3/26/2014
Bridge Name	SE Madison St Ran	np over Hwy 1E SB (S	E MLK Blvd) [Hawthorne]	Checked by:	kpbu	Date:	5/20/2014
Bridge Number	02757B						
Bridge Location	East Approaches						
Seismic Event	1000 Yr	Desire	ed Performance Level	No Col	lapse (NC	;)	
Vulnerability Number	5	As-Built Dwg. File	1956-1991_Hawthorne_E_Ap	proach_1991_E_T	ransition	_Str.pdf	
Vulnerable Component	Superstructure Sea	ating on Expansion B	ent	Drawing #	47784, 4	7790, 4779	96
Description of Vulnerability	,,,		off, as seismic restrainers are in				
vanierability							
Proposed Retrofit	Rehabilitate restrai	iners as needed.					
	Rehabilitate restrai	iners as needed.		PDF Page #	117		

Vulnerability Number	6	As-Built Dwg. File	1956-1991_Hawthorne_E_Appr	oach_1991_E_T	ransition_Str.pdf
Vulnerable Component	Superstructure Sea	ating on Bent 7M, 6W,	7H	Drawing #	47801
Description of Vulnerability	Abutments are vuli	nerable to pull off if so	eat width or dowels are not adequ	ate.	
Proposed Retrofit	Install seat extende	ers and lateral shear l	ugs		
Number of Locations	3			PDF Page #	133
Unit Cost of Retrofit	\$75,000	each		Figure Ref. #	HA405

Vulnerability Number	7	As-Built Dwg. File	1956-1991_Hawthorne_E_Approach_1991_E_Transition_Str.pdf				
Vulnerable Component	Columns	Columns Drawing #					
Description of Vulnerability	Bents H1 through Top of Columns fra	•	M20. Base of Columns frame into pile cap. Detailing not sufficient for hinging.				
Proposed Retrofit	Column jacketing is necessary to provide ductility, shear resistance, and lateral force resistance						
Number of Locations	86		PDF Page # 22				
Unit Cost of Retrofit	\$75,000	each	Figure Ref. # HA406				

Vulnerability Number	8	As-Built Dwg. File	1956-1991_Hawthorne_E_/	Approach_1991_E_T	ransition_Str.pdf
Vulnerable Component	Pile Cap Footings			Drawing #	
Description of Footings may need to be strengthened to force hinging in the new retrofitted columns. Vulnerability					
Proposed Retrofit	osed Retrofit Footing overlay on top of footing, some additional micropiles may be necessary				
Number of Locations	86			PDF Page #	11
Unit Cost of Retrofit	\$500,000	each		Figure Ref. #	HA407

Bridge Complex	Hawthorne			Compiled by:	AJCA	Date:	3/26/2014
Bridge Name	SE Madison St Ram	p over Hwy 1E SB (SE	E MLK Blvd) [Hawthorne]	Checked by:	kpbu	Date:	5/20/2014
Bridge Number	02757B						
Bridge Location	East Approaches						
Seismic Event	1000 Yr	Desired	l Performance Level	No Col	apse (NC)		
Vulnerability Number	9	As-Built Dwg. File	1956-1991_Hawthorne_E_App	roach_1991_E_T	ransition_S	Str.pdf	
Vulnerable Component	Superstructure Sea	ting Abutments A1, A	2, A3	Drawing #			
Description of Vulnerability	Abutments are vuir	ierable to pull off if se	at width or dowels are not adeq	uate.			
Proposed Retrofit	Install seat extende	ers and lateral shear lu	gs				
Number of Locations	3			PDF Page #	11		
Unit Cost of Retrofit	\$75,000	each		Figure Ref. #	HA408		

Bridge Complex	Hawthorne			Compiled by:	AJCA	Date:	3/26/2014
Bridge Name	SE Madison St Ra	mp over Hwy 1E SB (S	E MLK Blvd) [Hawthorne]	Checked by:	kpbu [Date:	5/20/2014
Bridge Number	02757B						
Bridge Location	East Approaches						
Seismic Event	500 Yr	Desire	ed Performance Level	No Col	lapse (NC)		
	-			•			
Vulnerability Number	1	As-Built Dwg. File	1956-1991_Hawthorne_E	Approach_1991_E_T	ransition_St	r.pdf	
Vulnerable Component	Columns			Drawing #	47776	-	
Description of Vulnerability	-	M, 5W, 7H. Base of Co out. Tops frame into be	olumns frame into pile cap. I ent caps.	Detailing not sufficier	nt for hinging	. Fairl	y short

Vulnerability Number	2	As-Built Dwg. File	1956-1991_Hawthorne_E_Appro	ach_1991_E_Ti	ransition_Str.pdf	
Vulnerable Component	Pile Cap Footings			Drawing #	47776	
Description of Footings may need to be strengthened to force hinging in the new retrofitted columns Vulnerability						
Proposed Retrofit	trofit Footing overlay on top of footing, some additional micropiles may be necessary					
Number of Locations	32			PDF Page #	109	
Unit Cost of Retrofit	\$475,000	each		Figure Ref. #	HA401	

PDF Page # Figure Ref. #

109 HA401

Number of Locations Unit Cost of Retrofit

32 \$71,000

each

Vulnerability Number	3	As-Built Dwg. File	1956-1991_Hawthorne_E_Appro	oach_1991_E_T	ransition_Str.pdf	
Vulnerable Component	Superstructure Sea	uperstructure Seating on Pier 1 Drawing # 47774				
Description of Vulnerability						
Proposed Retrofit	Install seat extenders					
Number of Locations	1			PDF Page #	107	
Unit Cost of Retrofit	\$95,000	each		Figure Ref. #	HA402	

Vulnerability Number	4	As-Built Dwg. File	1956-1991_Hawthorne_E_A	Approach_1991_E_T	ransition_Str.pdf
Vulnerable Component	Superstructure Con	nnection at Pier 1		Drawing #	47774
Description of Vulnerability	Pier 1. No transver	se restraint provided.	No shear lugs present.		
Proposed Retrofit	Install restrainers a	nd lateral shear lugs			
Number of Locations	1			PDF Page #	107
Unit Cost of Retrofit	\$71,000	each		Figure Ref. #	HA403

Bridge Complex	Hawthorne			Compiled by	AJCA	Date:	3/26/2014
Bridge Name	SE Madison St Ramp over Hwy 1E SB (SE MLK Blvd) [Hawthorne]			Checked by	kpbu	Date:	5/20/2014
Bridge Number	02757B						
Bridge Location	East Approaches						
Seismic Event	500 Yr	Desire	ed Performance Level	No Co	lapse (NC)		
				•			
Vulnerability Number	5	As-Built Dwg. File	1956-1991_Hawthorne_E_Ap	proach_1991_E_1	ransition_	Str.pdf	
Vulnerable Component	Superstructure Se	ating on Expansion B	Bent	Drawing #	47784, 47	790, 4779	6
Vulnerability							
Proposed Retrofit	Rehabilitate restra	ainers as needed.					
Number of Locations	3			PDF Page #	117		

Vulnerability Number	6	As-Built Dwg. File	1956-1991	Hawthorne_E_Appro	ach_1991_E_T	ransition_Str.pdf
Vulnerable Component	Superstructure Sea	ting on Bent 7M, 6W, 7	Ή		Drawing #	47801
Description of Vulnerability	Abutments are vuln	erable to pull off if sea	at width or a	owels are not adequa	te.	
Proposed Retrofit	Install seat extende	rs and lateral shear lu	gs			
Number of Locations	3				PDF Page #	133
Unit Cost of Retrofit	\$71,000	each			Figure Ref. #	HA405

Vulnerability Number	7	As-Built Dwg. File	1956-1991_Hawthorne_E_	Approach_1991_E_T	ransition_Str.pdf					
Vulnerable Component	Columns	Columns Drawing #								
Description of Bents H1 through H21 and M1 through M20. Base of Columns frame into pile cap. Detailing not sufficient for hinging. Vulnerability Top of Columns frame into Bent Cap.										
Proposed Retrofit	Column jacketing is	Column jacketing is necessary to provide ductility, shear resistance, and lateral force resistance								
Number of Locations	86			PDF Page #	22					
Unit Cost of Retrofit	\$71,000	each		Figure Ref. #	HA406					

Vulnerability Number	8	As-Built Dwg. File	1956-1991_Hawthorne_E_A	pproach_1991_E_T	ransition_Str.pdf					
Vulnerable Component	Pile Cap Footings	Pile Cap Footings Drawing #								
Description of Vulnerability										
Proposed Retrofit	Proposed Retrofit Footing overlay on top of footing, some additional micropiles may be necessary									
Number of Locations	86			PDF Page #	11					
Unit Cost of Retrofit	\$475,000	each		Figure Ref. #	HA407					

Bridge Complex	Hawthorne			Compiled by:	AJCA Dat	te: 3/26/2014
Bridge Name	SE Madison St Ramp over Hwy 1E SB (SE MLK Blvd) [Hawthorne]			Checked by:	kpbu Dat	te: 5/20/2014
Bridge Number	02757B					
Bridge Location	East Approaches					
Seismic Event	500 Yr	Desire	ed Performance Level	No Coll	apse (NC)	
Vulnerability Number	9	As-Built Dwg. File	1956-1991_Hawthorne_E_Ap	proach_1991_E_T	ransition_Str.p	df
Vulnerable Component	Superstructure Se	ating Abutments A1, A	A2, A3	Drawing #		
Description of Vulnerability	Abutments are vui	nerable to pull off if s	eat width or dowels are not ade	quate.		
Proposed Retrofit	Install seat extend	ers and lateral shear l	lugs			
Number of Locations	3			PDF Page #	11	
Unit Cost of Retrofit	\$71,000	each		Figure Ref. #	HA408	

Bridge Complex	Hawthorne	Hawthorne			AJCA	Date:	3/26/2014
Bridge Name	SE Madison St Rai	SE Madison St Ramp over Hwy 1E SB (SE MLK Blvd) [Hawthorne]			ː kpbu	Date:	5/20/2014
Bridge Number	02757B						
Bridge Location	East Approaches						
Seismic Event	100 Yr	Desire	ed Performance Level	No Co	llapse (NC)		
			_				
Vulnerability Number	1	As-Built Dwg. File	1956-1991_Hawthorne_E_Appro	oach_1991_E_1	Fransition_	Str.pdf	
Vulnerable Component	Superstructure Se	ating on Pier 1		Drawing #	47774		
Description of Vulnerability	Pier 1. Longitudina	al restraint not provid	ed.				

Proposed Retrofit	Install seat extende	rs		
Number of Locations	1		PDF Page #	107
Unit Cost of Retrofit	\$56,000	each	Figure Ref. #	HA402

Vulnerability Number	2	As-Built Dwg. File	1956-1991_Hawthorne_	E_Approach_1991_E_T	ransition_Str.pdf			
Vulnerable Component	Superstructure Con	perstructure Connection at Pier 1 Drawing # 47774						
Description of Vulnerability	Pier 1. No transver	se restraint provided.	No shear lugs present.					
Proposed Retrofit	Install restrainers a	nd lateral shear lugs						
Number of Locations	1			PDF Page #	107			
Unit Cost of Retrofit	\$56,000	each		Figure Ref. #	HA403			

Vulnerability Number	3	As-Built Dwg. File	1956-1991_Ha	wthorne_E_Ap	proach_1991_E_T	ransition_Str.pdf
Vulnerable Component	Superstructure Sea	ating on Expansion Ber	nt		Drawing #	47784, 47790, 47796
Description of	Bent 4M, 4W, 4H ha	ave a low risk of pull of	t, as seismic re	strainers are in	istalled, adequacy	is not certain.
Vulnerability						
Proposed Retrofit	Rehabilitate restra	iners as needed.				
Number of Landiana	-				DD5 D #	447
Number of Locations	3				PDF Page #	117
Unit Cost of Retrofit	\$75,000	each			Figure Ref. #	HA404

Vulnerability Number	4	As-Built Dwg. File	1956-1991	_Hawthorne_E_Appro	oach_1991_E_1	ransition_Str.pdf
Vulnerable Component	Superstructure Se	ating on Bent 7M, 6W, 1	7H		Drawing #	47801
Description of Vulnerability	Abutments are vul	nerable to pull off if se	at width or a	owels are not adequa	nte.	
Proposed Retrofit	Install seat extend	ers and lateral shear lu	gs			
Number of Locations	3				PDF Page #	133
Unit Cost of Retrofit	\$56,000	each			Figure Ref. #	HA405

Bridge Complex	Hawthorne			Compiled by:		Date:	3/26/2014
Bridge Name	SE Madison St Ramp over Hwy 1E SB (SE MLK Blvd) [Hawthorne]			Checked by:	kpbu	Date:	5/20/2014
Bridge Number	02757B						
Bridge Location	East Approaches						
Seismic Event	100 Yr	Desire	d Performance Level	No Col	lapse (NC)		
Vulnerability Number	5	As-Built Dwg. File	1956-1991_Hawthorne_E_Ap	proach_1991_E_T	ransition_S	tr.pdf	
Vulnerable Component	Superstructure Sea	ating Abutments A1, A	2, A3	Drawing #			
Description of Vulnerability	Abutments are vul	nerable to pull off if se	eat width or dowels are not adec	juate.			
Proposed Retrofit	Install seat extend	ers and lateral shear lu	ugs				
Number of Locations	3			PDF Page #	11		
Unit Cost of Retrofit	\$56,000	each		Figure Ref. #	HA408		

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Attachment B

Vulnerability Figures

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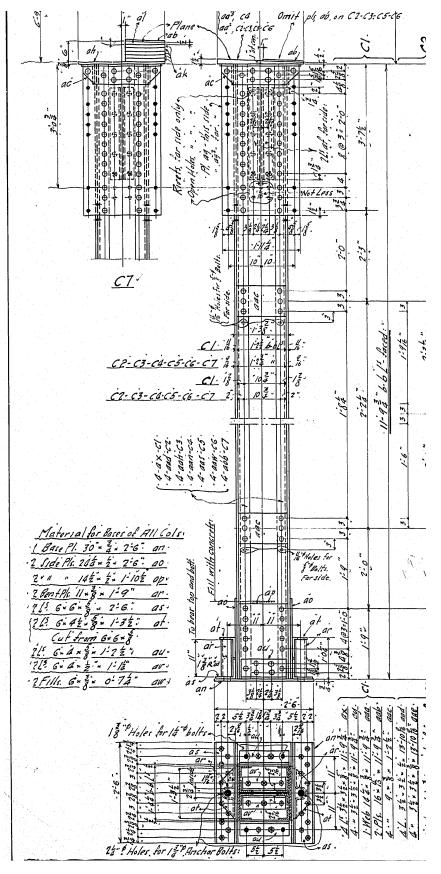


Figure BW001: Steel columns detail

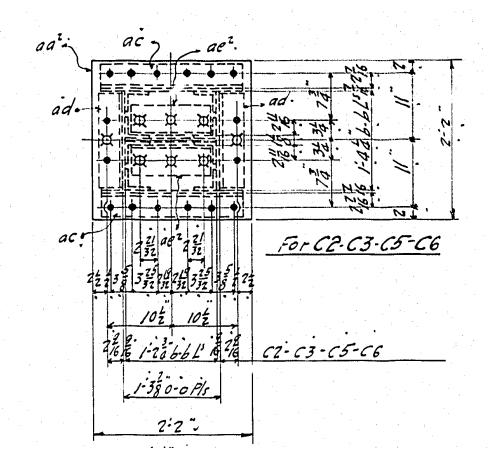
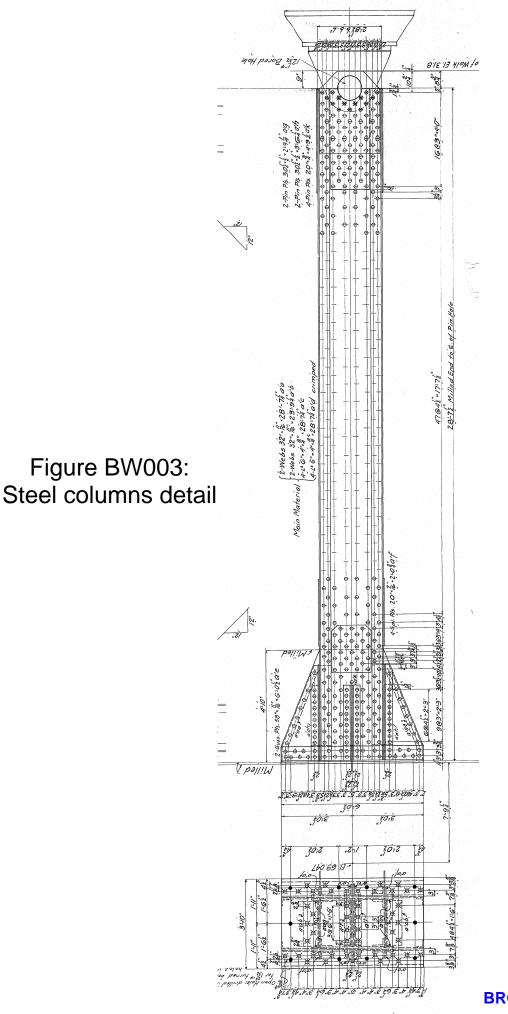
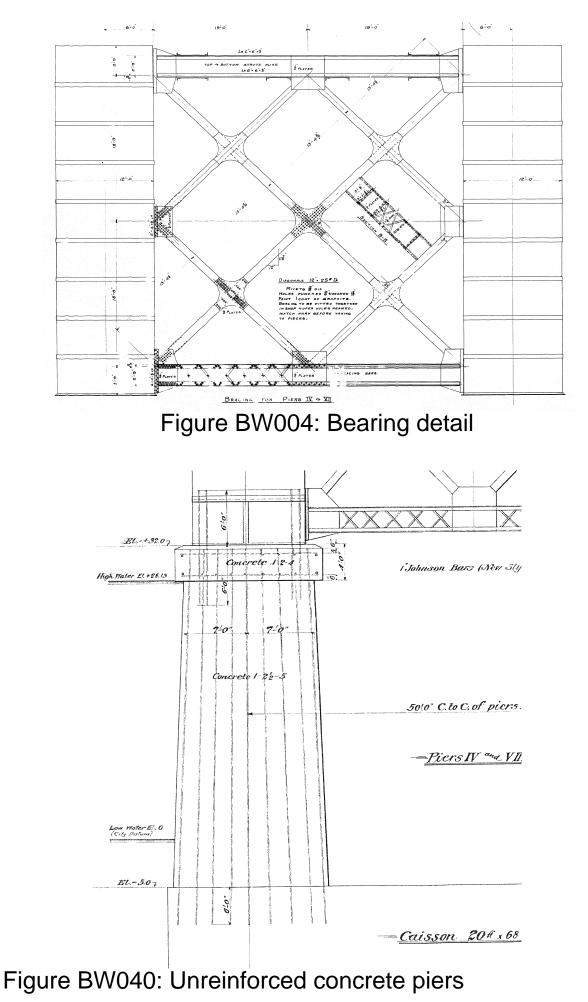


Figure BW002: Superstructure expansion bearing seats



BROADWAY FIGURES



BROADWAY FIGURES

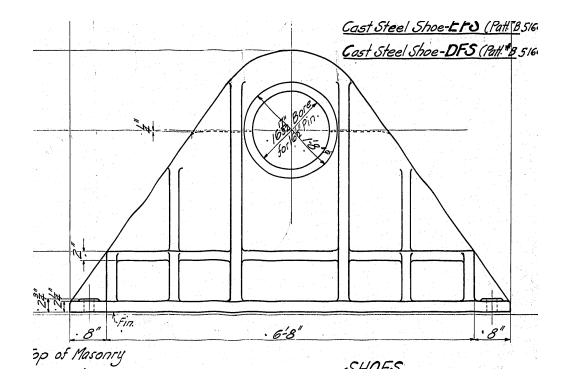


Figure BW050: Moveable span bearings

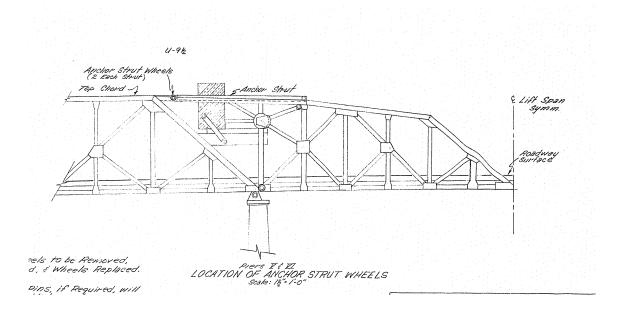


Figure BW051: Moveable span anchor strut

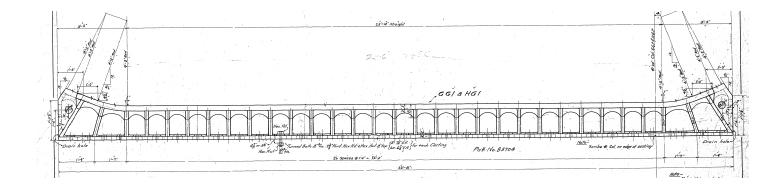


Figure BW052: Rall wheel track

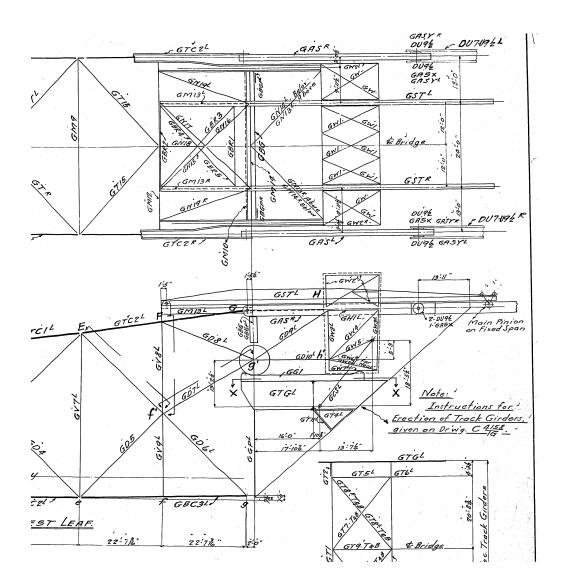
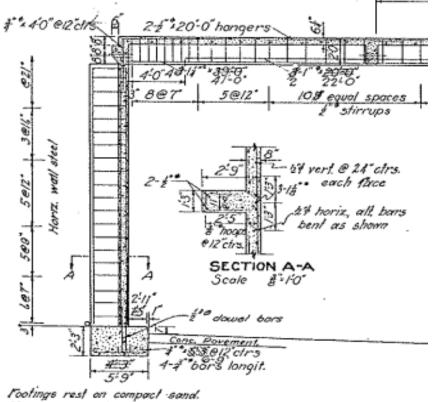


Figure BW053: Truss frame at rall wheels

BROADWAY FIGURES



Max. bearing 4000%

1_

Figure BW92: Abutment joint

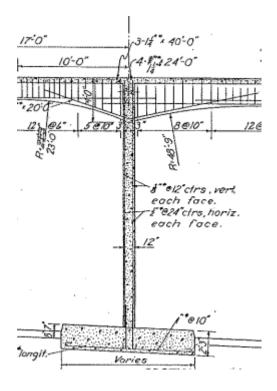


Figure BW93: Interior pier wall joint

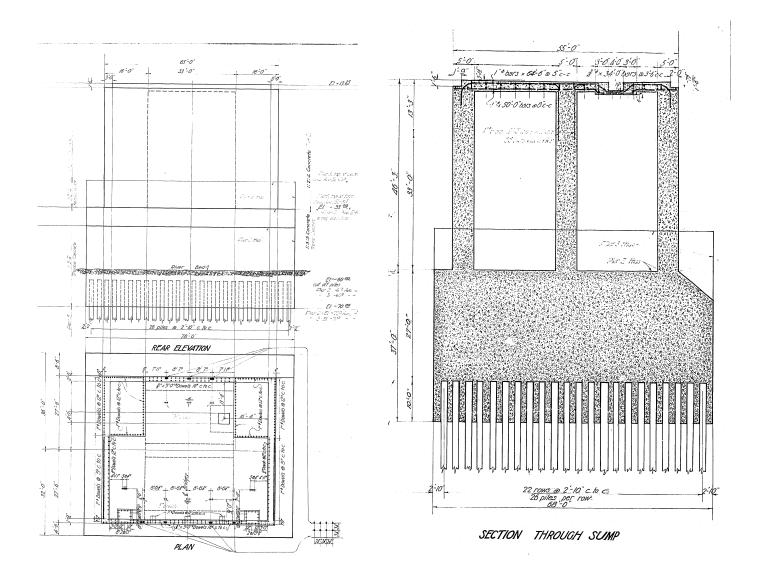


Figure BU101: Burnside Bridge Movable Spans Piers 2 & 3, foundation piles (outer piles) in both compression and uplift

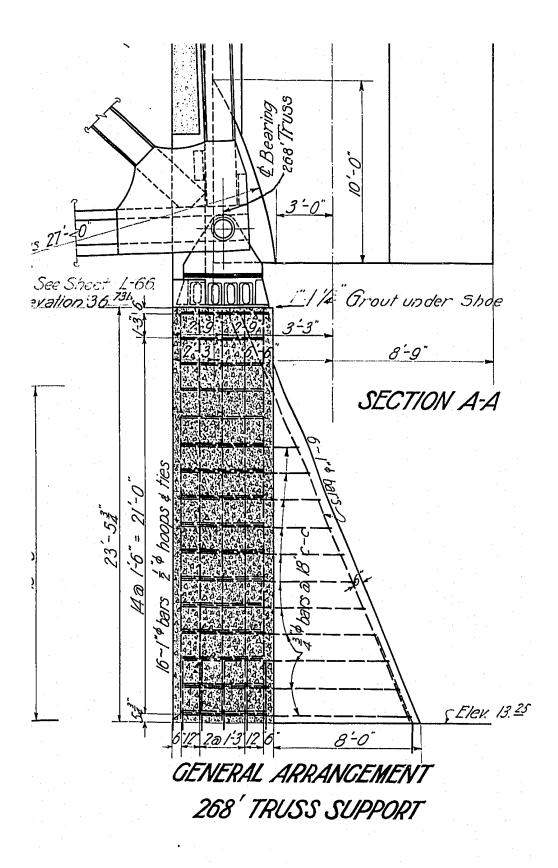
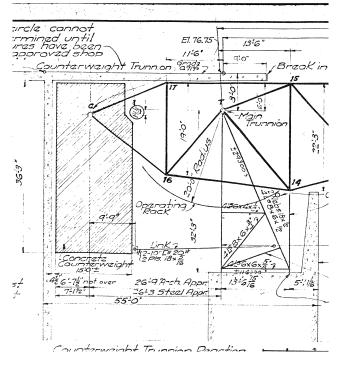
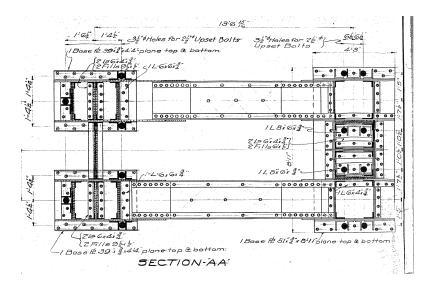


Figure BU102: Burnside Bridge Piers 2 & 3, Bascule Piers Wall without proper seismic reinforcing detailing, potential lost of axial support in seismic event





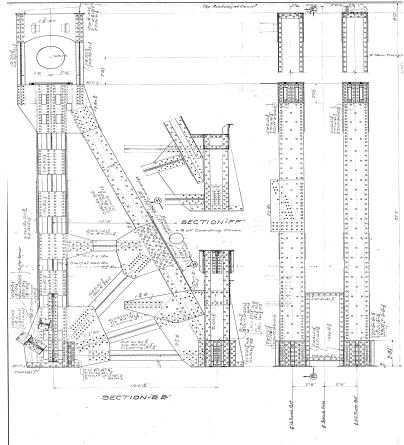


Figure BU103: Burnside Bridge Piers 2 & 3, Trunnion Support Vertical Post which could be subject to high Bending forces

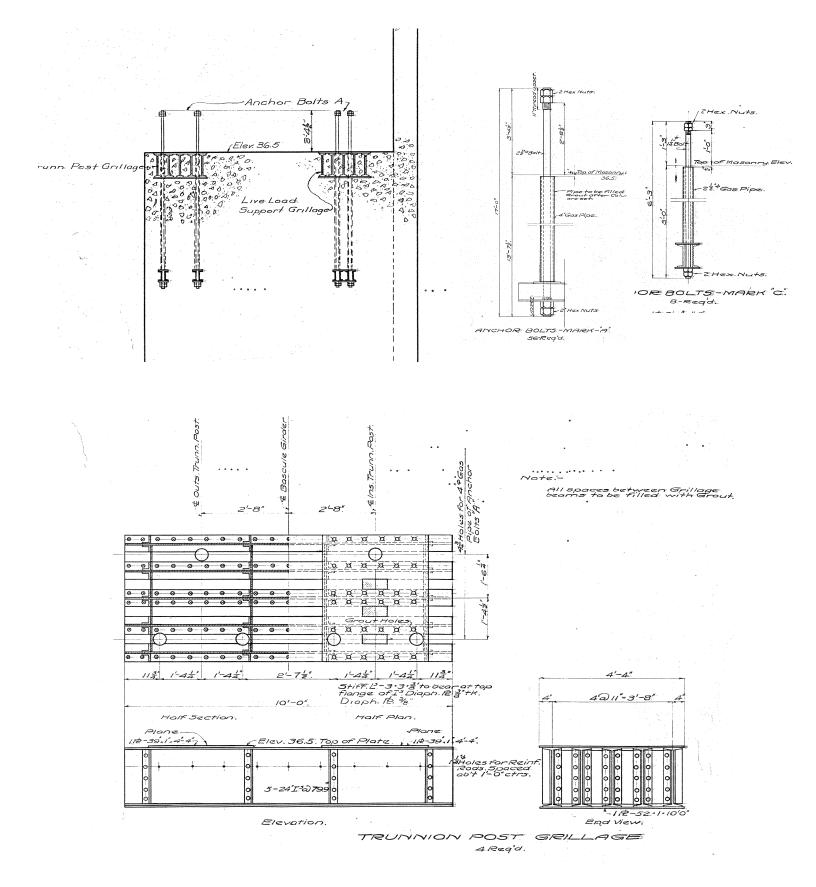


Figure BU104: Burnside Bridge Piers 2 & 3, Anchorage of the Trunnion Frame to the Bascule Piers

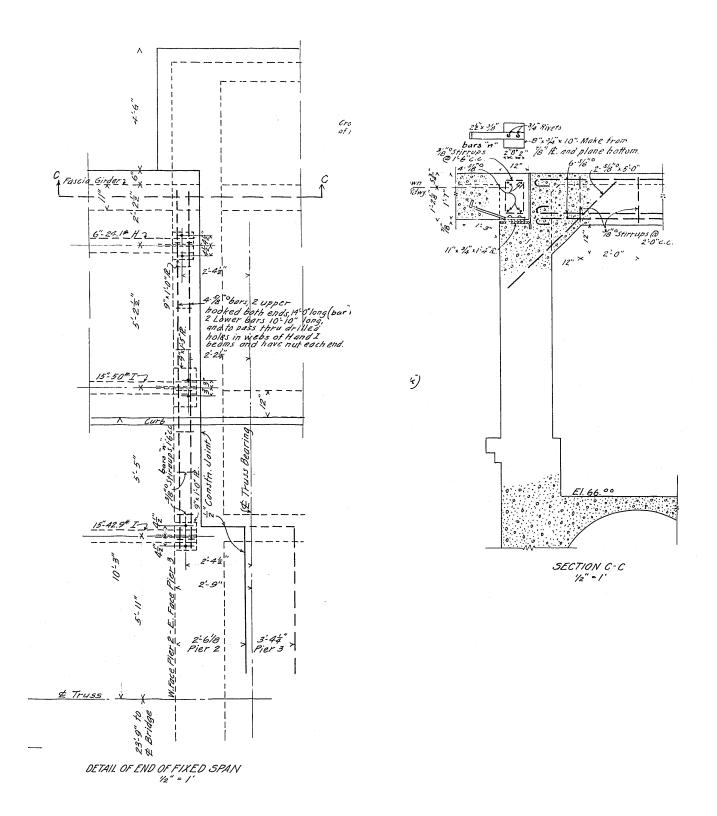


Figure BU105: Joint in the Deck System at Piers 2 & 3, Fixed and Expansion Spans

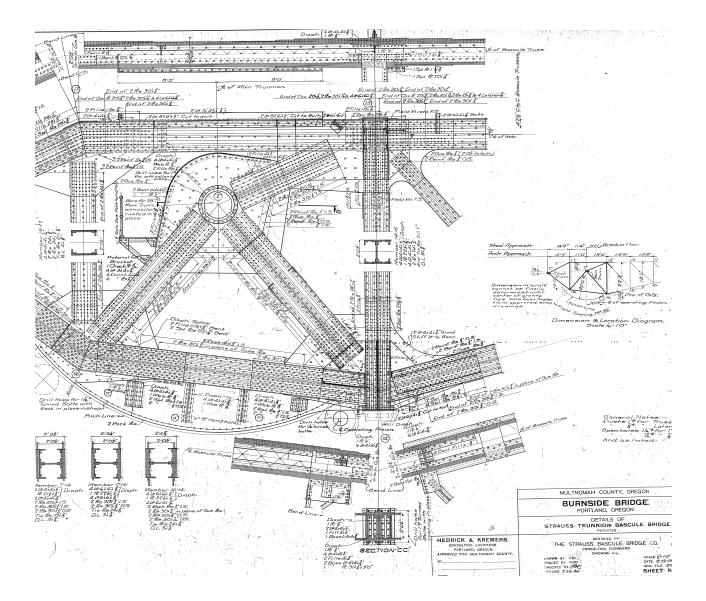


Figure BU106: Burnside Bridge Bascule Leaf Transverse Restraint at Point 14 to the Live Load Support Posts

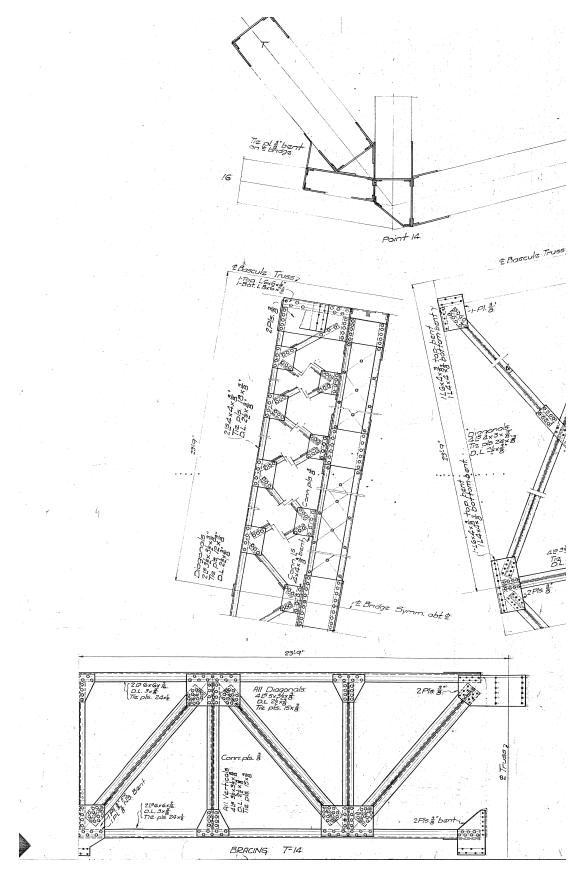


Figure BU107: Burnside Bridge Bascule Leaf Transverse Bracing will be weak if Transverse Restraint is added to Bascule Leaf at Point 14

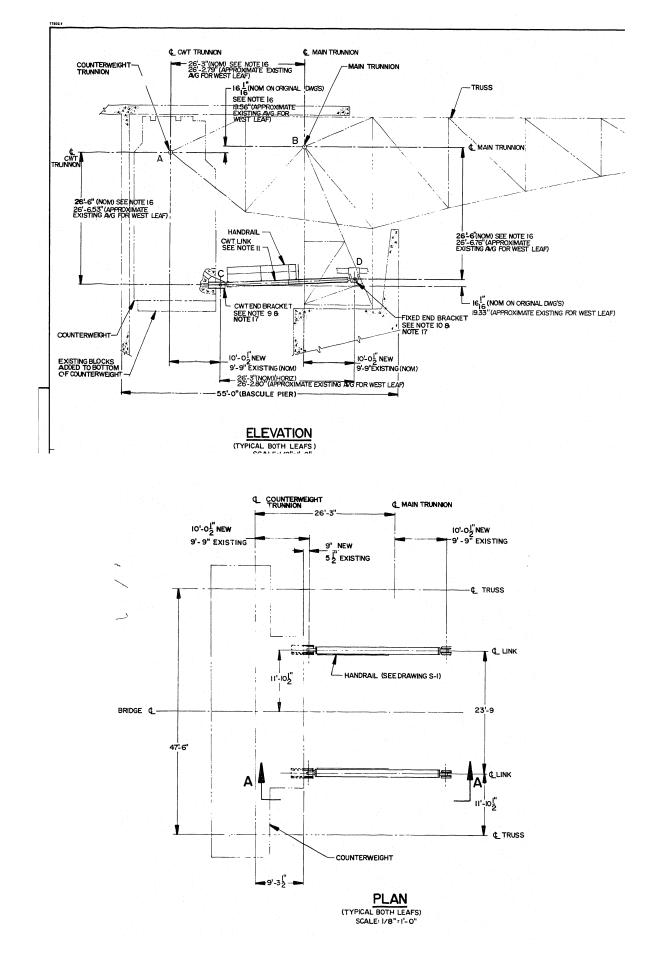


Figure BU108: Counterweight Links - Restrainers and Link Fuse required for Seismic Loadings

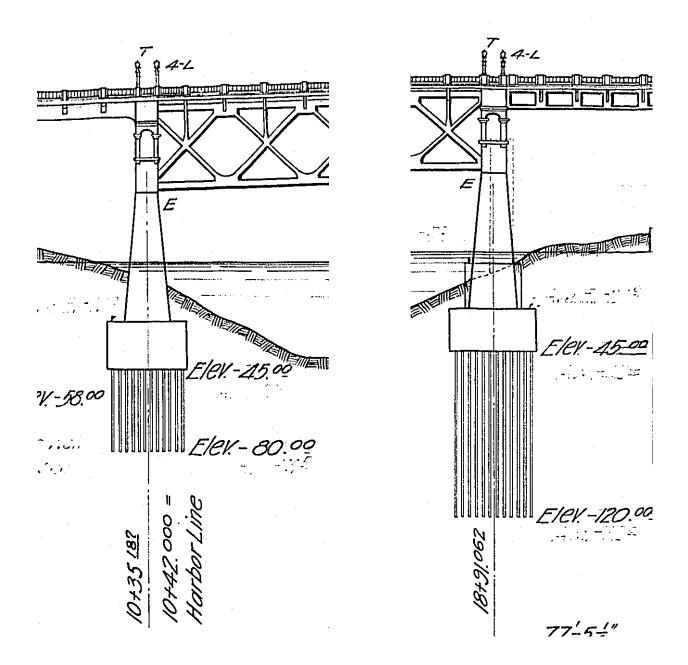


Figure BU201: Burnside Bridge Fixed Spans Piers 1 & 4 - showing sloping bank onto pile cap due to liquefaction

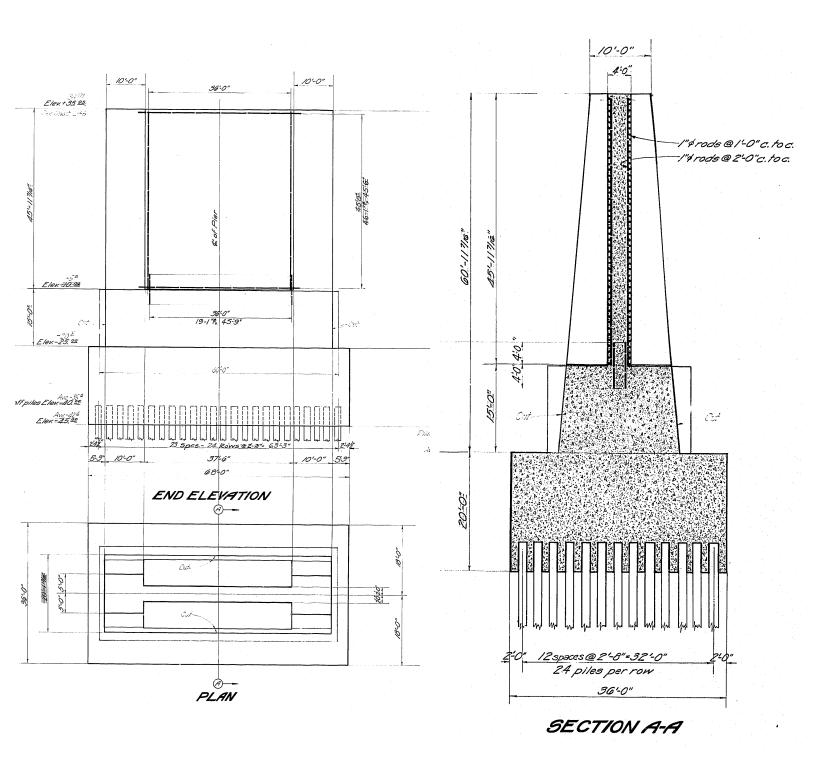
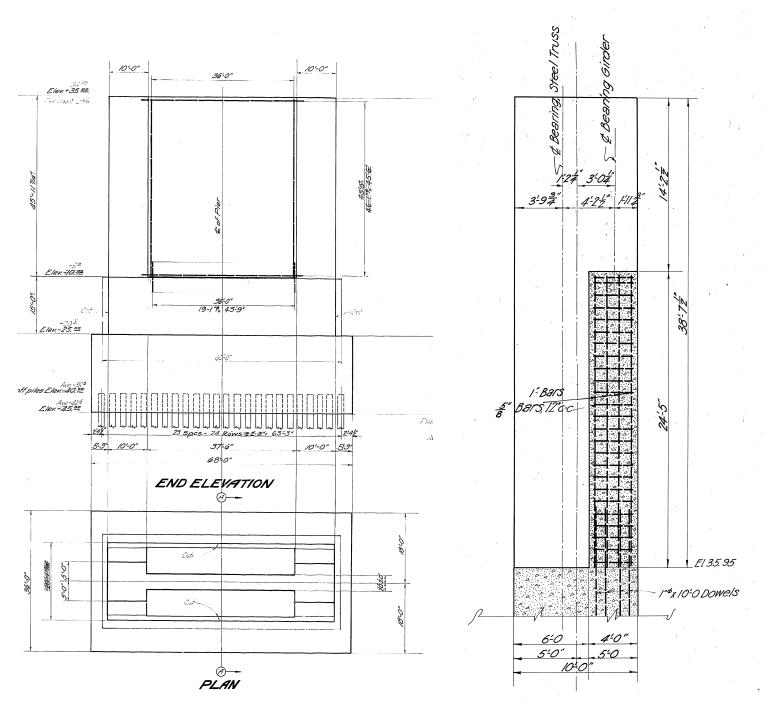


Figure BU202: Burnside Bridge Fixed Spans Piers 1 & 4, foundation piles (outer piles) in uplift, in bridge longitudinal direction



SECTION B-B

Figure BU203: Burnside Bridge Fixed Spans Piers 1 & 4 Columns, lightly reinforced and without proper seismic reinforcing detailing

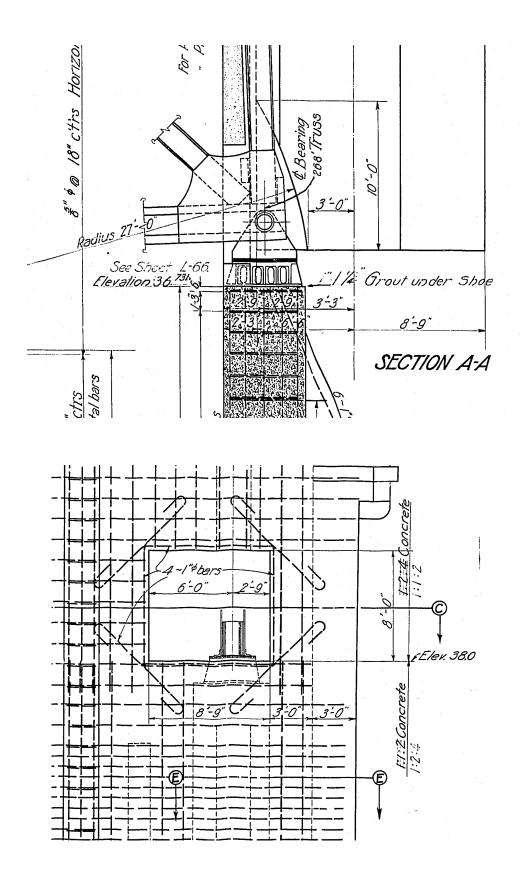


Figure BU204: Burnside Bridge Fixed Spans Truss Fixed Bearing and Bearing Seat Width (top, side view; bottom, front view) at Piers 2 & 3

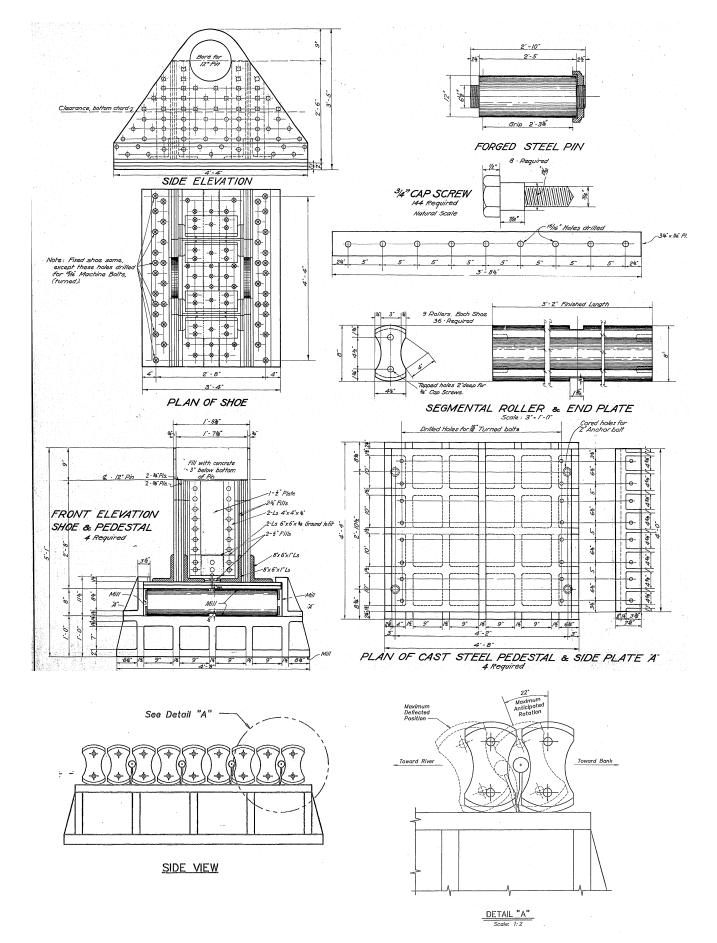


Figure BU205: Burnside Bridge Fixed Spans Truss Expansion Bearing and Bearing Seat Width at Piers 1 & 4, w/ modification in 2001

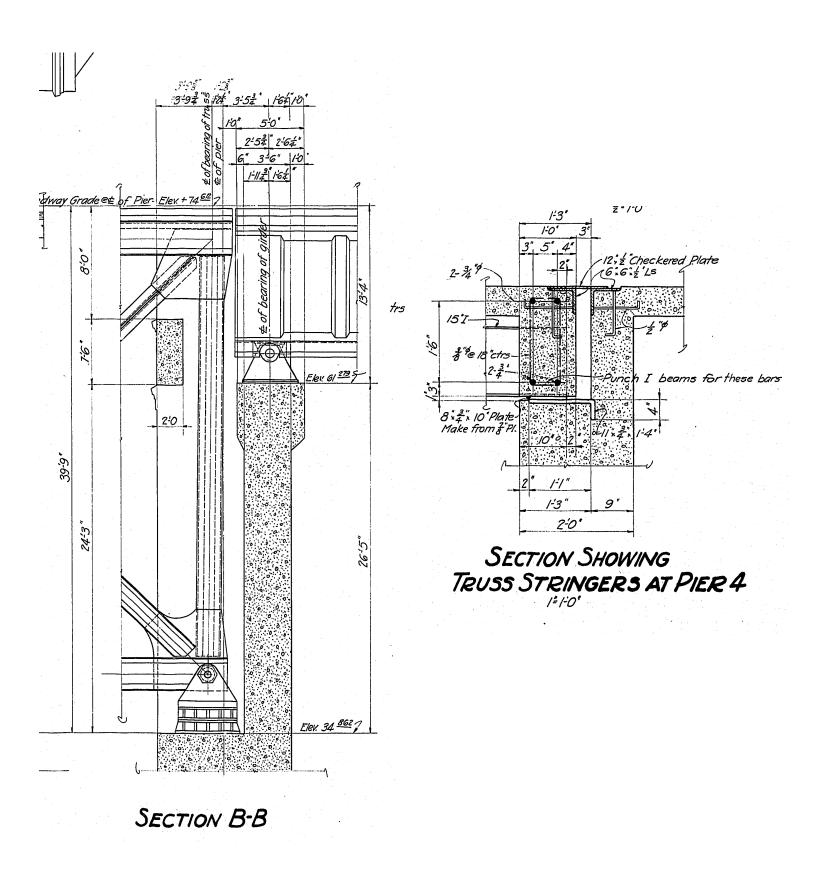


Figure BU206: Burnside Bridge Fixed Spans to Approach Joint in the Deck System

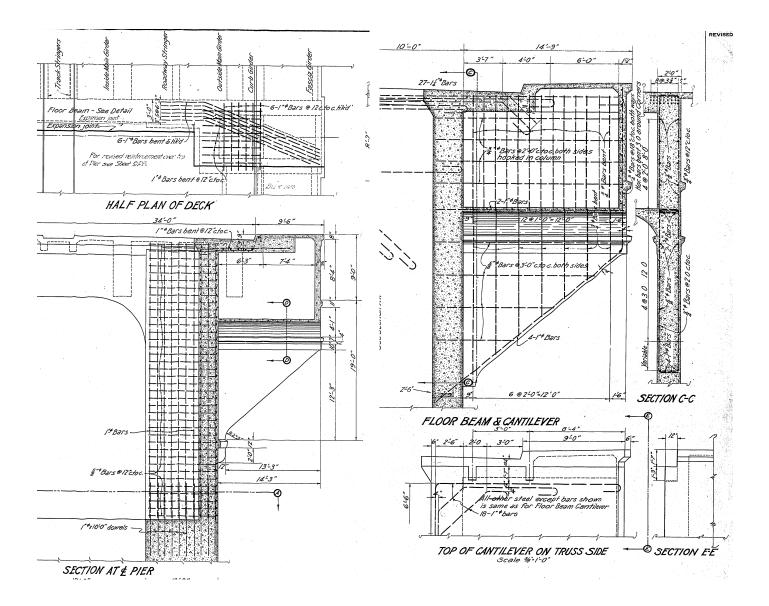


Figure BU207: Burnside Bridge Approach Span Deck Tie to Piers 1 & 4

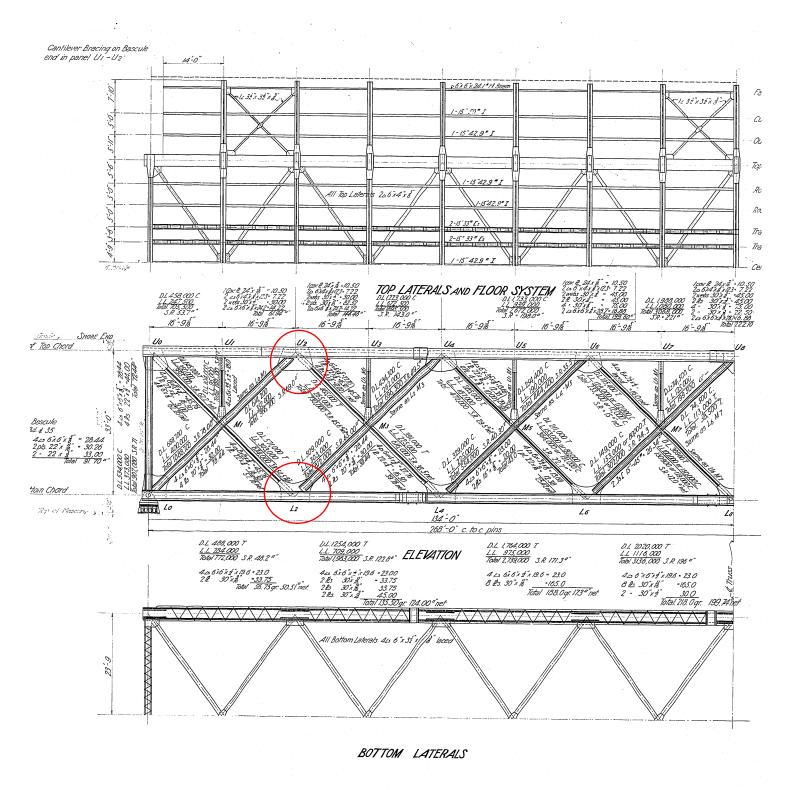


Figure BU208: Burnside Bridge Fixed Spans - Truss System Connections as Shown

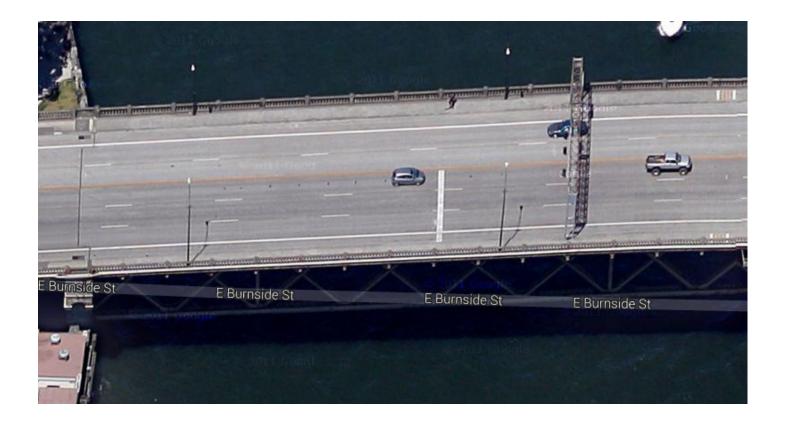
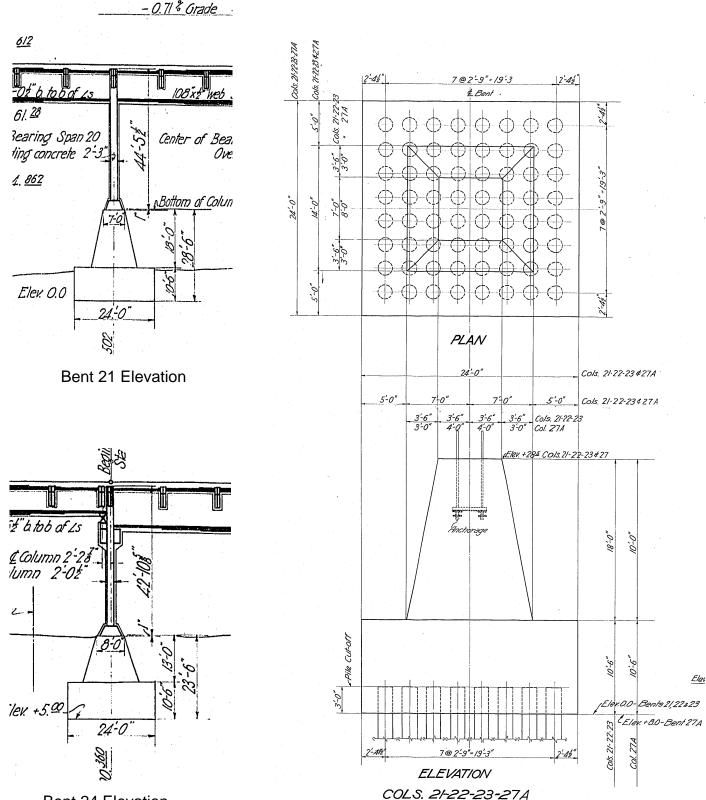


Figure BU209: Burnside Bridge Fixed Spans Aerial View - showing overhead structure and lightings on West Fixed Span (similar on East Fixed Span)



Bent 24 Elevation

Figure BU401: Burnside Bridge East Approach Bents 21-27, Unreinforced pile cap with timber pile. Bents 21-23 not buried. Bents 24 to 27 buried 20ft in ground.

64 PILES

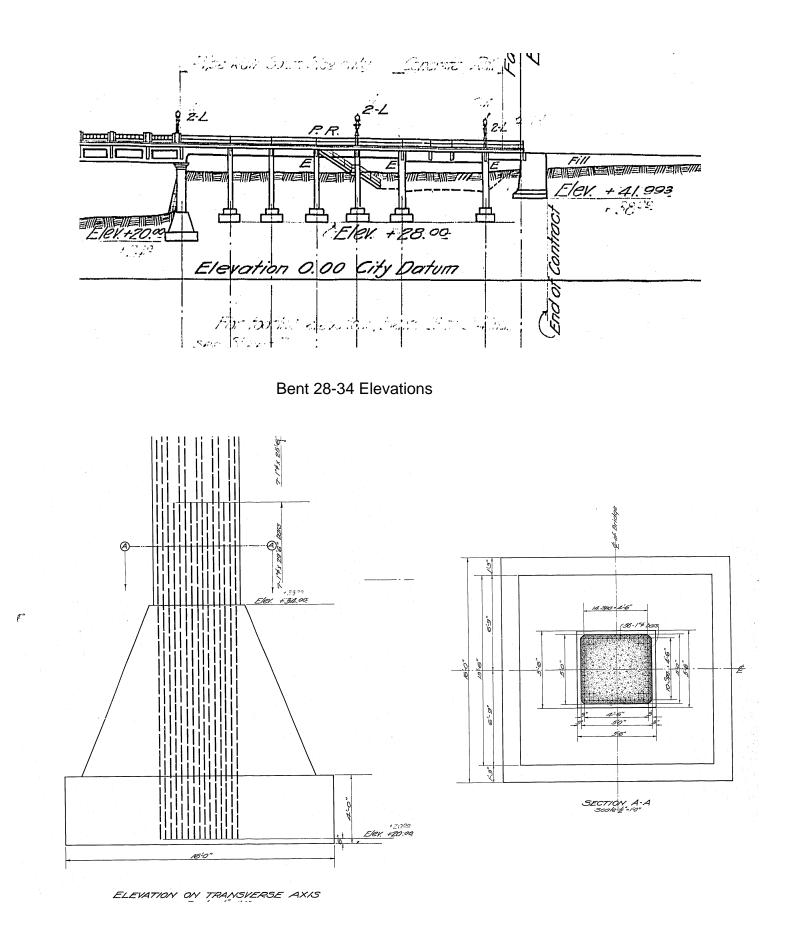
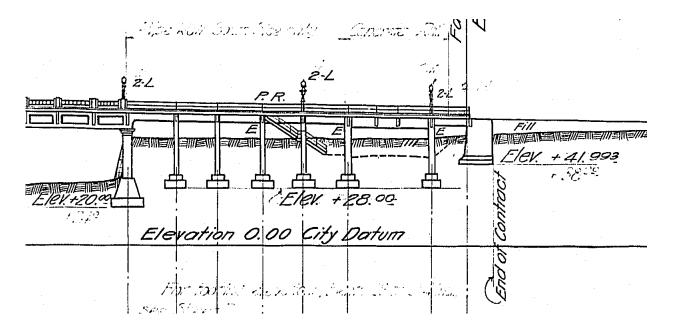
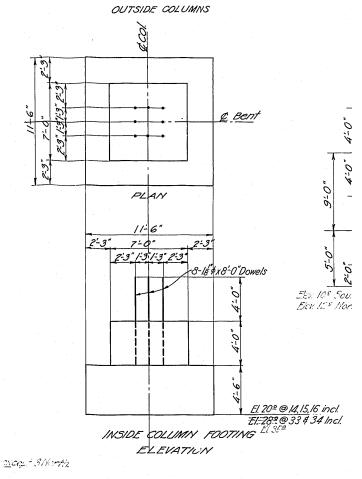


Figure BU402: Bent 28 Spread footing and column connection to base



Bent 28-34 Elevations



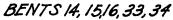


Figure BU403: Bents 29-34 Spread footing and column connection to base

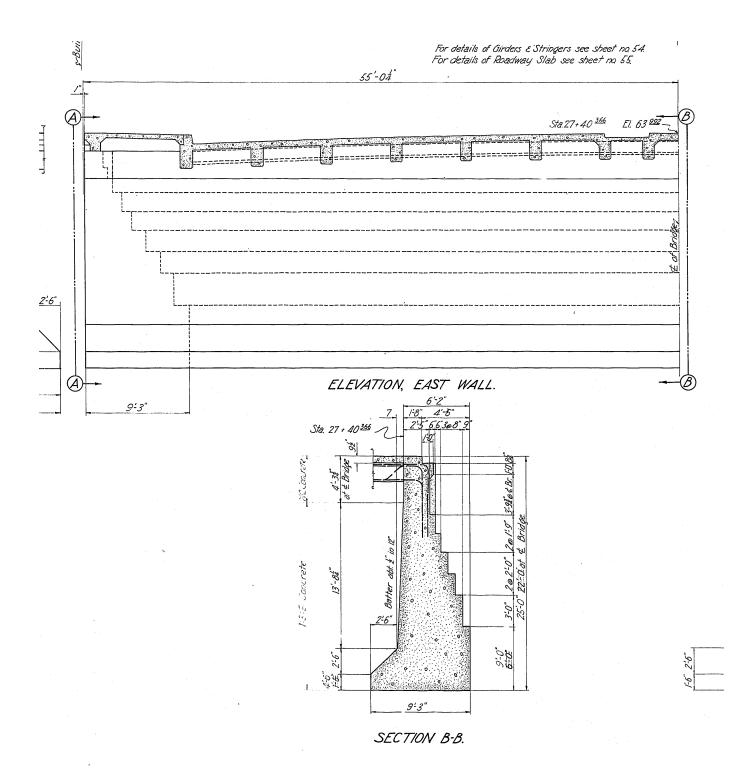


Figure BU404: Bent 35 East Approach Abutment

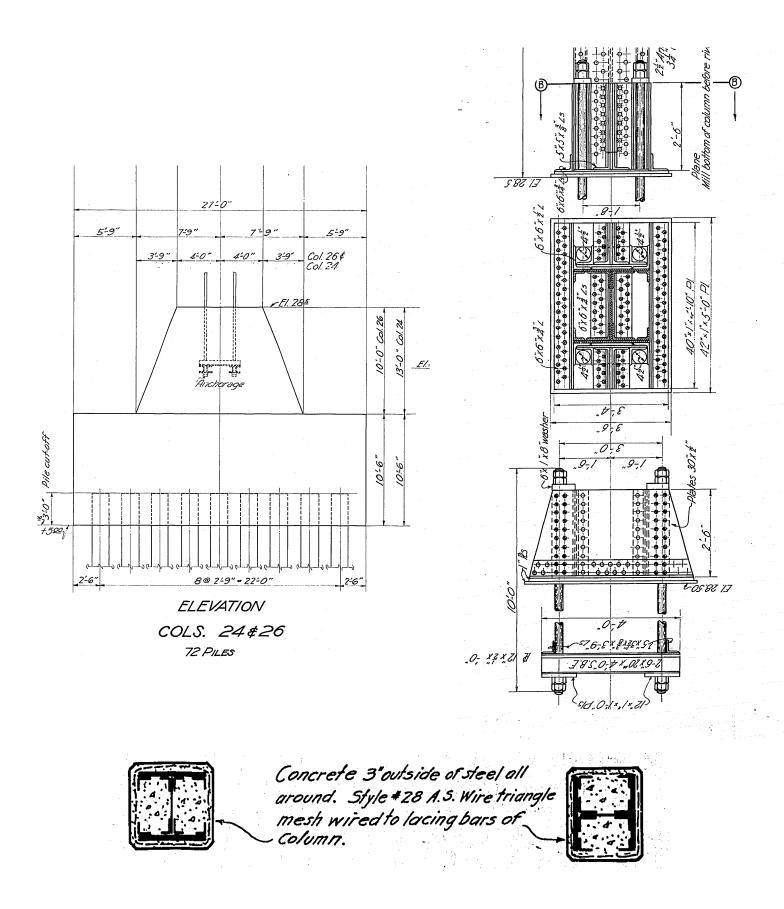


Figure BU405: Connections - Bents to Below Ground Foundations

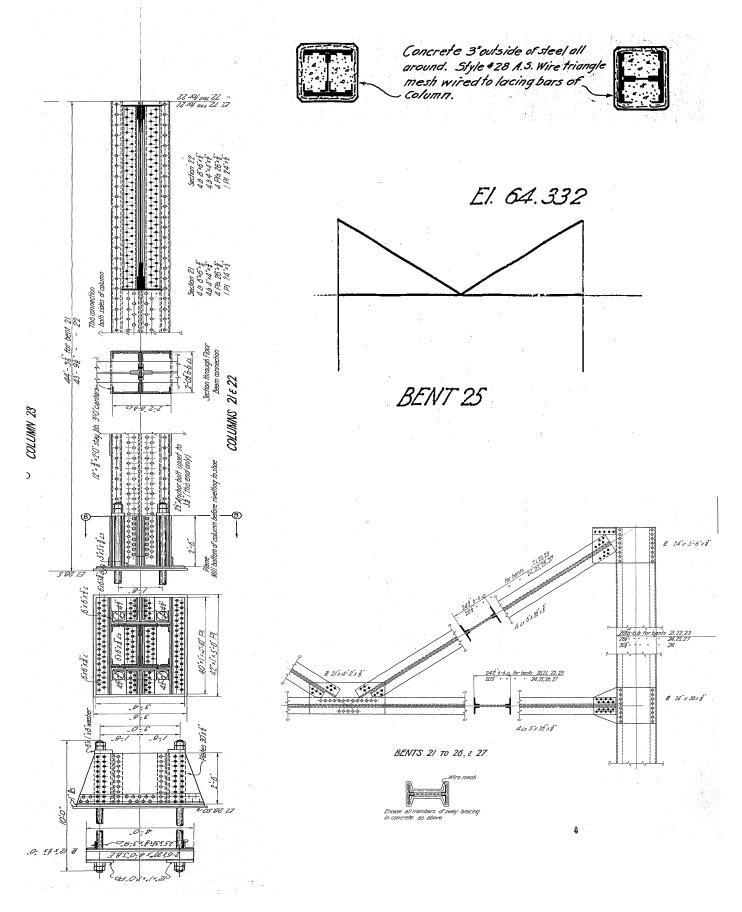
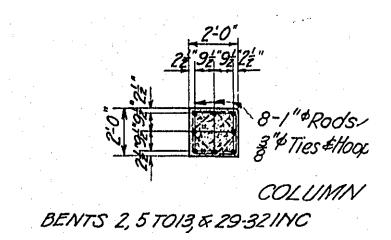


Figure BU406: Concrete encased steel column pairs with bracing

Nee New Court Albe and Concrete Albert N. Z·L ġ. 22 Fill E Kyme E 993 1.5825 Elev. + 28.00 1 Elevation 0.00 City Datum Endor



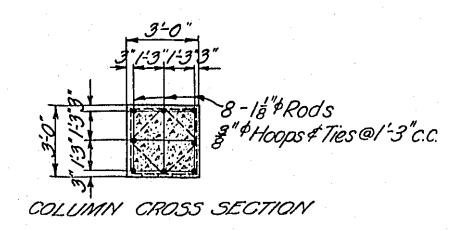


Figure BU407: Bents 29-34 Concrete columns

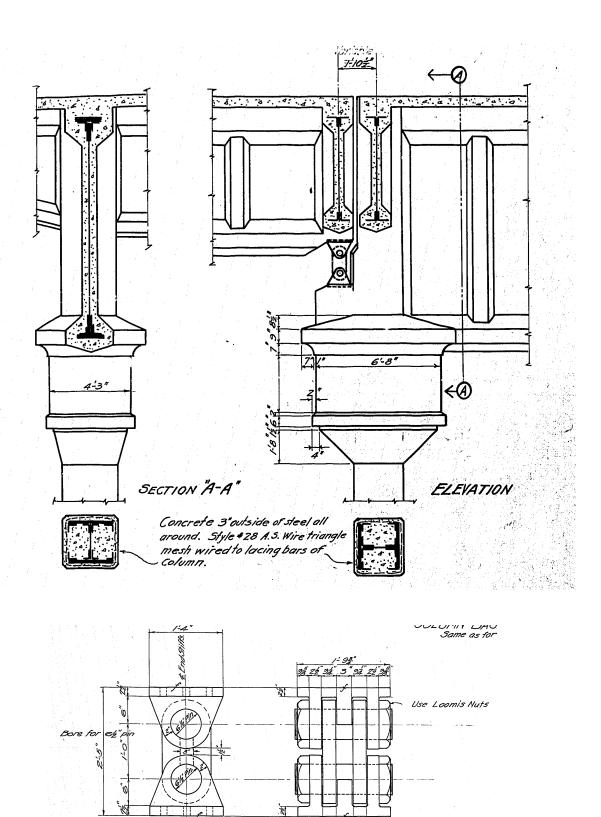
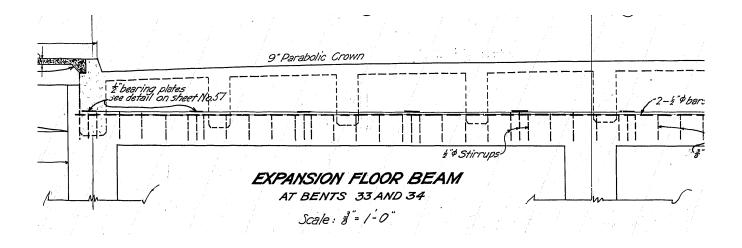


Figure BU408: Super to sub fixed condition and rocker bearing

DETAIL OF ROCKER SHOE Scale - 14" "10" as & Racker of Cast Steel. For Details of Connection see Sheets #49 & 50.

3 34



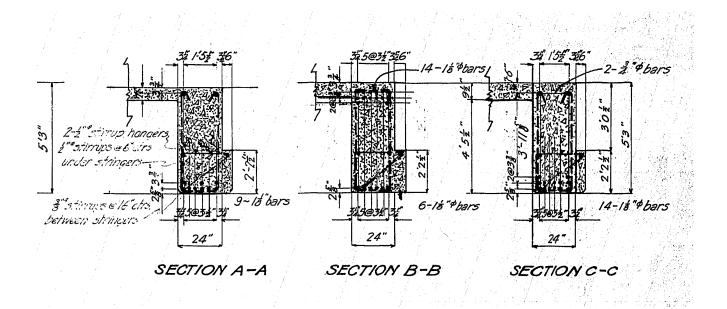
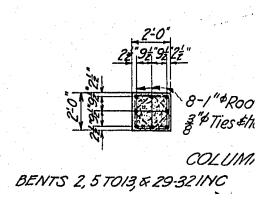
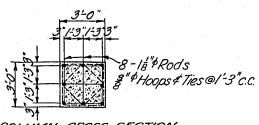


Figure BU409: Bents 31, 33, and 34 Expansion Seats





COLUMN CROSS SECTION

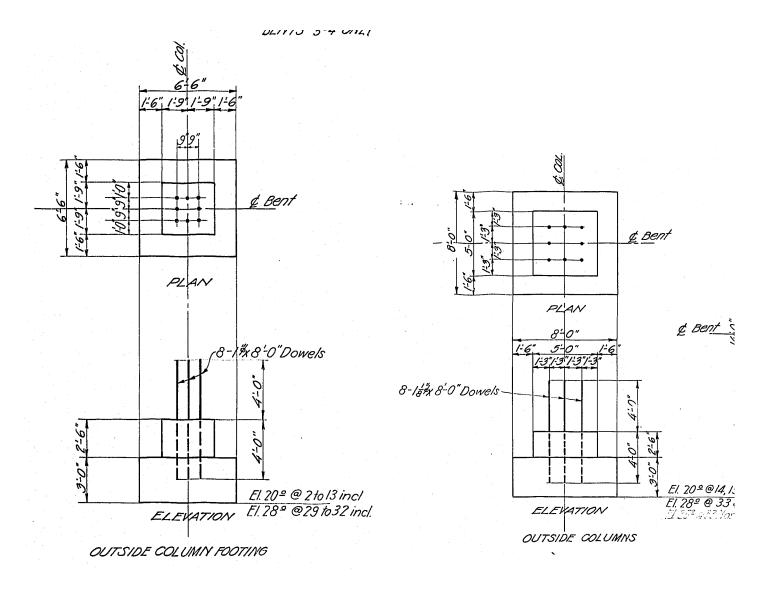


Figure BU410: RCDG to column connection with dowels

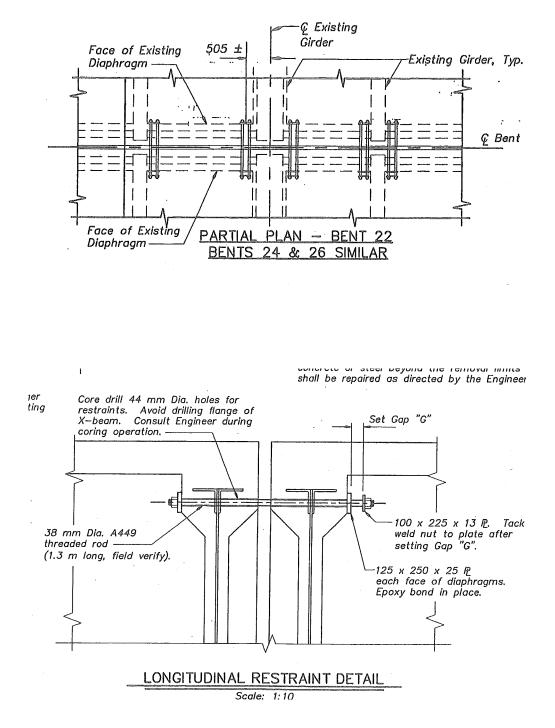
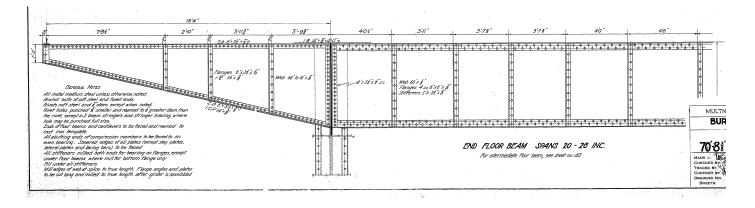
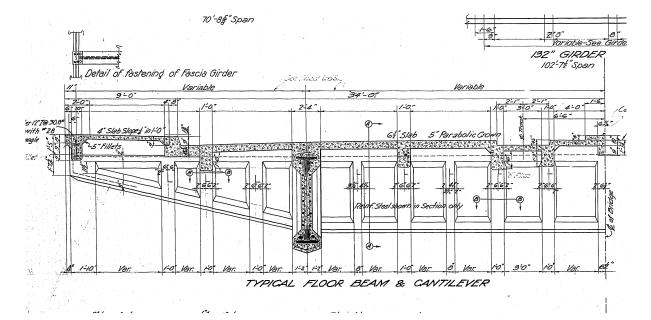


Figure BU411: Longitudinal Restraints at Exp. Joints





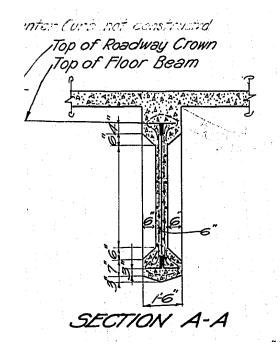


Figure BU412: Concrete encased steel floorbeam

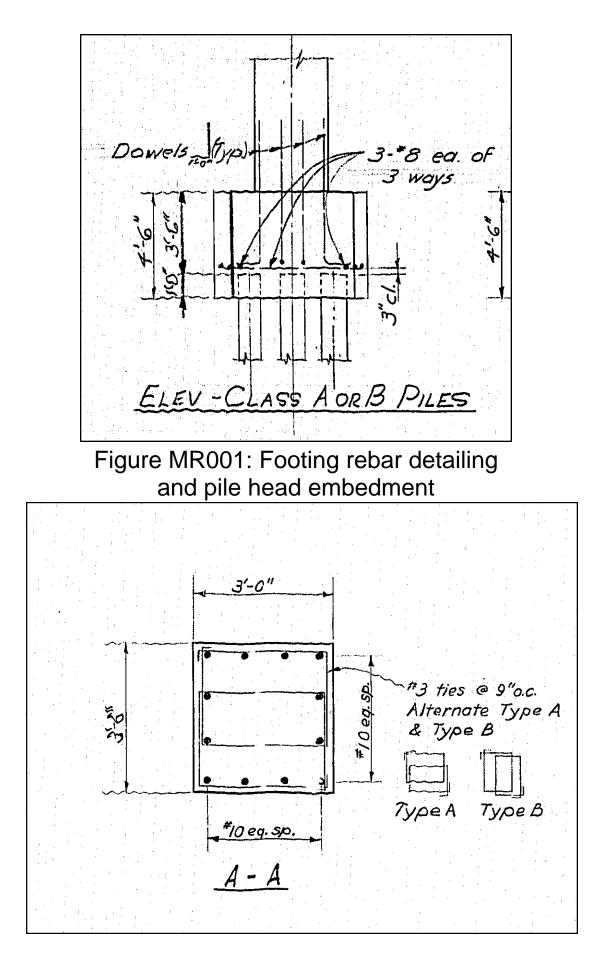


Figure MR002: Column flexural and shear reinforcement MORRISO

MORRISON FIGURES

1-#11×10'-0" b.l. 6-#11 +1. Centerover Column 3-#11 b.l.	
3-#5 ea. face	3
16 Spaces @ 5" 16 Spaces @ 5" 16 Spaces @ 6" 16 Sp	10"*10"*28"Key (typ.) (typ.) (4" 16 Spaces@ 6" Still Spaces@ 6" Still

Figure MR003: Bent cap rebar and column joint detailing

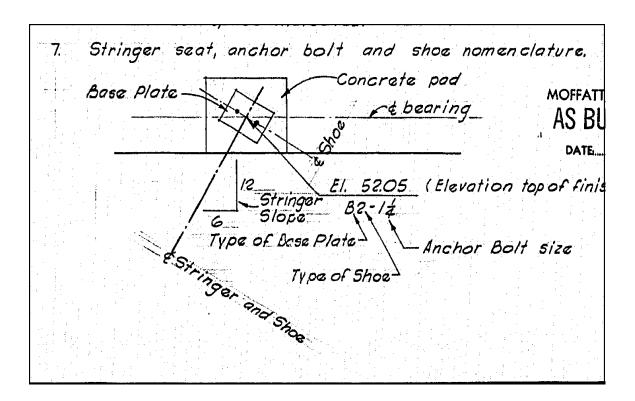


Figure MR004: Stringer shoe

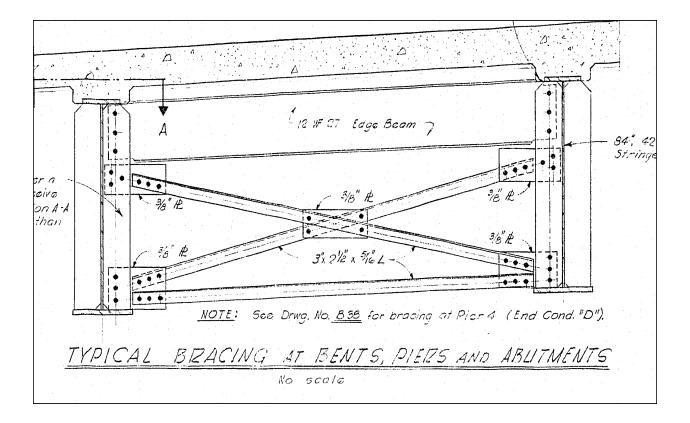


Figure MR005: Superstructure cross frame

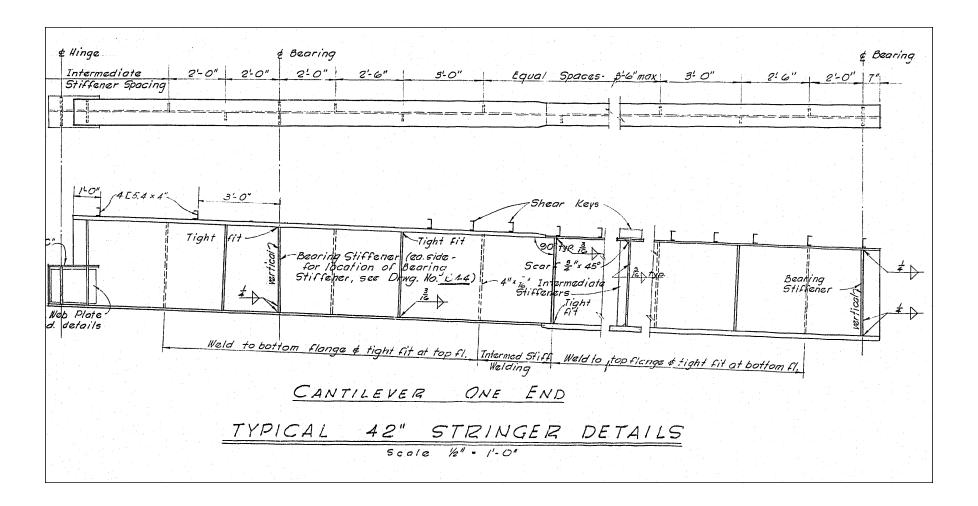


Figure MR006: Superstructure girder web stiffener

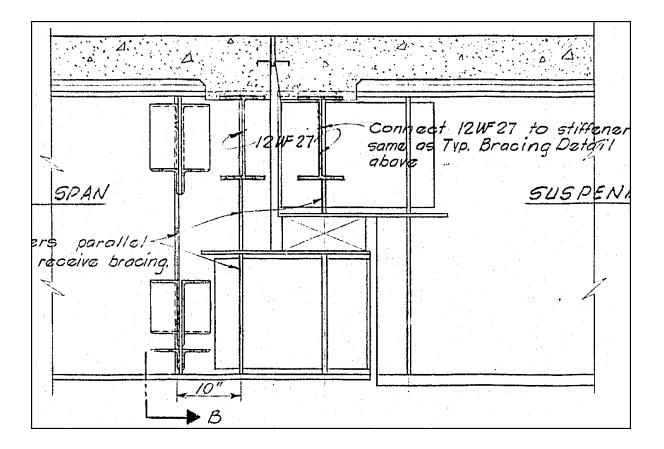


Figure MR007: In span hinge

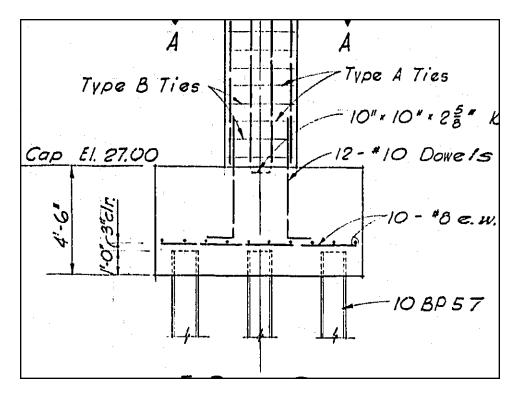


Figure MR008: Footing rebar detailing and pile head embedment

MORRISON FIGURES

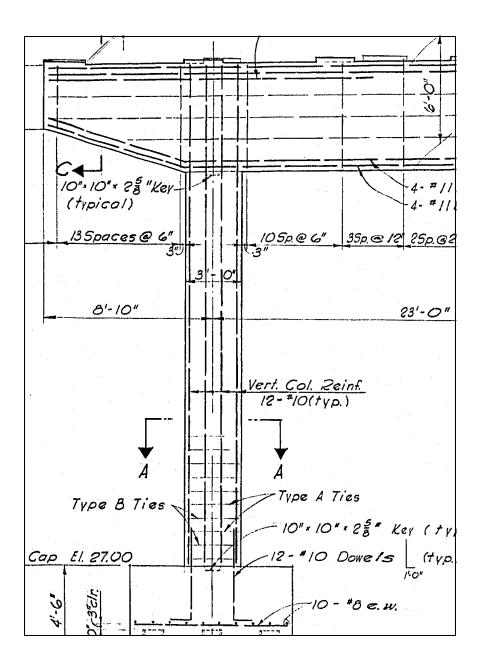


Figure MR009: Bent cap rebar and column joint detailing

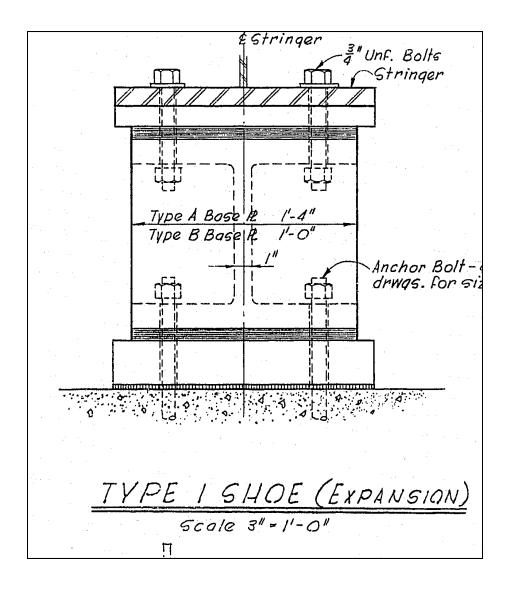


Figure MR010: Superstructure stringer shoe

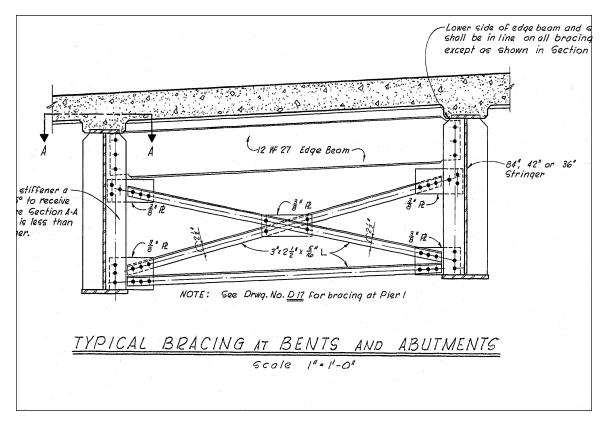


Figure MR011: Superstructure cross frame

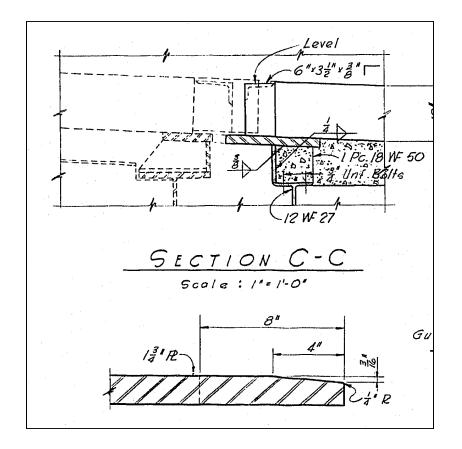


Figure MR012: Expansion joint

MORRISON FIGURES

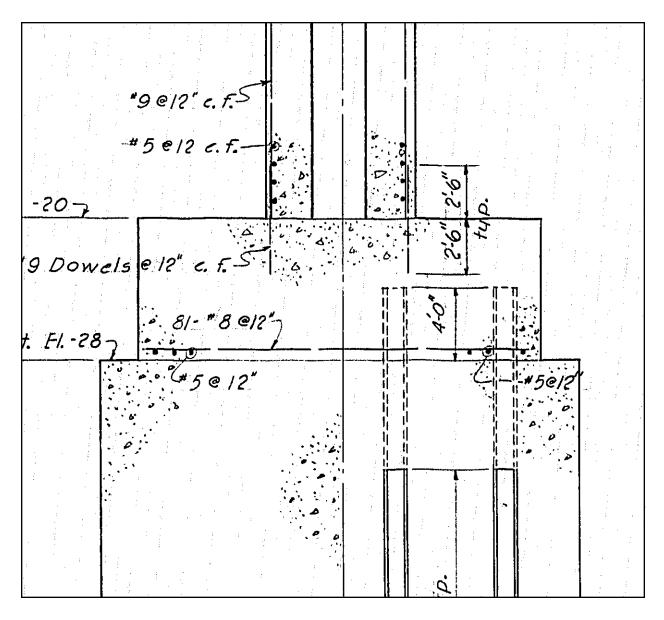


Figure MR014: Footing rebar detailing and pile head embedment

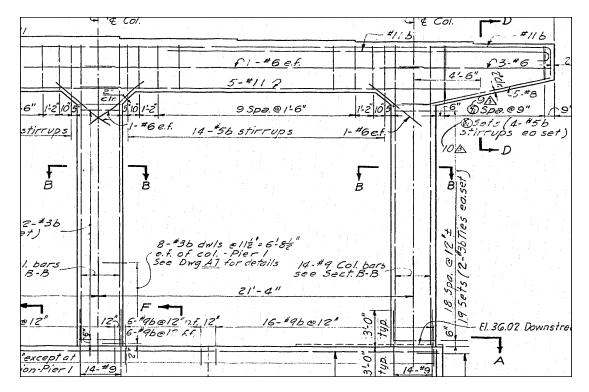


Figure MR015: Column and bent cap rebar detailing

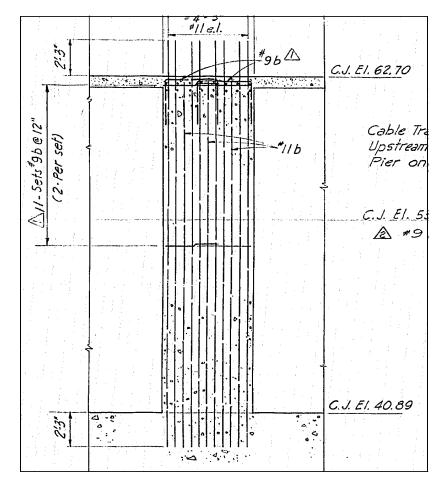


Figure MR016: Trunnion support frame rebar detailing

MORRISON FIGURES

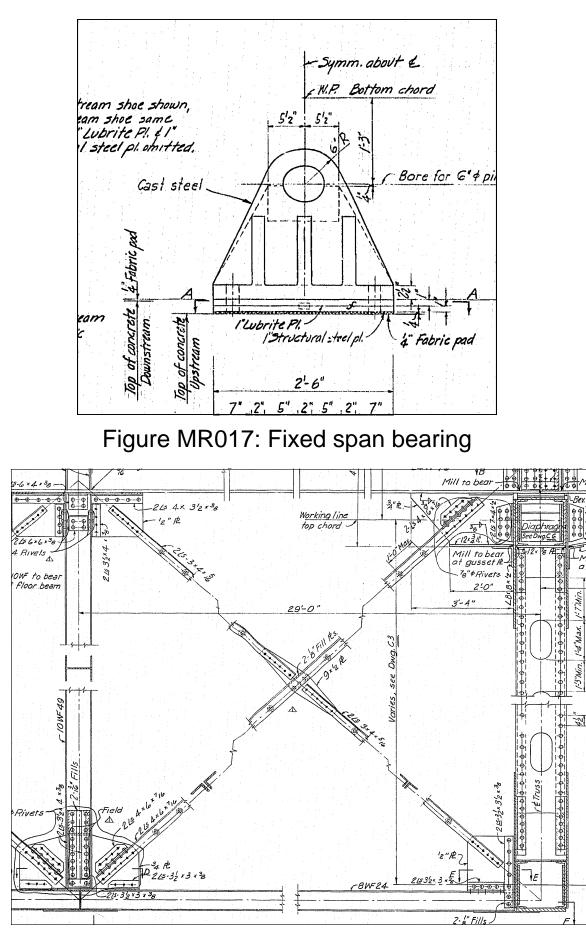


Figure MR018: Superstructure cross frame

MORRISON FIGURES

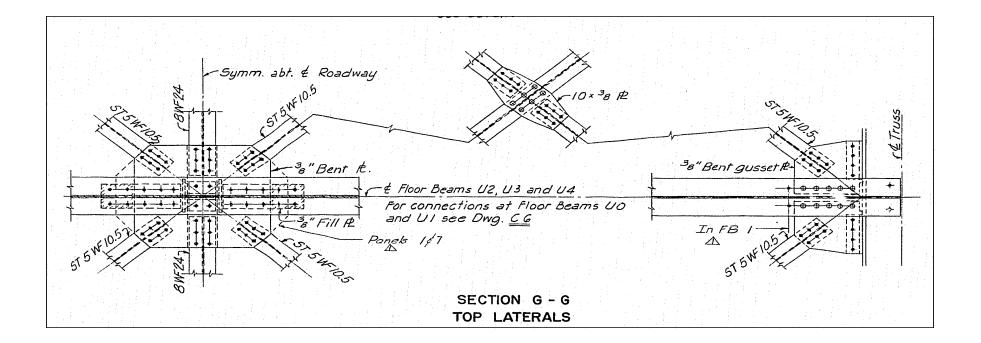


Figure MR019: Superstructure truss lateral brace

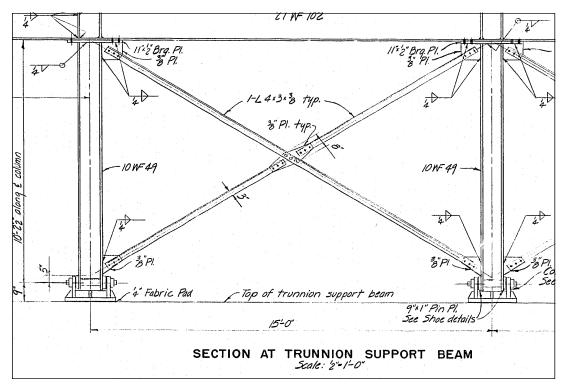


Figure MR020: Superstructure trunnion bearing and truss cross brace

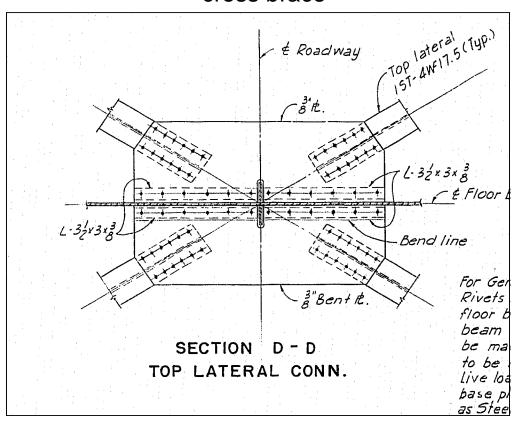


Figure MR021: Truss lateral brace

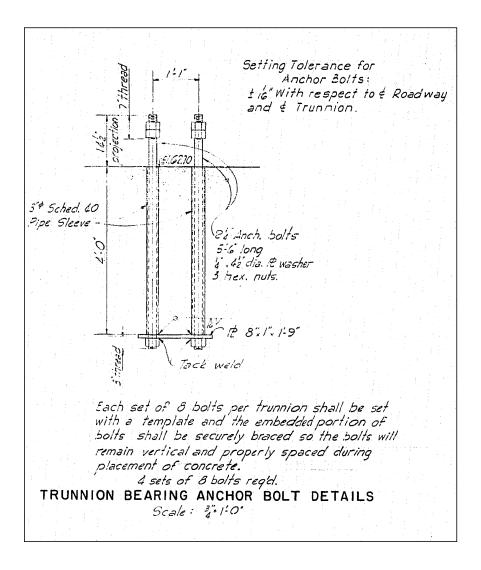


Figure MR022: Trunnion bearing anchor bolts

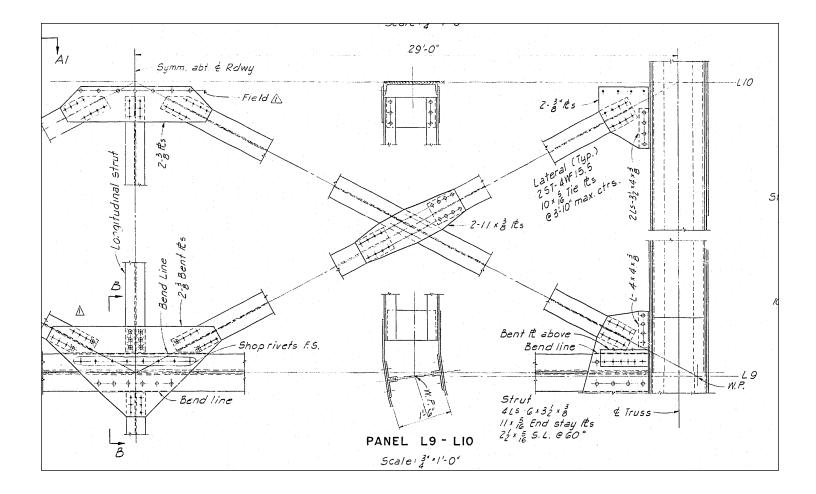


Figure MR024: Counterweight brace

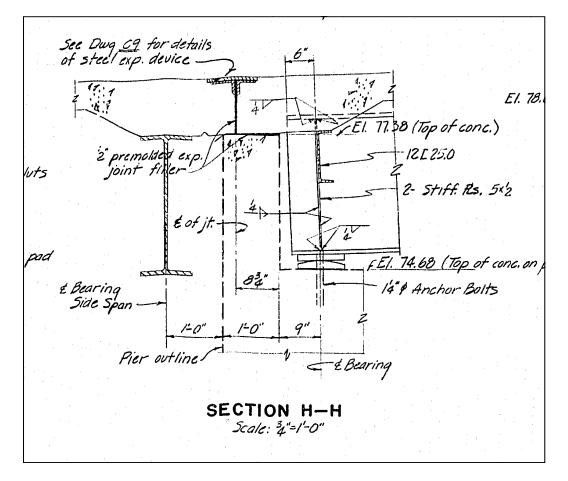


Figure MR030: Pit span bearing seat

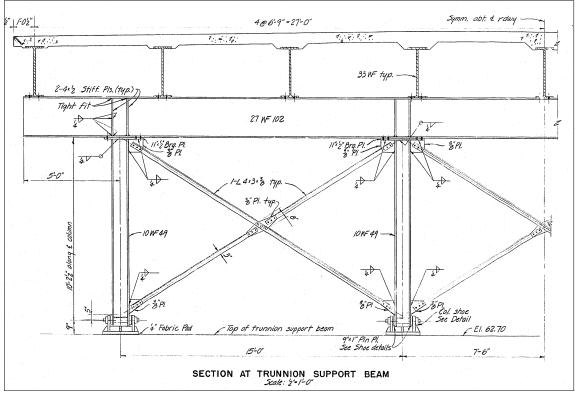


Figure MR031: Deck support columns at pit span

MORRISON FIGURES

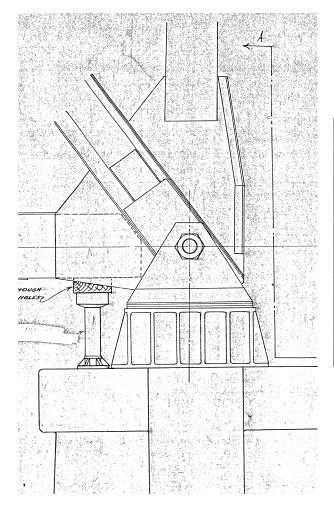
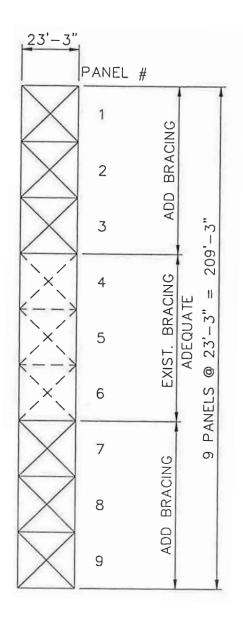






Figure HA101: Pier bearings

HAWTHORNE FIGURES





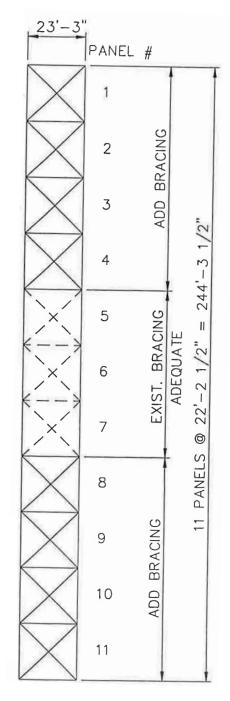
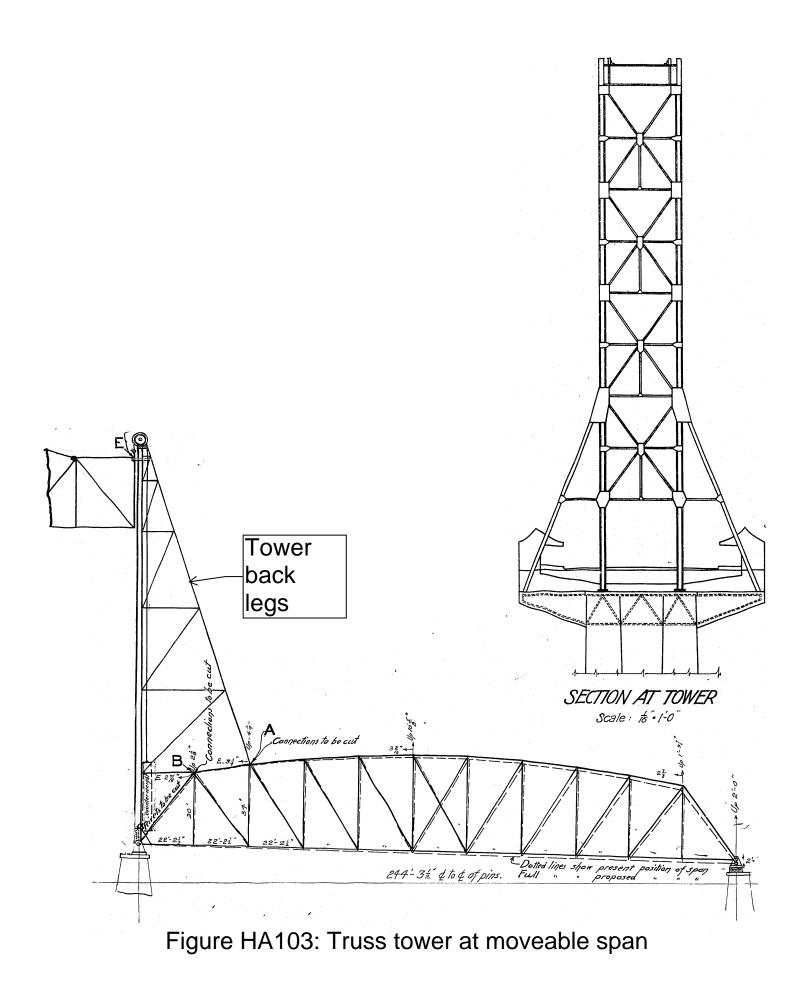




Figure HA102: Bottom chord lateral braces



HAWTHORNE FIGURES

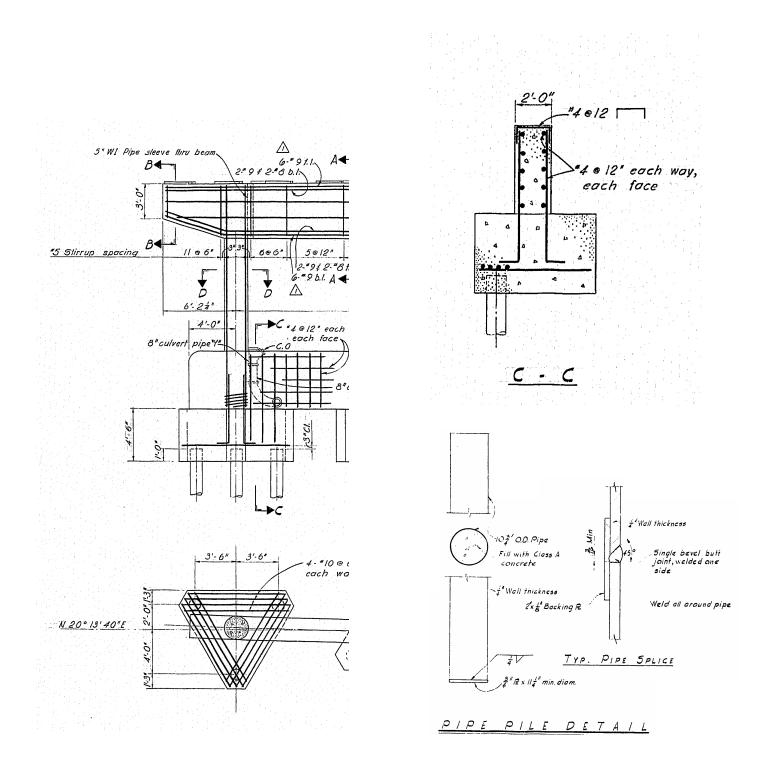


Figure HA301: Bent 1 pipe pile to cap connection

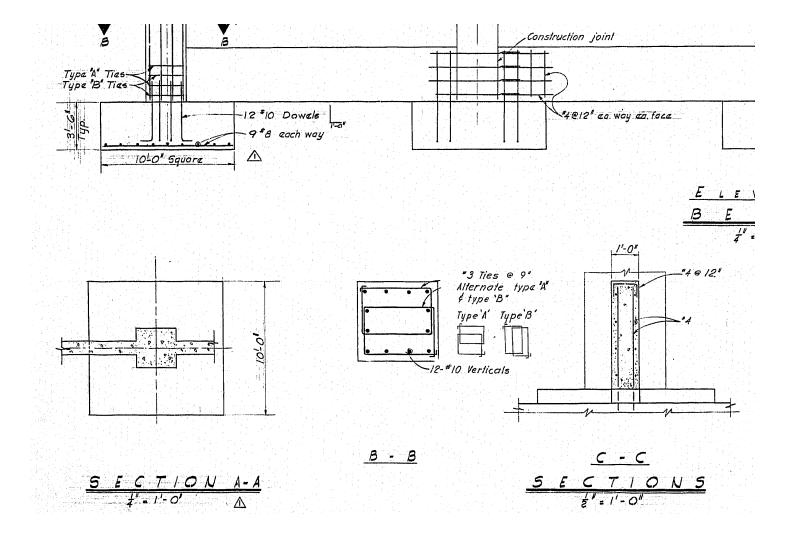


Figure HA302: Bents 2, 3, 4, 7, 8, 9, 10, and 11 spread footing with no top layer of reinforcing in footings. Only Bent 2 with short 1ft wall at bottom of column

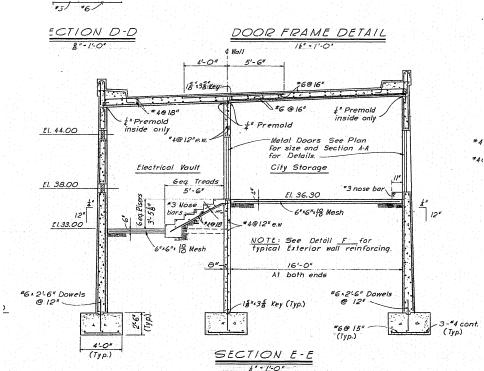


Figure HA303: Abutment 3 Electrical Vault, thin wall with dowels connected to footing. Vault room could collapse and affect the electrical supply for Hawthorne bridge

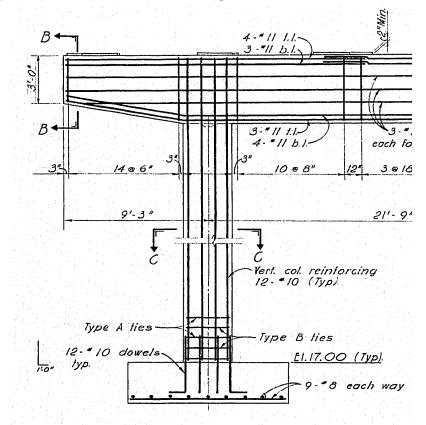


Figure HA304: Interior Bents Connections - Bents Columns to spread footing, inadequate reinforcing embedment

HAWTHORNE FIGURES

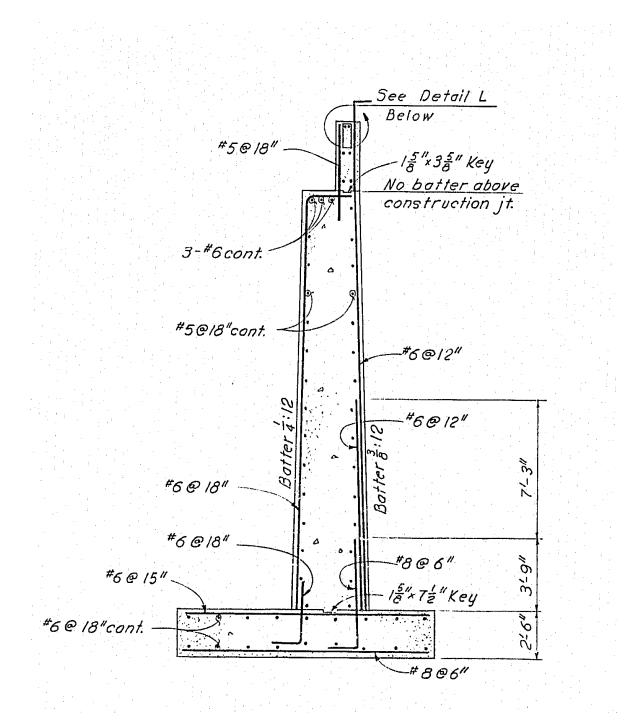


Figure HA305: Abutments 1, 2 and 3 to spread footings connection, inadequate reinforcing embedment length

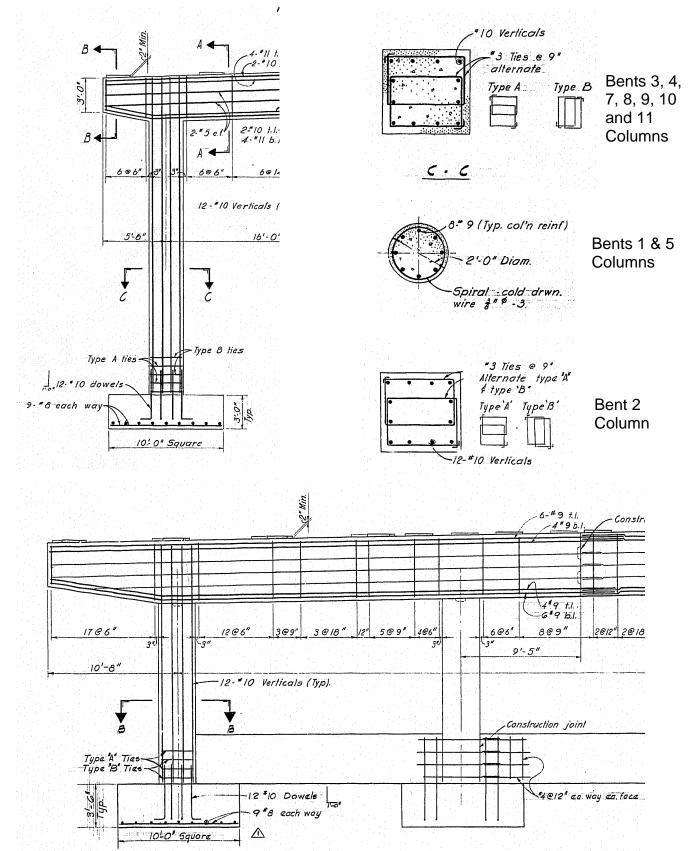


Figure HA306: Bents 1, 2 and 5 columns with inadequate shear capacity; Bents 3, 4, 7, 8, 9, 10 and 11 columns with inadequate flexural capacity

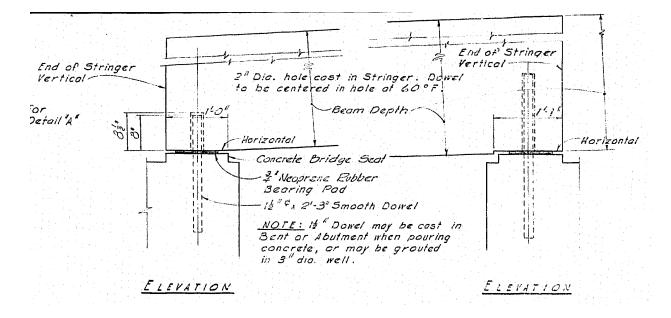


Figure HA307: Marginal longitudinal seat widths at bents

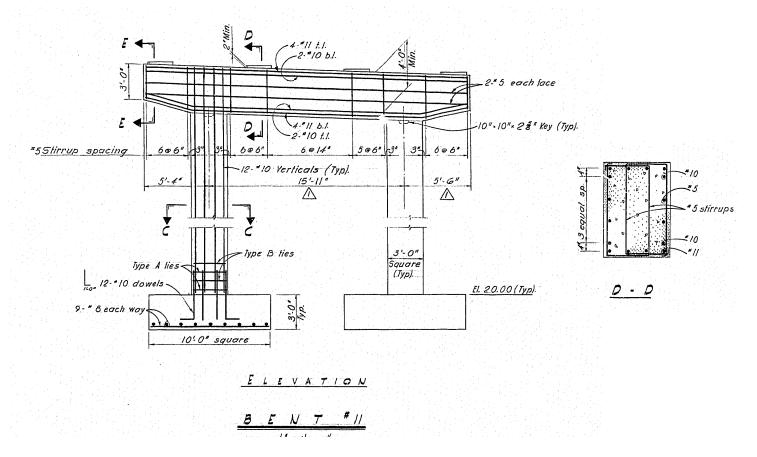


Figure HA309: Cap beam as capacity protected members but with inadequate flexural reinforcing

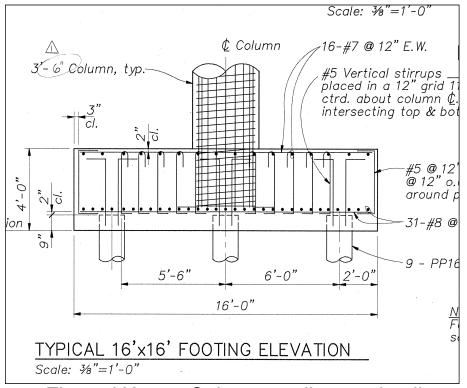


Figure HA401: Column to pile cap detail

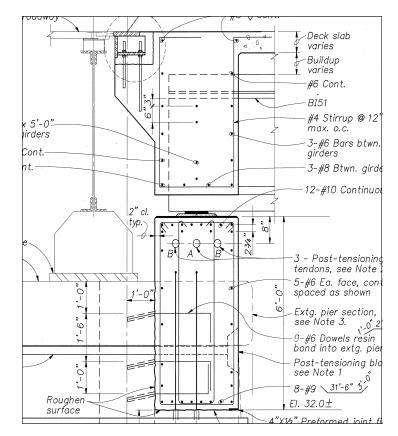


Figure HA402: Superstructure bearing seat

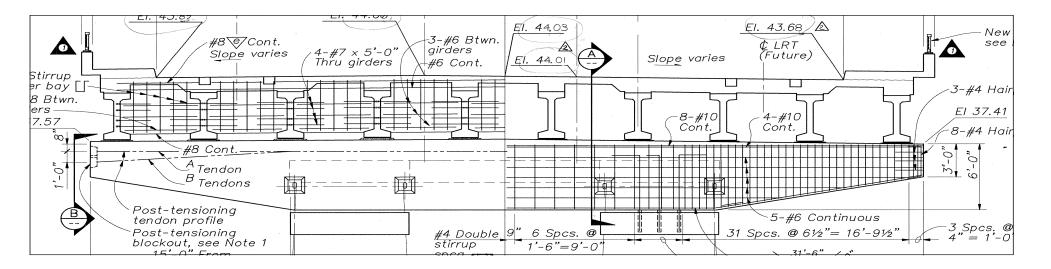


Figure HA403: Bent cap detail at Pier 1 (no transverse restraints observed)

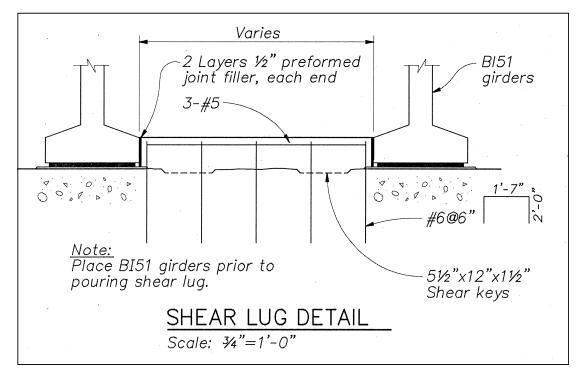


Figure HA404: Existing lateral restraint detail

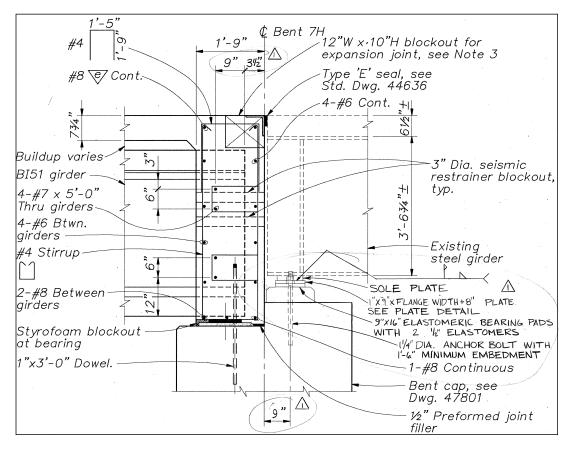


Figure HA405: Abutment seat detail

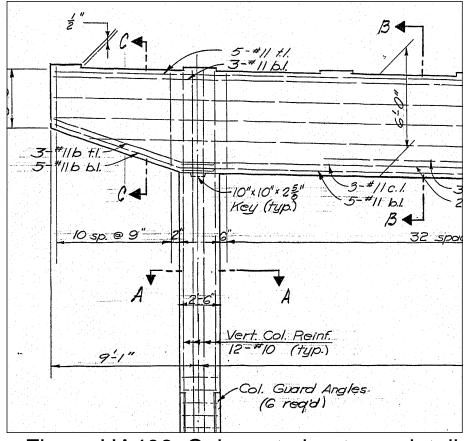


Figure HA406: Column to bent cap detail

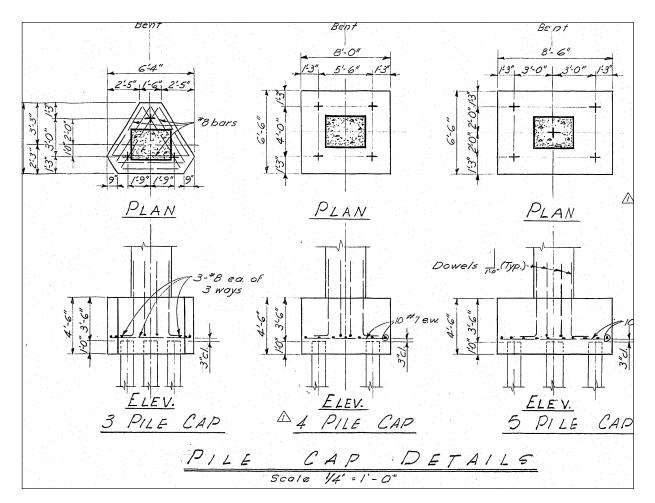


Figure HA407: Pile cap rebar detail

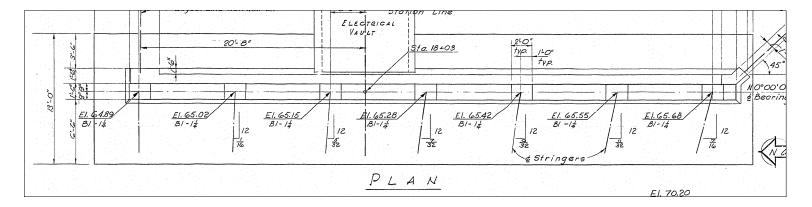


Figure HA408: Abutment seat detail

Attachment C

Retrofit Cost Details

Multnomah County CIP - Seismic

	-			By: TCA Checked: KPBU	5/20/2014 5/21/2014				
Bridge	Location	Vulnerability #	Count	Author's Description	Matched Standard description	cost for 1000 yr event		0.75 factor 100 yr event	
Broadway	West Approach	1	1	Steel Bent Columns	Column strengthening	\$ 75,000 / Column	\$	56,000	\$ 71,000
Broadway	West Approach	2	2	Expansion Bearing Seat Widths	Seat Extender	\$ 75,000 / Bent	\$	56,000	\$ 71,000
Broadway	West Approach	3	3	Footings	Footing strengthening (Standard footing)	\$ 500,000 / Footing	\$	375,000	\$ 475,000
Broadway	West Approach	4	4	Footings	Soil Densification	/ Bridge Site (i.e West Side of \$ 7,000,000 Broadway Bridge)	\$	5,250,000	\$ 6,650,000
Broadway	Fixed River Spans	1	5	Pier 2 Steel Columns	Column strengthening	\$ 75,000 / Column	\$	56,000	\$ 71,000
Broadway	Fixed River Spans	2	6	Pier 1, 3, 4, 7 Jacketed Columns	Unique - Broadway Large Steel Column Retrofit	\$ 500,000 / Column	\$	375,000	\$ 475,000
Broadway	Fixed River Spans	3	7	Pier 2, 3, 4, 7, E. Abut Bearings	Isolation bearings	\$ 500,000 / Bearing	\$	375,000	\$ 475,000
Broadway	Fixed River Spans	4	8	Pier 2, 3, 4, 7 Conc. Piers	Pier strengthening	\$ 2,500,000 / Pier	\$	1,875,000	\$ 2,375,000
Broadway	Fixed River Spans	5	9	Staircase to Naito Parkway	Longitudinal restrainers	\$ 100,000 / Bent / Bridge Site (i.e	\$	75,000	\$ 95,000
Broadway	Fixed River Spans	6	10	Geotechnical Hazards - Piers 1, 2 and 3	Soil Densification	West Side of \$ 7,000,000 Broadway Bridge)	\$	5,250,000	\$ 6,650,000
Broadway	Fixed River Spans	7	11	Geotech Hazard - Pier 4	Soil Densification	/ Bridge Site (i.e West Side of \$ 7,000,000 Broadway Bridge)	\$	5,250,000	\$ 6,650,000
Broadway	Moveable Spans	1	12	Piers 5, 6 Pier Walls	Pier strengthening	\$ 2,500,000 / Pier	\$	1,875,000	\$ 2,375,000
Broadway	Moveable Spans	2	13	Pier 5, 6 Bearings	Isolation bearings	\$ 500,000 / Bearing	\$	375,000	\$ 475,000
Broadway	Moveable Spans	3	14	Pier 5, 6 Footings	Footing strengthening (Major Footing)	\$ 2,000,000 / Pier	\$	1,500,000	\$ 1,900,000
Broadway	Moveable Spans	4	15	Anchor Struts	Unique - Strengthen or replace anchor struts	\$ 500,000 / Anchor Strut	\$	375,000	\$ 475,000
Broadway	Moveable Spans	5	16	Rall Wheel Track	Lateral Restrainers (Bascule)	/ Location (counterweight, toe \$ 200,000 etc.)	s, \$	150,000	\$ 190,000
Broadway	Moveable Spans	6	17	Truss Frame at Counterweight	Truss frame strengthening (increase member size)	\$ 2,000,000 / Area identified	\$	1,500,000	\$ 1,900,000
Broadway	Moveable Spans	7	18	Truss Frame at Rall Wheel	Truss frame strengthening (increase member size)	\$ 2,000,000 / Area identified	\$	1,500,000	\$ 1,900,000
Broadway	Moveable Spans	8	19	Bascule Leaf Lateral Movement	Lateral Restrainers (Bascule)	\$ 200,000 (counterweight, toe	\$	150,000	\$ 190,000
Broadway	Moveable Spans	9	20	Live Load Shoes	Transverse restraint (shear keys)	\$ 75,000 / Bent	\$	56,000	\$ 71,000
Broadway	East Approach	1	21	Abutments	Abutment strengthening (provide concrete built up connection at joint)	\$ 100,000 / Abutment	\$	75,000	\$ 95,000
Broadway	East Approach	2	22	Interior Pier Wall	Abutment strengthening (provide concrete built up connection at joint)	\$ 100,000 / Abutment	\$	75,000	\$ 95,000

Multnomah County CIP - Seismic Vulnerability Form Descriptions matched to Standard Retrofit Types

			futerieu to otuni								
					Solution Column strengthening footing Solution Solutio						
		Vulnerability				cost for 1000 yr		w/ 0.7	5 factor	w/ 0.	.95 Factor
Bridge	Location	#	Count	Author's Description	Matched Standard description			for 10	10 yr event	for 5	500 yr event
					I	includes 1.75 facto	r for Burnside higher p	perfor	mance leve	el	
Burnside	West Approach	1	1	Columns	Column strengthening	\$ 130,000	/ Column	\$	98,000	\$	124,000
<u>Burnside</u>	West Approach	2	2	Footings		\$ 880,000	/ Footing	\$	660,000	\$	836,000
Burnside	West Approach	3	3	Superstructure Seating on Expansion Bent	Longitudinal restrainers	\$ 180.000	/ Bent	\$	135,000	\$	171,000
Burnside	West Approach	4	4	Pier Caps/Floor Beams	Bent cap strengthening	1	/ Bent	\$	195,000	\$	247,000
Burnside	Fixed River Spans	1&2	5	Liquefaction/Slope Stability/Lateral Spreading	Soil Densification	\$ 12,250,000	West Side of	\$	9,188,000	\$	11,638,000
<u>Burnside</u>	Fixed River Spans	3	6	Piers 1, 4 Foundation Timber Piles	None	\$ -		\$	-	\$	-
Burnside	Fixed River Spans	4	7	Piers 1, 4, Columns	Column strengthening	\$ -	/ Column	\$	-	\$	-
Burnside	Fixed River Spans	5	8	Connections - super to sub., Fixed Bearings and Seat Width	Bearing replacement	\$ 130,000	/ Bent	\$	98,000	\$	124,000
Burnside	Fixed River Spans	6	9	Connections - super to sub., Expansion Bearings and Seat Width	Bearing replacement	\$ 130,000	/ Bent	\$	98,000	\$	124,000
Burnside	Fixed River Spans	7	10	Joint in Deck System	Abutment strengthening (provide concrete built up connection at joint)	\$ 180,000	/ Abutment	\$	135,000	\$	171,000
Burnside	Fixed River Spans	8	11	Approach Deck Fixed Connection to Piers 1 & 4	None	\$ -		\$	-	\$	-
Burnside	Fixed River Spans	9	12	Truss System - Connections of Primary Members	None	\$-		\$	-	\$	-
<u>Burnside</u>	Fixed River Spans	10 & 11	13	Overhead Sign Structures / Lightings	None	\$ -		\$	-	\$	-
Burnside	Moveable Spans	1	14	Pier 2, 3 Foundation Timber Piles	Footing strengthening (Major Footing)	\$ 3,500,000	/ Pier	\$ 3	2,625,000	\$	3,325,000
Burnside	Moveable Spans	2	15	Piers 2 & 3 Bascule Pier Wall below Truss Seats	Pier strengthening	\$ 4,380,000	/ Pier	\$	3,285,000	\$	4,161,000
Burnside	Moveable Spans	3	16	Connections - super to sub., Trunnion Support Vertical Post	Unique - Install transverse braces to trunnion support posts	\$ 1,750,000	/ Location	\$	1,313,000	\$	1,663,000
Burnside	Moveable Spans	4	17	Connections - super to sub., Anchorage of Trunnion to Bascule Piers	Isolation bearings	\$ 880,000	/ Bearing	\$	660,000	\$	836,000
Burnside	Moveable Spans	5	18	Joint in the Deck System at Piers 2 and 3	Longitudinal restrainers	\$ 180,000		\$	135,000	\$	171,000
<u>Burnside</u>	Moveable Spans	6	19	Bascule Leaf Transverse Restraint	Lateral Restrainers (Bascule)	\$ 350,000	/ Location (counterweight, toe, etc.)	\$	263,000	\$	333,000
Burnside	Moveable Spans	7	20	Bascule Leaf Transverse Bracing	Truss frame strengthening (increase member size)	\$ 3,500,000	/ Area identified	\$ 3	2,625,000	\$	3,325,000
Burnside	Moveable Spans	8	21	Counterweight Restrainers	Lateral Restrainers (Bascule)	\$ 350,000	/ Location (counterweight, toe, etc.)	\$	263,000	\$	333,000
Burnside	Moveable Spans	9	22	Counterweight Link Fuse	Unique - Install steel strut to counterweight link	\$ 880,000	/ Leaf	\$	660,000	\$	836,000
Burnside	Moveable Spans	10	23	Mechanical Equipment / Working Parts	Bearing replacement	\$ 888,000	/ Leaf	\$	666,000	\$	844,000
Burnside	Moveable Spans	11	24	Pier Houses		\$-		\$	-	\$	-
Burnside	Moveable Spans	12	25	Lightings		\$-		\$		\$	-
Burnside	East Approach	1	26	Pile Caps	Column strengthening		/ Column	\$	98,000		124,000
Burnside Burnside	East Approach	2	27	Spread Footing	None	\$ -		\$ ¢		\$ ¢	-
Burnside Burnside	East Approach	3 4	28	Spread Footing Superstructure Seating on Abutment	None Seat Extender	\$ -	/ Pont	\$		\$ ¢	-
Burnside Burnside	East Approach East Approach	4 5	30	Connections - Bents to Below Ground Foundations	Column strengthening	\$ 130,000 \$ 130,000	/ Bent / Column	\$ \$	98,000 98,000		124,000 124,000
Burnside	East Approach	6	31	Bent Column (concrete encased steel column pairs with bracing)	Column strengthening		/ Column	\$	98,000	\$	124,000
Burnside	East Approach	7	32	Bent Column (concrete column)	Column strengthening	\$ 130,000		\$	98,000	\$	124,000
Burnside	East Approach	8	33	Rocker Bearing	Bearing replacement	\$ 130,000		\$	98,000		124,000
Burnside	East Approach	9	34	Seat Width (Expansion)	Seat Extender	\$ 130,000	-	\$	98,000	\$	124,000
Burnside	East Approach	10	35	Connection - Substructure to Superstructure	Column strengthening	1	/ Location	\$	98,000	\$	124,000
Burnside	East Approach	11	36	Expansion Joint	None	\$ -		\$	-	\$	-
Burnside	East Approach	12	37	Concrete Encased Steel Floorbeam	Unique - Provide additional floorbeam bracing	\$ 180,000	/ Location	\$	135,000	\$	171,000
Burnside	East Approach	13	38	Overhead Structure near end of East Approach	None	\$ -		\$	-	\$	-

Multnomah County CIP - Seismic

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				By: TCA Checked: KPBU				
				Checked. KPB0	5/21/2014	1		
Bridge	Location	Vulnerability #	Count	Author's Description	Matched Standard description	cost for 1000 yr event	.75 factor 100 yr event	
	-			-		-		
Morrison	West Approach	1	1	Footing	Footing strengthening (Standard footing)	\$ 500,000 / Footing	\$ 375,000	\$ 475,000
Morrison	West Approach	2	2	Footing	Footing strengthening (Standard footing)	\$ - / Footing	\$ -	\$ -
Morrison	West Approach	3	3	Column	Column strengthening	\$ 75,000 / Column	\$ 56,000	71,000
Morrison	West Approach	4	4	Bent Cap	Bent cap strengthening	\$ 150,000 / Bent	\$ 113,000	143,000
Morrison	West Approach	5	5	Girder Restraint	Longitudinal restrainers	\$ 100,000 / Bent	\$ 75,000	95,000
Morrison	West Approach	6	6	Superstructure bearings at bent caps	Bearing replacement	\$ 75,000 / Bent	\$ 56,000	71,000
Morrison	West Approach	7	7	Superstructure Diaphragms	Girder Strengthening at Bearings	\$ 75,000 / Bent	\$ 56,000	\$ 71,000
Morrison	West Approach	8	8	Expansion Joints	Longitudinal restrainers	\$ - / Bent	\$ -	\$ -
Morrison	Fixed River Spans	1	9	Footing	Footing strengthening (Major Footing)	\$ 2,000,000 / Pier	\$ 1,500,000	\$ 1,900,000
Morrison	Fixed River Spans	2	10	Column	Column strengthening	\$ 75,000 / Column	\$ 56,000	\$ 71,000
Morrison	Fixed River Spans	3	11	Bent Cap	Bent cap strengthening	\$ 150,000 / Bent	\$ 113,000	\$ 143,000
Morrison	Fixed River Spans	4	12	Trunnion Support Frame	Unique - Strengthen Trunnion Beam and supports	\$ 1,500,000 / Leaf	\$ 1,125,000	\$ 1,425,000
Morrison	Fixed River Spans	5	13	Superstructure Bearing at bent caps	Isolation bearings	\$ 500,000 / Bearing	\$ 375,000	\$ 475,000
Morrison	Fixed River Spans	6	14	Superstructure Diaphragms	Truss lateral brace strengthening	\$ 500,000 / Area identified	\$ 375,000	\$ 475,000
Morrison	Fixed River Spans	7	15	Truss Laterals	Truss lateral brace strengthening	\$ 500,000 / Area identified	\$ 375,000	\$ 475,000
Morrison	Fixed River Spans	8	16	Pit Span Bearing Seats	Seat Extender	\$ 75,000 / Bent	\$ 56,000	\$ 71,000
Morrison	Fixed River Spans	9	17	Deck Support Columns at Pit Span	Truss frame strengthening (increase member size)	\$ 2,000,000 / Area identified	\$ 1,500,000	\$ 1,900,000
Morrison	Moveable Spans	1	18	Superstructure bearings at bent caps	Isolation bearings	\$ 500,000 / Bearing	\$ 375,000	\$ 475,000
Morrison	Moveable Spans	2	19	Truss Diaphragms	Truss frame strengthening (increase member size)	\$ 2,000,000 / Area identified	\$ 1,500,000	\$ 1,900,000
Morrison	Moveable Spans	3	20	Bascule Truss Lateral Brace	Truss lateral brace strengthening	\$ 500,000 / Area identified	\$ 375,000	\$ 475,000
Morrison	Moveable Spans	4	21	Truss Bearing Anchor Bolts	Bearing replacement	\$ 75,000 / Bent	\$ 56,000	\$ 71,000
Morrison	Moveable Spans	5	22	Counterweight Braces	Truss frame strengthening (increase member size)	\$ 2,000,000 / Area identified	\$ 1,500,000	\$ 1,900,000
Morrison	Moveable Spans	6	23	Truss Lateral Support	Truss lateral brace strengthening	\$ 500,000 / Area identified	\$ 375,000	\$ 475,000
Morrison	Moveable Spans	7	24	Piers 2 and 3	Pier strengthening	\$ 2,500,000 / Pier	\$ 1,875,000	\$ 2,375,000
Morrison	East Approach	1	25	Footing	Footing strengthening (Standard footing)	\$ 500,000 / Footing	\$ 375,000	\$ 475,000
Morrison	East Approach	2	26	Footing	Footing strengthening (Standard footing)	\$ - / Footing	\$ -	\$ -
Morrison	East Approach	3	27	Column	Column strengthening	\$ 75,000 / Column	\$ 56,000	\$ 71,000
Morrison	East Approach	4	28	Bent cap	Longitudinal restrainers	\$ 100,000 / Bent	\$ 75,000	\$ 95,000
Morrison	East Approach	5	29	Bent cap - Restrainers	Bent cap strengthening	\$ 100,000 / Bent	\$ 75,000	\$ 95,000
Morrison	East Approach	6	30	Superstructure Bearing at bent caps	Bearing replacement	\$ 75,000 / Bent	\$ 56,000	\$ 71,000
Morrison	East Approach	7	31	Superstructure Diaphragms	Girder Strengthening at Bearings	\$ 75,000 / Bent	\$ 56,000	\$ 71,000
Morrison	East Approach	8	32	Superstructure Girders	Girder Strengthening at Bearings	\$ 75,000 / Bent	\$ 56,000	\$ 71,000
Morrison	East Approach	9	33	In Span Hinge Restraints	Longitudinal restrainers	\$ 100,000 / Bent	\$ 75,000	\$ 95,000

Multnomah County CIP - Seismic

				By: TCA Checked: KPBL	5/20/2014 5/21/2014			
					3/2//2014	1		
Bridge	Location	Vulnerability #	Count	Author's Description	Matched Standard description	cost for 1000 yr event	w/ 0.75 factor for 100 yr event	
Hawthorne	West Approach	1	1	Pile to cap connection	Footing strengthening (Standard footing)	\$ 500,000 / Footing	\$ 375,000	\$ 475,000
Hawthorne	West Approach	2	2	Spread footing	Footing strengthening (Standard footing)	\$ 500,000 / Footing	\$ 375,000	\$ 475,000
Hawthorne	West Approach	3	3	Abutment 3 Electrical Vault	Abutment strengthening (provide concrete built up connection at joint)	\$ 100,000 / Abutment	\$ 75,000	\$ 95,000
Hawthorne	West Approach	4	4	Connections - Bents columns to spread footings	Column strengthening	\$ - / Column	\$ -	\$ -
Hawthorne	West Approach	5	5	Connections - Abutments to spread footings	Abutment strengthening (provide concrete built up connection at joint)	\$ 100,000 / Abutment	\$ 75,000	\$ 95,000
Hawthorne	West Approach	6	6	Bent columns	Column strengthening	\$ 75,000 / Column	\$ 56,000	\$ 71,000
Hawthorne	West Approach	7	7	Seat Widths	Seat Extender	\$ 75,000 / Bent	\$ 56,000	\$ 71,000
Hawthorne	West Approach	8	8	Cap Beams	Bent cap strengthening	\$ 150,000 / Bent	\$ 113,000	\$ 143,000
Hawthorne	Fixed River Spans	1	9	Bearings for Piers 1-4, 7	Isolation bearings	\$ 500,000 / Bearing	\$ 375,000	\$ 475,000
Hawthorne	Fixed River Spans	2	10	Superstructure pulling off Piers 1-4, 7	Transverse restraint (shear keys)	\$ 75,000 / Bent	\$ 56,000	\$ 71,000
Hawthorne	Fixed River Spans	3	11	Piles at Piers 1 & 7	Soil Densification	 / Bridge Site (i.e West Side of \$ 7,000,000 Broadway Bridge) 	\$ 5,250,000	\$ 6,650,000
Hawthorne	Fixed River Spans	4	12	Bottom Chord lateral bracing spans 1-4, 6	Truss lateral brace strengthening	\$ 500,000 / Area identified	\$ 375,000	\$ 475,000
Hawthorne	Fixed River Spans	5	13	Existing Piers	Pier strengthening	\$ 2,500,000 / Pier	\$ 1,875,000	\$ 2,375,000
Hawthorne	Moveable Spans	1	14	Bearings for Pies 5-6	Isolation bearings	\$ 500,000 / Bearing	\$ 375,000	\$ 475,000
Hawthorne	Moveable Spans	2	15	Superstructure pulling off Piers 5-6	Transverse restraint (shear keys)	\$ 75,000 / Bent	\$ 56,000	\$ 71,000
Hawthorne	Moveable Spans	3	16	Bottom Chord Lateral Bracing Span 5	Truss lateral brace strengthening	\$ 500,000 / Area identified	\$ 375,000	\$ 475,000
Hawthorne	Moveable Spans	4	17	Towers at Bents 5&6	Unique - Strengthen tower members	\$ 8,000,000 / Tower	\$ 6,000,000	\$ 7,600,000
Hawthorne	Moveable Spans		18	Existing Piers	Pier strengthening	\$ 2,500,000 / Pier	\$ 1,875,000	2,375,000
Hawthorne	East Approach	1	19	Columns	Column strengthening	\$ 75,000 / Column	\$ 56,000	\$ 71,000
Hawthorne	East Approach	2	20	Pile Cap Footings	Footing strengthening (Standard footing)	\$ 500,000 / Footing	\$ 375,000	475,000
Hawthorne	East Approach	3	21	Superstructure Seating on Pier 1	Longitudinal restrainers	\$ 100,000 / Bent	\$ 75,000	95,000
Hawthorne	East Approach	4	22	Superstructure Connection at Pier 1	Transverse restraint (shear keys)	\$ 75,000 / Bent	\$ 56,000	71,000
Hawthorne	East Approach	5	23	Superstructure Seating on Expansion Bent	Longitudinal restrainers	\$ 75,000 / Bent	\$ 56,000	71,000
Hawthorne	East Approach	6	24	Superstructure Seating on Bent 7M, 6W, 7H	Seat Extender	\$ 75,000 / Bent	\$ 56,000	71,000
Hawthorne	East Approach	7	25	Columns	Column strengthening	\$ 75,000 / Column	\$ 56,000	\$ 71,000
Hawthorne	East Approach	8	26	Pile cap footings	Footing strengthening (Standard footing)	\$ 500,000 / Footing	\$ 375,000	475,000
Hawthorne	East Approach	9	27	Superstructure Seating Abutments A1, A2, A3	Seat Extender	\$ 75,000 / Bent	\$ 56,000	\$ 71,000

Multnomah County CIP - Seismic Standard and Unique Retrofit Descriptions and Unit Costs

By: TCA	5/20/2014
Checked: KPBU	5/21/2014

Retrofit Description	Bridge	construction activities	Notes	Total	Unit
		•Create access for work area			
Abutment strengthening		•Dowel in new rebar at abutment to			
(provide concrete built up		superstructure connection, form and		\$ 100,00	0 / Abutment
connection at joint)		pour concrete build up sections		φ 100,00	o //toutiliont
		 Allow concrete to cure before project 			
		clean up			
		Create access for work area		-	
		Jack superstructure and provide			
Bearing replacement		temporary supports for dead load •Remove and replace or strengthen		\$ 75,00	0 / Bent
bearing replacement		existing bearing		φ /0,00	0 / Done
		•Lower superstructure and remove			
		temporary supports			
		Create access for work area			
		•Remove existing concrete by hammer		1	
		or drill, leaving existing rebar exposed			
Bent cap strengthening		•Dowel or tie new flexural and shear	Assumes cap build-up with post	\$ 150,00	0 / Bent
		reinforcement, form and pour concrete	tensioning		
		•Allow concrete to cure before project	-	-	
		clean up			
		Provide post tensioning of bent cap		1	
		•Create access for work area including			
		column tops			
		 At connections, remove existing 			
		concrete from column by hammer or			
		drill, leaving rebar exposed		-	
		•At connections, dowel or tie new	Assumes connection detail modifications		
		flexural and shear reinforcement, form	at top and bottom of column.		
Column strengthening		and pour concrete over rebar		\$ 75,00	0 / Column
		 Place steel jacket around the column 	Assumes steel jacketing used as primary		
		and weld seam to seal enclosure	strengthening measure.		
		-Dour concrete filler between evicting		1	
		 Pour concrete filler between existing column surface and jacket to close void 			
		-			
		•Allow concrete to cure before project			
		clean up Isolate work area from traffic or 			_
		temporary road closure			
		•Excavate area around footing and		1	
		provide shoring as needed			
		•Remove deteriorated existing concrete		1	
		from footing by drill or hammer, leaving	Assumed to have tight work areas		
		rebar exposed			
Footing strengthening		•Dowel or tie in additional flexural and			
(standard footing)		shear rebar, form and pour new footing	Assumed for footings on land.	\$ 500,00	0 / Footing
		 Place new deep foundation members 			
		(micro-piles, drilled shafts, piles)			
		•Place new reinforcing cage and			
		concrete			
		•Allow concrete to cure before project			
		clean up			

Multnomah County CIP - Seismic Standard and Unique Retrofit Descriptions and Unit Costs

By: TCA	5/20/2014
Checked: KPBU	5/21/2014

	5		Netes		
Retrofit Description	Bridge	construction activities	Notes	Total	Unit
		•Create isolated work area around foundation with cofferdam and dewater			
		•Create access to the foundation location by work bridge, barge, or other measures			
		•Remove deteriorated existing concrete from footing by drill or hammer, leaving rebar exposed	Assumed for footings in river		
Footing strengthening (Major Footing)		•Excavate area around footing and provide shoring as needed		\$ 2,000,000) / Pier
		•Drill and dowell into existing foundation			
		•Place new deep foundation members (micro-piles, drilled shafts, piles)			
		•Place new reinforcing cage and concrete			
		•Allow concrete to cure before project clean up			
Girder Strengthening at		Create access for work area			
Bearings		 Install additional diaphragms or stiffeners to girders 		\$ 75,000) / Bent
		Create access for work area			
		 Jack superstructure and provide 		1	
Isolation boorings		temporary supports for dead load	These secure large basis of factors	\$ 500,000	/ Rearing
Isolation bearings		•Remove and replace existing bearing with isolation bearing	These assume large bearings for truss supports.	\$ 500,000) / Bearing
		•Lower superstructure and remove		•	
		temporary supports			
Lateral Restrainers		Create access for work area	Assumed to include counterweight	-	/ Location
(Bascule)		 Install lateral restraining devices alongside bascule or lift portions of bridge 	Assumed to include counterweight restraints, toe restraints, or heal restraints.	\$ 200,000) (counterweight , toe, etc.)
		•Create access for work area •Install transverse shear keys			
Longitudinal restrainers		 Install retrainer cable connections to girders and bent cap, install restrainer cable with recommended minimum sag Assumed to also include transverse shear keys in most locations 		\$ 125,000) / Bent
		•Create access to the pier location by work bridge or barge.			
		 Isolate work area river using cofferdams 			
Pier strengthening		Install additional anchor bolts where needed	Assumed to be pier in water	\$ 2,500,000) / Pier
		•drill and dowel additonal reinforcing into pier			
		•Place concrete encasement/strengthening around pier			
		•Create access to work area			/ Bridge Site
Soil Densification		 Provide soil densification via injection grouting, stone columns, or other method 	Assumed area is large enough to provide support of bridge foundations under large lateral spreading movement or liquifaction	\$ 7,000,000	(i a West Side
		•Create access to work area			
Seat Extender		•Furnish and install new seat extender (concrete seat extenders require doweling of new rebar, steel extenders require new anchorage such as steel rods)		\$ 75,000) / Bent
		•Create access for work area			
Transverse restraint (Shear Keys)		Install transverse shear keys	Assumed to be in areas where longitudinal restrainers are not needed.	\$ 75,000) / Bent

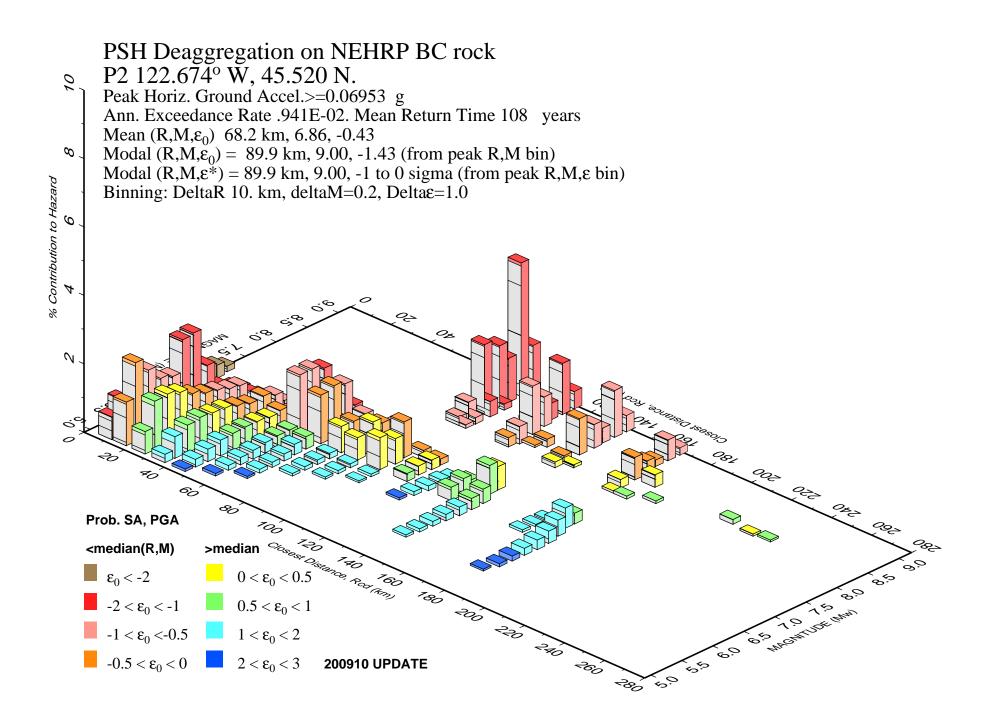
Multnomah County CIP - Seismic Standard and Unique Retrofit Descriptions and Unit Costs

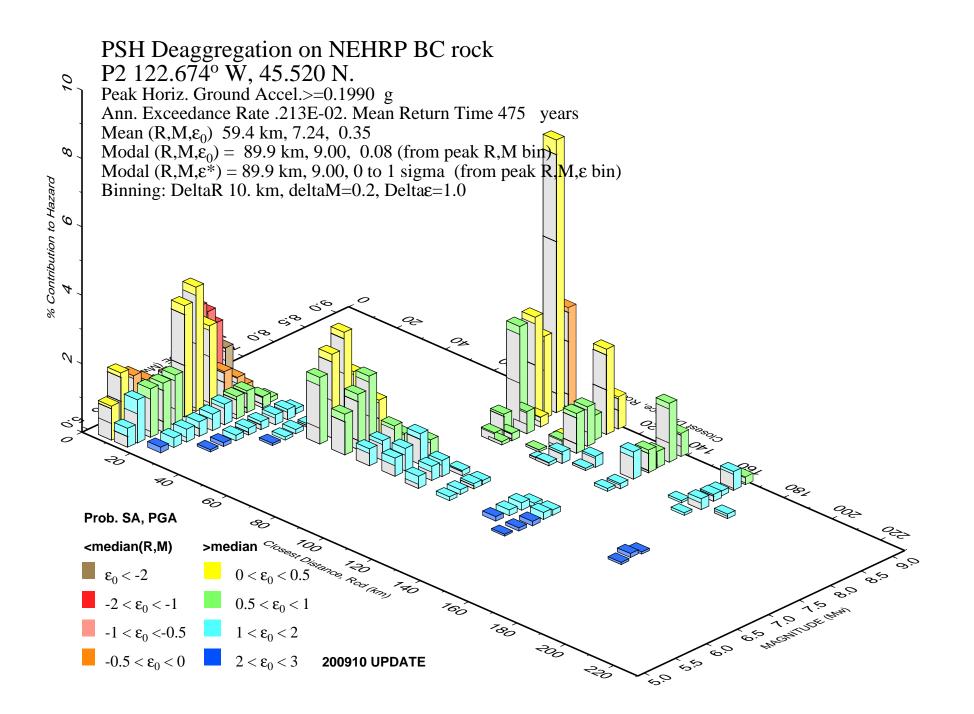
By: TCA	5/20/2014
Checked: KPBU	5/21/2014

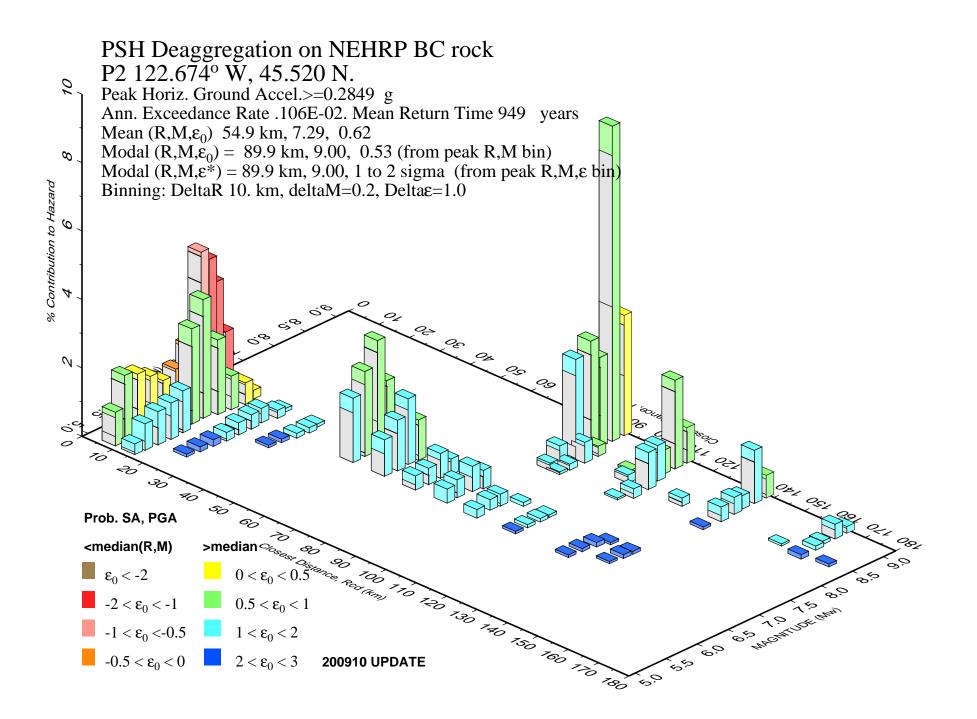
Retrofit Description	Bridge	construction activities	Notes	Total	Unit	
	-	•Create access to the truss location				
Truss frame strengthening (increase member size)		•Support adjacent connecting members and superstructure temporarily		\$ 2,000,000	/ Area identified	
		•Remove and replace or build up deficient truss member	Cost is per area identified (ie frame around counterweight, portal frames,etc)		laonanoa	
		 Create access to the truss location 		_		
Truss lateral brace strengthening		•Support adjacent connecting members and superstructure temporarily		\$ 500,000	/ Area identified	
		•Remove and replace or build up deficient truss member				
		•Create access for work area including column tops	Assumes connection detail modifications at top and bottom of column.			
Unique - Broadway Large Steel Column Retrofit	BW	•Place steel jacket around the column and weld seam to seal enclosure		\$ 500,000	/ Column	
		•At connections, dowel or tie new flexural and shear reinforcement, form and pour concrete over rebar				
		Install braces between columns Create access to the moveable span		-		
Unique - Strengthen or replace anchor struts	BW	anchor strut location by scaffolding or other measures		\$ 500,000	/ Anchor Stru	
		•Remove and replace existing anchor strut with stronger, stiffer member			,	
Unique - Install transverse		•Create access to the trunnion location by scaffolding or other measures				
braces to trunnion support posts	ort BU	 Install traverse braces to trunnions (steel bumpers, additional anchorages doweled into trunnion cap) 		\$ 1,000,000	/ Location	
Unique - Install steel strut to counterweight link	BU	•Create access to the counterweight and counterweight link location by scaffolding or other measures •Furnish and install steel strut to restrain		- \$ 500,000	/ Leaf	
		longitudinal movement of the counterweight				
		•Create access to the floorbeam location by scaffolding or other measures				
Unique - Provide additional floorbeam bracing	BU	 Isolate work area from traffic or temporary road closure 		\$ 100,000	/ Location	
		•Furnish and drill new brace connection plates, then install new braces				
		•Create access to the tower location by				
Unique - Strengthen		scaffolding or other measures •Support adjacent connecting members tomporarily		-		
Trunnion Beam and Supports	MO	temporarily •Place steel, concrete, and post tensioning to strengthen trunnion beam.		\$ 1,500,000	/ Leaf	
		•Strengthen trunnion towers		1		
		•Create access to the tower location by				
		scaffolding or other measures	_			
Linique Strengther tour		 Support adjacent connecting members temporarily 				
Unique - Strengthen tower members	HA	HA *Remove/replace and strengthen deficient tower members •Install dampening devices		\$ 8,000,000	/ Tower	
members						
	Install dampening devices Isolate work area from traffic or					
		temporary road closure				

Attachment D

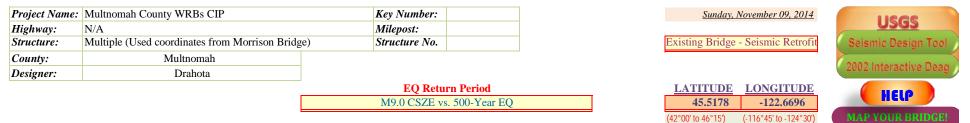
Probabilistic Seismic Hazard Plots











	2002 US	GS Seismic Haz	ard Data								_	
Site Class	PGA (g)	S _s (g)	S ₁ (g)	\mathbf{F}_{pga}	Fa	F _v	A _s (F _{pga} *PGA	$S_{DS} (F_a * S_s)$	$\mathbf{S}_{\mathbf{D}1} \left(\mathbf{F}_{\mathbf{v}}^{*} \mathbf{S}_{1} \right)$	SDC	$T_S = S_{D1} / S_{DS}$	$T_0 = 0.2 T_S$
С	0.1914	0.4500	0.1533	1.2000	1.2000	1.6467	0.2297	0.5401	0.2524	III	0.47	0.09
	0.1358	0.2775	0.1271	1.2000	1.2000	1.6729	0.1629	0.3330	0.2126		0.64	0.13

500-Year EQ								
Period, T (sec)	S _a (g)							
0.00	0.2160							
0.09	0.5401							
0.20	0.5401							
0.47	0.5401							
0.60	0.4207							
0.80	0.3155							
1.00	0.2524							
1.20	0.2103							
1.40	0.1803							
1.60	0.1578							
1.80	0.1402							
2.00	0.1262							
2.20	0.1147							
2.40	0.1052							
2.60	0.0971							
2.80	0.0901							
3.00	0.0841							
3.20	0.0789							
3.40	0.0742							
3.60	0.0701							
3.80	0.0664							
4.00	0.0631							
4.00	0.0631							

