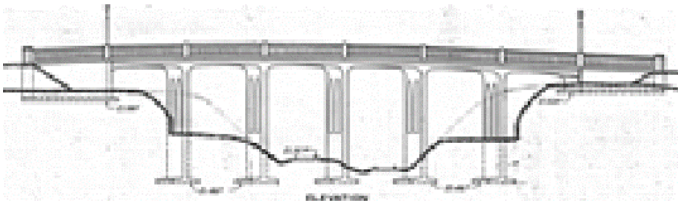
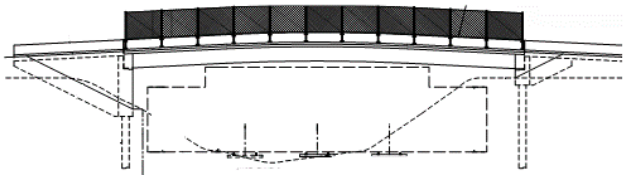




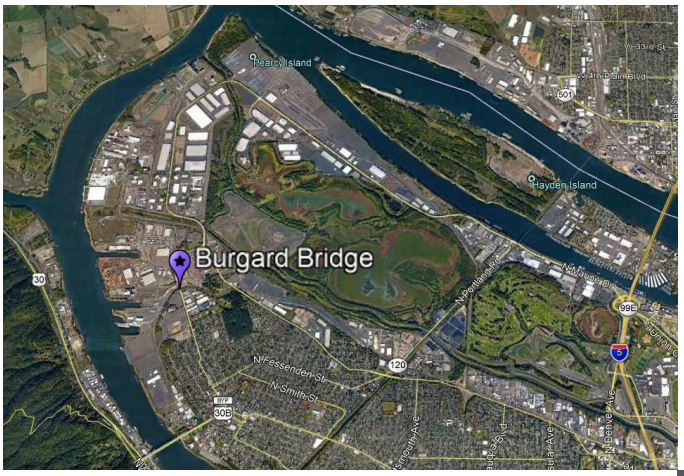
Feasibility Report (Draft)

PBOT North Burgard Road Bridge
Bridge Replacement Feasibility Study

Prepared for:

October 21, 2020

PBOT
PORTLAND BUREAU OF TRANSPORTATION



Contents

Figures

Appendices

Acronyms and Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
ADA	Americans with Disabilities Act
BDM	Bridge Design Manual
BNSF	Burlington Northern Santa Fe
LRFR	Load & Resistance Factor Rating
LRFD	Load and Resistance Factor Design
ODOT	Oregon Department of Transportation
PBOT	City of Portland Bureau of Transportation
pcf	pounds per cubic foot
ROW	right-of-way
UPRR	Union Pacific Railroad

1 Executive Summary

The existing Burgard Road Bridge (Portland Bureau of Transportation [PBOT] Bridge No. 001, National Bridge Inventory Bride No. 25B01) carries vehicular and pedestrian traffic of North Lombard Street (Burgard Street) over Union Pacific Railroad (UPRR). The six span 125'-0" long reinforced concrete bridge was originally constructed in 1930 and has been modified and rehabilitated numerous times. Based on the 2012/2013 PBOT appraisal, it was assessed to have a remaining service life of *negative* 8 years and is in need of Phase 1&2 seismic rehabilitation.

This feasibility report is a desktop study that assembles available technical information and background data to develop a concept level recommendation for bridge replacement that can be used by the PBOT for future planning and project development. The report is supported by a series of preliminary technical memorandums developed over the course of the study, all of which are provided as appendices to this report as follows:

- Preliminary Geotechnical Engineering Assessment (Appendix C)
- Burgard Bridge Cross Sections (Appendix D)
- Site Research and Design Files (Appendix E)
- Bridge Replacement Construction Staging Considerations (Appendix F)

This feasibility study recommendation establishes a preliminary programmatic cost estimate for the project based on a proposed configuration that includes bridge type, roadway cross section, horizontal and vertical alignments, and overall extents of the project. The intent and function of the bridge is discussed, and the design criteria is established which identifies relevant design code documents and project specific geometric factors for both permanent and temporary conditions.

2 Geometric Factors and Constraints

The primary geometric constraints are related to the existing right-of-way (ROW) at the project site, UPRR minimum vertical and horizontal clearance requirements, and compliance with Americans with Disabilities Act (ADA) requirements.

2.1 Right-of-way Considerations

Project objectives defined in the scope of work for the feasibility study establish that the bridge is to provide a single clear span across the UPRR ROW, which measures 100'-0" at a skewed orientation to the roadway alignment. The proposed bridge is also to be located within the existing City of Portland ROW, which measures 80'-0 out-to-out perpendicular to the roadway alignment. These requirements also apply to the construction phase, which was a primary layout consideration for the various alternatives considered in *Analysis of Construction Staged Options* memorandum (Appendix F).

2.2 Vertical Clearance Requirements

The UPRR requirement for vertical clearance is 23'-6" as defined in the UPRR Guidelines for Railroad and Grade Separated Projects. The vertical clearance envelope was established based on this requirement, and considers an additional or future track within the horizontal clearance envelope. The vertical clearance window establishes the low chord elevation of the proposed bridge, which defines the vertical alignment of the roadway based on the structure depth required to clear span the UPRR ROW.

2.3 ADA Requirements

The proposed bridge must comply with ADA requirements and meet the accessibility criteria for either a pedestrian circulation path (if the grade is 5 percent or less) or an access ramp with landing (if the grade is greater than 5 percent but less than or equal to 8.33 percent).

Cross slopes on sidewalks and walkways should not exceed 2 percent, but should be of sufficient grade to facilitate positive drainage and prevent water accumulating on the surface.

When grades need to exceed 5 percent (20 Horizontal:1 Vertical [H:V]), ramps and landings need to meet ADA requirements by providing:

- A maximum ramp slope of 8.33% (12H:1V) over a total vertical rise of 2'-6" (results in 30'-0" maximum length ramps at the maximum permitted grade).
- Landings providing a minimum of 5'-0" horizontal distance before and after ramps.

Compliance with the 5 percent ADA grade requirement establishes the extents of the projects based on the revised vertical alignment of the proposed bridge.

3 Design Criteria

The design criteria is anticipated to be a living document for overall project development from the initial feasibility study through the Type, Selection, and Location phase to final design and contract document development. The design criteria may require future modifications and refinements due to items such as evolving design standards, updated project objectives and stakeholder goals, or new site specific information that require additional criteria.

3.1 Applicable Design Standards and Reference

Primary design standards include the following reference documents:

- American Association of State Highway and Transportation Officials (AASHTO) Load and Resistance Factor Design (LRFD) Bridge Design Specifications, 9th Edition, 2020 (AASTHO LRFD)

- AASHTO LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, First Edition, 2015 with current interims through 2019 (AASHTO Signs)
- AASHTO *Guide Specifications for LRFD Seismic Bridge Design*, 2nd edition, 2011 with 2014 and 2015 Interims (AASHTO Seismic)
- AASHTO Manual for Bridge Evaluation, 2nd Edition
- Oregon Department of Transportation (ODOT) Bridge Design Manual, 2020 (ODOT BDM)
- ODOT Geotechnical Design Manual, 2019 (ODOT GDM)
- ODOT Highway Design Manual
- ODOT Load & Resistance Factor Rating (LRFR) Load Rating Manual, 2018 (ODOT LRFR)
- PBOT Standard Specifications for Construction
- City of Portland Street Design Guidelines for Trucks (Portland Street)
- City of Portland Protected Bike Lane Guide (Portland Bike)
- UPRR-Burlington Northern Santa Fe (BNSF) Guidelines for Railroad Grade Separation Project, 2016 (UPRR-BNSF)

3.2 Structural Design

Design basis of the bridge and retaining wall structures are primarily based the design standard provisions of AASHTO LRFD, ODOT BDM, and ODOT GDM.

Design loads are developed in accordance with these design standards, and structural analysis is performed to establish force demands for bridge superstructure, bridge substructure, and retaining wall components of the project.

3.2.1 Traffic Structure Design

The project is expected to require new and replacement traffic structures, including signal and light poles. The design will be in accordance with AASHTO Signs, and incorporate PBOT standards.

3.2.2 Structure Design Loading

Design loads are developed in accordance with the referenced design standards, with primary design loads for structural components summarized as follows:

Dead Loading

- Cast-in-place concrete: 155 pounds per cubic foot (pcf)
- Structural Steel: 490 pcf
- Soil: 125 pcf (unless prescribed otherwise by project-specific geotechnical reports)

- Additional dead loads of materials as necessary pcf if identified during design progression

Live Loading

- Pedestrian: 75 psf in accordance with the AASHTO LRFD
- HL-93 Load in accordance with the AASHTO LRFD
- ODOT Permit Vehicles in accordance with ODOT BDM and ODOT LRFR:
  - Type OR-STP-4E (13 Axle, GVW 258k)
  - Type OR-STP-5BW (9 Axle, GVW 204k)

Seismic Design

Seismic design will be in accordance AASHTO LRFD, AASHTO Seismic, and ODOT BDM. The design basis will consider both Life-Safety and Operational seismic events.

3.3 Civil Design

Project civil design component requirements include vertical and horizontal roadway alignments, grading plans, ROW, permitting, and surface drainage. Given the staged construction aspect of the project, the design will need to meet requirements for both temporary and permanent conditions.

4 Bridge Replacement Recommendation

Conceptual engineering drawings for the proposed replacement bridge are provided in Appendix A. The permanent configuration of the bridge is shown on sheet BR-1 with a plan view, elevation view, and typical section. Construction staging drawings are provided as an attachment to the memorandum provided in Appendix F.

4.1 Project Purpose and Bridge Function

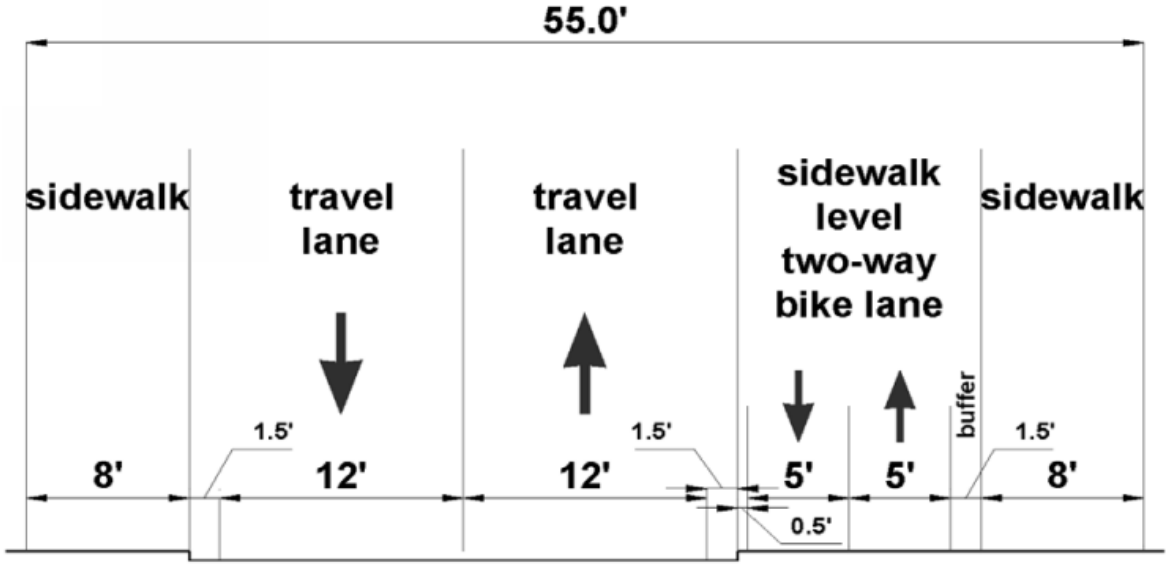
The existing Burgard Road Bridge provides a single lane of traffic in both directions and supports utilities cantilevered from the west side of the structure. On the east side of the structure, a raised pedestrian sidewalk is provided with bike lanes located on the roadway surface between the sidewalk curb and traffic lane delineators. The proposed replacement bridge will provide the same basic function, but with an increased cross section width that accommodates pedestrian sidewalks on both sides of the structure and locates the bike lanes on the raised sidewalk on the east side.

4.2 Roadway Cross Section

The recommended roadway cross section of the bridge was established in the Toole Memorandum, *Burgard Bridge Cross-Section Recommendations*, which is provided in Appendix D. That recommendation, shown in Figure 1, provides a 55-foot-wide cross section for vehicular and pedestrian traffic at the project site. A raised sidewalk for both

pedestrian and two-way bicycle traffic was recommended based on feedback from PBOT, which must comply with ADA regulations and be accounted for when the proposed vertical alignment is established.

Figure 1. Proposed Multi-Use Bridge Deck Cross Section



Note: The recommended cross section provides an overall deck width similar to 48’-8” provided by the existing bridge configuration.

Based on direction from PBOT staff, received during a work session on July 8, 2020, the temporary cross section during construction must provide pedestrian access and at least one vehicular lane of traffic. Because the site will not be closed during construction, a signalized single lane of traffic is the minimum standard, but a preference for two lanes was established. Though preferable, maintenance of bicycle traffic throughout construction is not required, however pedestrian access will be provided for all construction stages. A minimum vehicular lane width of 11’-0” and a minimum pedestrian sidewalk width of 5’-0” was established as the basis of design for the temporary condition during construction, with pedestrians separated from vehicular traffic with a median barrier or other similar approved measures.

4.3 Bridge Type and Configuration

The proposed replacement bridge is a 110’-0” long single-span structure with an out-to-out deck width of 57’-8”. The proposed bridge configuration was established in the *Site Research and Design Files memorandum* provided in Appendix E. The scope of the feasibility study was limited to conventional beam type structures that provide a clear span over the UPRR ROW, realistic design solution, and reasonable baseline for future phases of project development. To maintain both pedestrian and vehicular traffic during construction, the replacement bridge will be constructed in multiple construction stages as discussed in Section 4.4.

Bridge Superstructure

A conventional beam structure type, single-span, replacement bridge is proposed and composed of either precast prestressed concrete beams or structural steel beams. The structure will have a reinforced concrete bridge deck that is composite with either beam type. These beam structure types result in similar structure depth at the proposed span range, therefore not affecting the vertical alignment of the project in a meaningful way. Both beam types are commercially available and product delivery is not an obstacle based on the location of the project site. For the feasibility study, 48-inch deep precast prestressed concrete box beams are proposed. A spread (or spaced) box configuration is provided to accommodate differential deflections given the staged construction considerations discussed in Section 4.4.

As a Federal Highway Administration-defined National Highway System connector route, the proposed bridge is required to have 42-inch tall bridge rails that are crash tested to the TL-5 standard in accordance with the AASHTO Manual for Assessing Safety Hardware Joint Implementation Agreement (2016). The cross section of the proposed bridge locates the bridge rails on raised pedestrian sidewalks, which invokes the requirements associated with pedestrian rails. AASHTO LRFD requirements for pedestrian rails include a minimum height of 42 inches and a 54-inch height for rails adjacent to bicyclists. Additionally, protective fence must be included for the portion of the bridge rail that extends over the railroad ROW in accordance with UPRR-BNSF requirements.

All bridge deck surfaces will provide positive drainage to shed water away from the centerline of the bridge towards allowable retention areas or removed from the site by a deck drainage system meeting design and environmental standards. Bridge deck drainage will be designed to meet environmental standards and managed in accordance with the City of Portland's Stormwater Management Plan.

Bridge Substructure and Foundations

Design of bent foundations will consider structural and geotechnical behavior and interaction. Deep foundations comprised of either driven steel piles or drilled shafts are expected. These deep foundation elements will support a reinforced bent cap beam and the bridge superstructure. This substructure and foundation configuration will accommodate staged construction, which is expected based the maintenance of traffic requirements during construction.

Refined geotechnical information will be obtained from future project-specific geotechnical reports based on subsurface investigations, laboratory testing, and analysis. The Preliminary Geotechnical Assessment desktop study, developed by RhinoOne, is provided in Appendix C.

Retaining Walls

Retaining walls are expected throughout the project to accommodate the increased roadway embankment that results from the modified vertical alignment. Retaining walls may be parallel to UPRR ROW and roadway alignment. Temporary retaining walls will be required to accommodate grade changes during staged construction. Recommendations for the type of retaining wall(s) will be determined in conjunction with the geotechnical

engineer based on refined project-specific geotechnical subsurface investigations, laboratory testing, and analysis.

4.4 Staged Construction Scheme

Analyzing options for construction staging of the replacement bridge as maintenance of vehicular and pedestrian traffic is essential through construction. The *Analysis of Construction Staged Options* technical memorandum considered options for both staged construction with partial demo of the existing and partial construction of the replacement bridge including an option that uses an on-site temporary detour bridge (Appendix F). The memorandum's recommendation of staged construction per Alternative B was reviewed and accepted by PBOT as the basis for this feasibility study.

4.5 Programmatic Cost Estimate

The estimated costs associated with the recommended bridge replacement project are presented in worksheet summary FEAS-BURGARD, provided in Appendix B, and summarized below.

Base Construction Cost Subtotal

The base construction subtotal cost is estimated at $3.42M in 2020 dollars. Given the conceptual design level of the feasibility study, base construction costs are determined using a cost per square foot basis as follows:

- Bridge Construction: $285/square foot of bridge deck area
- Roadway Approach Construction: $40/square foot of roadway area

The base construction cost for bridge components was based on historical bid data published by ODOT for similar bridge types. Bridge construction costs typically range from $200 to $250 per square foot. The higher end value was selected as a baseline for this feasibility study, and then conservatively increased to account for complexities associated with staged construction and pedestrian features given the preliminary design development level.

The base construction cost for the roadway component was based on a preliminary cost estimate that considered primary bid items within the project limits, as shown in Attachment A of the *Site Research and Design Files Memorandum* (Appendix E). The preliminary cost estimate was developed based on conceptual level quantity takeoffs and associated unit costs of primary bid items that were then used to determine a cost per square foot of roadway area within the project limits.

Construction Cost Subtotal

The construction cost subtotal, which includes the base construction cost subtotal and the additional construction costs, is estimated at $4.00M in 2020 dollars. The additional construction costs are defined by PBOT and applied as factors to the base construction cost subtotal as shown in Table 1.

Table 1. PBOT Construction Cost Factors Applied to Estimated Base Costs

Contractor Mobilization	11.00%
Temporary Protection and Direction of Traffic	1.50%
Erosion Control	1.00%
Pollution Control Plan	0.10%
Removal of Structures and Obstructions	1.00%
Clearing and Grubbing	2.50%

Project Cost

The project cost subtotal, which includes the construction cost subtotal and soft costs, is estimated at $7.88M in 2020 dollars. Soft costs are defined by PBOT and applied as factors to the base construction cost subtotal as shown in Table 2.

Table 2. PBOT Soft Costs Applied to Total Construction Costs

Contract Contingency	10.00%
Construction Contingency	3.50%
Project Management	5.00%
Design Engineering	25.00%
Construction Management	15.00%
Project Engineering and Management Overhead	80.85%
Right-of-Way	2.00%

Programmatic Total Cost

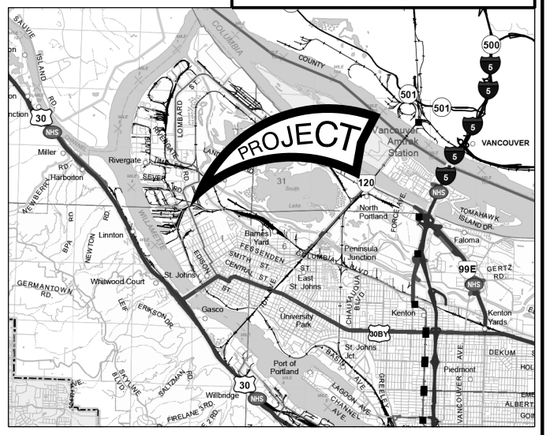
The total programmatic project cost, which applies a 20 percent allowance for design refinement to the project cost subtotal, was estimated at $9.45M in 2020 dollars.

5 Summary Next Steps

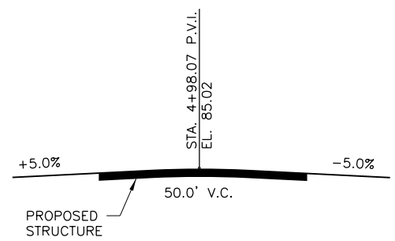
This study identified a feasible design solution for the replacement of the Burgard Road Bridge. The preliminary recommendation for bridge replacement is a 110’-0” single span structure with a total, estimated programmatic cost of $9.45M in 2020 dollars. This preliminary recommendation, along with the supporting technical information assembled as part of the study, establishes a reasonable starting point for future phases of project development.

Appendix A. Bridge Replacement Concept Drawings

PRELIMINARY REVIEW
10/2020



LOCATION MAP
NO SCALE



GRADELINE DIAGRAM
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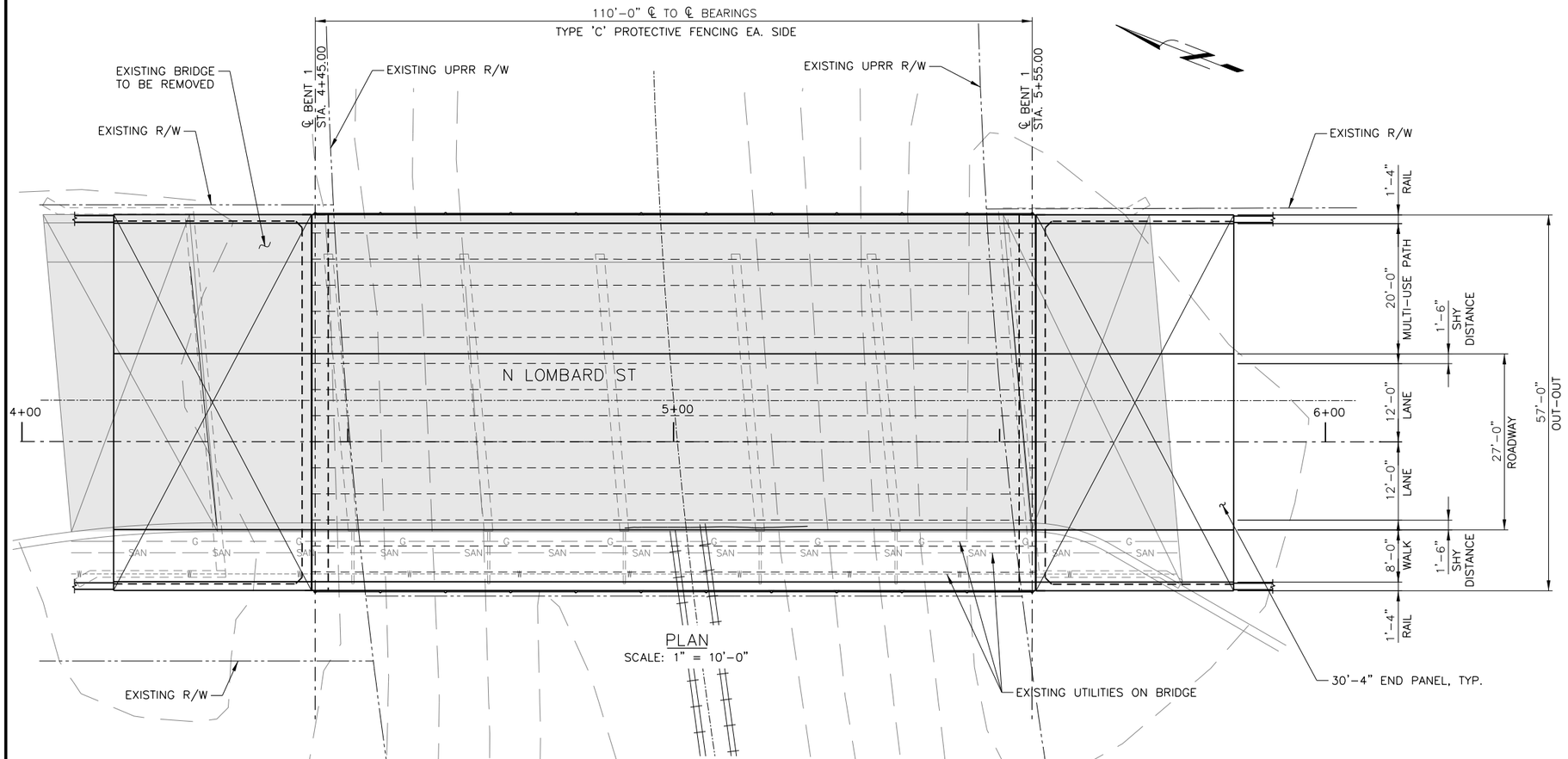
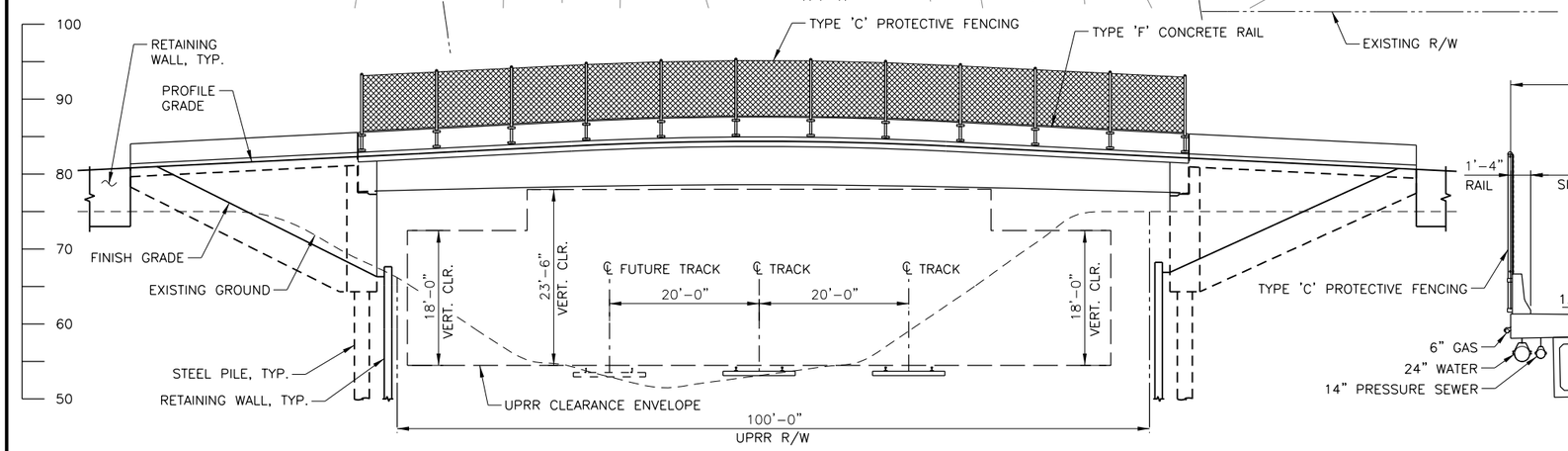
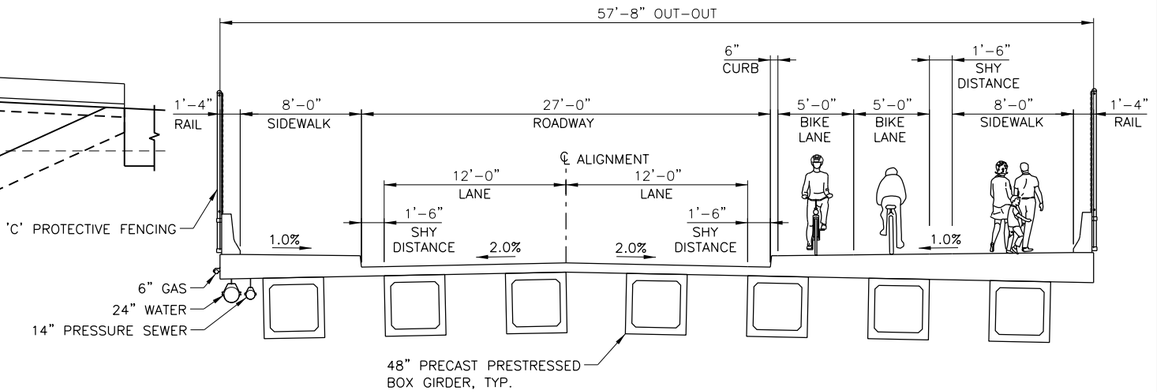


PLAN
SCALE: 1" = 10'-0"



ELEVATIONS SHOWN ARE BASED ON CITY OF PORTLAND DATUM.

ELEVATION
SCALE: 1" = 10'-0"



SECTION
(LOOKING BACK ON STATION)
SCALE: 1" = 5'-0"

WARNING
0 ½ 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

HDR

NO.	DATE	DESCRIPTION	DESCRIPTION	APPD.
		REVISION	REVISION	

DESIGNED BY	ER
CAD BY	HG
CHECKED BY	ES
DATE APPROVED	
DIV. ENGINEER	--

FEASIBILITY STUDY

NOT FOR CONSTRUCTION

APPROVALS:

SUPERVISING ENGINEER

CITY ENGINEER — REG. PROF. ENGR. NO. 51538PE

PBOT
PORTLAND BUREAU OF TRANSPORTATION
CHLOE EUDALY — COMMISSIONER
STEVE TOWNSEN, P.E. — CITY ENGINEER

CITY OF PORTLAND OREGON 1851

McLoughlin Blvd and Burgard Road Bridge Studies

LOMBARD ST BRIDGE OVER UPRR

PLAN AND ELEVATION

1/4 SECTION	---
PROJECT NO.	310001599 --
SHEET NO.	BR-1

Filename: $FILE$
$TIME$
Plot Date: $DATE$

Appendix B. Programmatic Cost Estimate

Bridge Name: Burgard Bridge Replacement

PBOT#: **FEAS-Burgard**

BASE CONSTRUCTION COSTS

Alignment Section name	Unit	Structure Width	Quantity (SQFT-DECK)	Unit Cost	Total
Bridge Construction	SQFT	57.667	6,343	$ 285.00	$ 1,807,850
Roadway/Civil Construction	SQFT	57.667	40,208	$ 40.00	$ 1,608,339
				SUBTOTAL	**$ 3,416,189**

SUBTOTAL	1.00	**$ 3,416,189**

TOTAL CONSTRUCTION COSTS

Contractor Mobilization	11.00%	$ 375,781
Temporary Protection and Direction of Traffic	1.50%	$ 51,243
Erosion Control	1.00%	$ 34,162
Pollution Control Plan	0.10%	$ 3,416
Removal of Structures and Obstructions	1.00%	$ 34,162
Clearing and Grubbing	2.50%	$ 85,405
	SUBTOTAL	**$ 4,000,358**

TOTAL PROJECT COSTS

Contract Contingency	10.00%	$ 400,036
Construction Contingency	3.50%	$ 140,013
Project Management	5.00%	$ 200,018
Design Engineering	25.00%	$ 1,000,089
Construction Management	15.00%	$ 600,054
Project Engineering and Management Overhead	80.85%	$ 1,455,430
Right-of-Way	2.00%	$ 80,007
	SUBTOTAL	**$ 7,876,004**

ESCALATION AND ALLOWANCE FOR DESIGN REFINEMENTS

Construction Year:	2020

Allowance for Design Refinement	20.00%	$ 1,575,201
Escalation	5.10%	$ -

TOTAL	**$ 9,451,205**

Appendix C. Preliminary Geotechnical Engineering Assessment

RhinoOne GEOTECHNICAL

May 15, 2020

HDR, Inc.
Attn: Mr. Travis Kruger, PE
Senior Project Manager, Transportation
1001 SW 5th Avenue, Suite 1800
Portland, Oregon 97204

Re: Preliminary Geotechnical Engineering Assessment
Existing Bridge at North Burgard Street Viaduct at UPRR Tracks
Portland Bureau of Transportation (PBOT)
Portland, Oregon
Rhino One Project Number: HDR-2020-016

Dear Mr. Kruger:

RhinoOne Geotechnical (ROG) is pleased to present this preliminary geotechnical engineering assessment for the replacement of the existing bridge at North Burgard Street Viaduct over Union Pacific Railroad (UPRR) tracks. The bridge location is shown on Figure 1. This work is being completed as part of our on-call contract with the City of Portland, Bureau of Transportation (PBOT) through HDR Engineering, Inc.

The existing bridge was originally built in 1930 with rehabilitations in 1951, 1971, and 1989. The bridge is 126 feet long by 48.7 feet wide with a concrete deck. The bridge is supported on five piers and abutments at each end. The as-builts indicates the five piers are founded on spread footing with a base elevation of 46 feet (datum unknown). The two abutments are also supported on spread footings with a base elevation of 66 and 68 feet. The approximate location of the bridge is shown on the attached Figure 2.

Review of Regional Geology and Subsurface Conditions

The site is located within the Portland Basin. The Portland Basin is part of the Puget-Willamette fore-arc trough within the western North American plate tectonic boundary known as the Cascadia Subduction Zone[1]. The northwest elongated rectangular topographic basin is situated between the Cascade Volcanic Arc to the east and the Coast Range to the west and originated in Miocene time approximately 20 million years ago.

Published geologic mapping indicates the site vicinity consists of the glacial-outburst Missoula Flood deposits deposited approximately 15,500 and 12,500 years ago[2]. The mapping indicates the project area is underlain by the fine-grained deposits of the Missoula Floods (Map unit Mff) [3]. The fine-grained facies of the Missoula Flood deposits mostly consist of silts and silty sands. The fine-grained deposits are underlain by coarse-grained flood deposits consisting of unconsolidated sands and gravels. A research of available well logs (Mult 59497and L35111) in the vicinity indicates the upper ± 50 feet of material consists of silts and silty sands (fine-grained

[1] Evarts, R., O'Connor, J., Wells, R., Madin, I., (2009). *The Portland Basin: A (big) river runs through it*. Geological Society of America, GSA Today, V.19, no. 9.
[2] Allen, J.E., Burns, M., and Sargent, S. (1986). *Cataclysms on the Columbia*, Timber Press, Portland, Page 211.
[3] Ma, L., Madin, I.P., Duplantis, S., and Williams, K.J. (2012). Lidar-Based Surficial Geologic Map and Database of the Greater Portland Area, Clackamas, Columbia, Marion, Multnomah, Washington, and Yamhill Counties, Oregon, and Clark County, Washington: Department of Geology and Mineral Industries. Open-File Report O-12-02.

deposits of the Missoula Floods). These fine-grained deposits are underlain by the coarse-grained sands and gravels below a depth of approximately 50 feet. The mapping suggests the Missoula Flood Deposits are underlain by Troutdale Formation mudstone or cemented sands and gravels.

Information provided by the US Geological Survey (USGS) *Estimated Depth to Groundwater Study of the Portland Metro Area* (USGS, 2018)[4], along with a review of existing well logs in the area, indicates groundwater is approximately 30 feet below ground surface in this location.

Seismic Design Criteria and Considerations

The seismic design criteria for the new bridge for this site are governed by Oregon Department of Transportation (ODOT) *Geotechnical Design Manual* (GDM) dated December 2019. In accordance with ODOT, this bridge should be designed for two-level seismic design criteria, Life Safety and Operational.

Life-Safety Design Criteria: Under this level of shaking, the bridge must be able to withstand the design forces and displacements without collapse of any portion of the bridge. The bridge should be designed for ground motions having an average return period of 1000 years (7% probability of exceedance in 75 years). A soil profile type "D" can be used for the seismic design of the bridge based on the interpreted subsurface conditions. Please note, borings should be drilled at each proposed foundation location to further refine this soil classification. Ground motion parameters are based on the 2014 USGS seismic hazard maps.

Table 1 USGS 2014 Seismic Design Criteria

	Short Period	**1 Second**
1,000 Year Event Spectral Acceleration	S_s = 0.5968 g	S_1 = 0.2212 g
Site Class[1]	D	
Site Coefficient	F_a = 1.3226	F_v = 2.1575
Adjusted Spectral Acceleration	S_{MS} = 0.7893 g	S_{M1} = 0.4773 g
Peak Ground Acceleration (Site Class B)	PGA = 0.2736 g	
Site Coefficient (F_{pga})	F_{PGA} = 1.3264	
Peak Ground Acceleration Adjusted for Site Class (A_s)	A_s = 0.3629 g	
1: ODOT recommend site specific seismic analysis for sites classified as Class "D". This should be considered during final design of the project		

Operational Design Criteria: In addition to the "Life Safety" performance design criteria, the bridge and wall shall be designed to remain in service following a level of ground shaking associated with a full-rupture Cascadia Subduction Zone Earthquake (CSZ). Seismic hazard maps and spectral accelerations of CSZ have been developed based on the full-rupture CSZ event. The PGA, 0.2 second, and 1 second accelerations are 0.1870g, 0.2654g and 0.3036g, respectively.

Preliminary Liquefaction Analysis: Based on the location of groundwater and the interpreted sub-surface conditions at the site as discussed above, the preliminary liquefaction risk at this site can be characterized quantitively as "medium". However, we recommend a detailed geotechnical exploration program be completed at the bridge foundations and abutment location

[4] USGS, U. G. (2018, May 17). *Estimated Depth to Ground Water in the Portland, Oregon Area*. Retrieved from http://or.water.usgs.gov/projs_dir/puz/

to quantify liquefaction and lateral spreading hazards. This detailed program will be required to properly design the bridge, retaining walls, and approach embankments.

Preliminary Bridge Foundation Recommendations

The bridge can be founded on the underlying coarse-grained Missoula Flood Deposits using deep foundation systems such as driven piles or drilled shafts. Based on the well logs, these deposits were encountered below a depth of 50 feet BGS. We anticipate driven piles or drilled shafts into the coarse-grained Missoula Flood Deposits will be suitable for support of the proposed bridge replacement. If the existing bridge foundations are used, the load can be transferred into the bearing strata using micropiles.

We anticipate steel pipe piles or H-piles could be driven to refusal on the coarse-grained Missoula Flood deposits. Piles driven to refusal in this material can likely develop capacities on the order of 200 to 400 kips. The driven piles may require 20 to 25 feet of embedment into the coarse-grained Missoula Flood Deposits to achieve this range of capacities. Similarly, drilled shafts will probably be embedded 15 to 20 feet into the coarse-grained Missoula Flood deposits. Seismically induced lateral loads can be resisted by the structural strength of the pile/drilled shaft in bending and the passive resistance of the soil adjacent to the pile cap.

Limitations

This technical memorandum has been prepared exclusively for the Project design team for the above-mentioned project, in accordance with generally accepted geotechnical engineering practice. This review is based on the existing information only and the recommendations are preliminary. Note that a detailed geotechnical study is recommended before the design of these bridges is finalized.

Rhino One hopes this submittal meets your requirements at this time. Please call us if you need further information.

Sincerely,

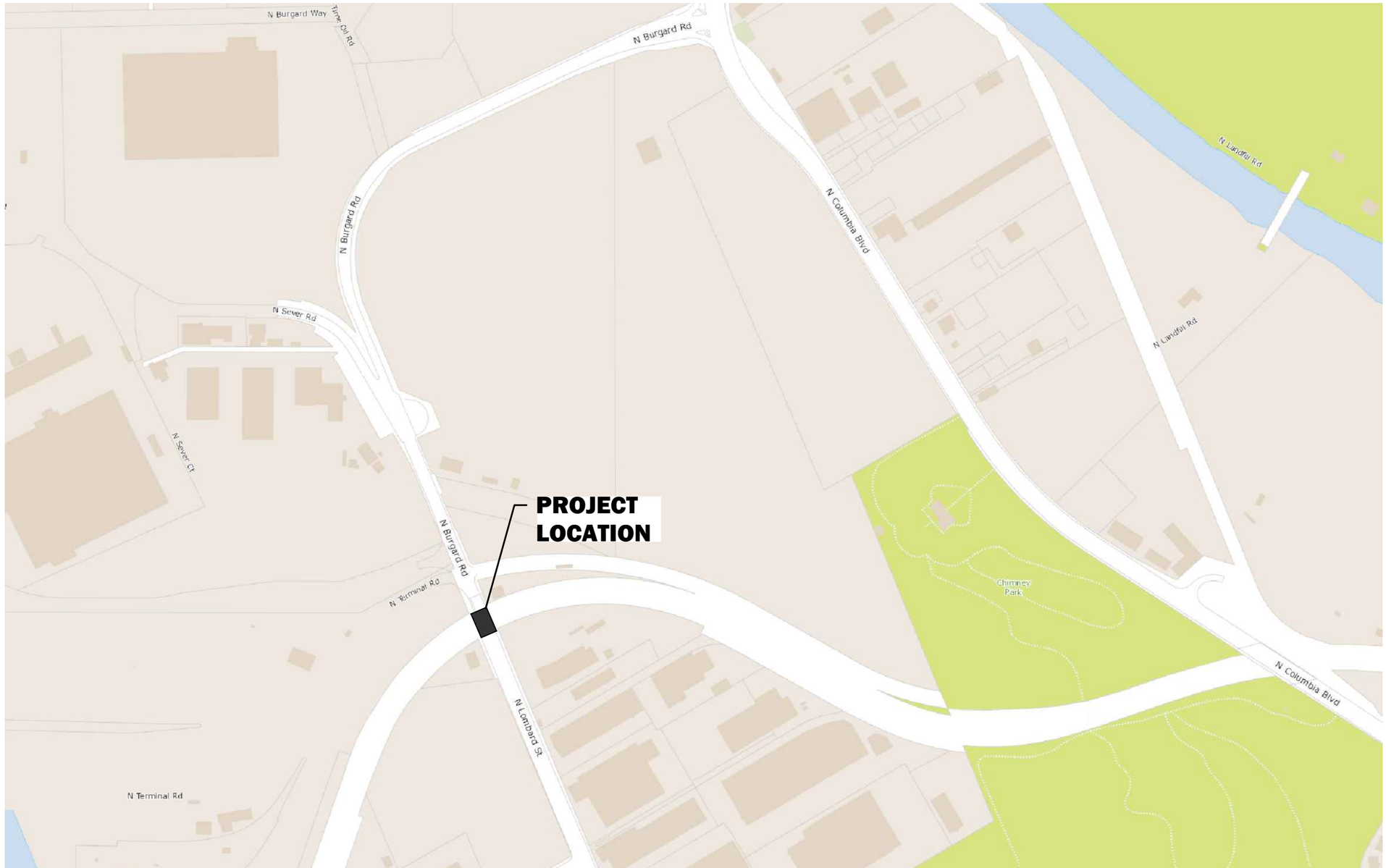
Christina Hemberry, PE
Staff Geotechnical Engineer

05/15/2020

Rajiv Ali, PE, GE (OR)
Geotechnical Engineer

Attachments

Figure 1: Site Location Map
Well Logs Mult 59497and L35111 from Oregon Water Resources Department



RhinoOne
GEOTECHNICAL

12308 NE 56th Street, Suite 1107
Vancouver, Washington 98682
360-258-1738

NORTH BURGARD ROAD BRIDGE

10700 BLOCK NORTH LOMBARD STREET
PORTLAND, OREGON 97203

FIG 1 - SITE LOCATION MAP

PROJECT
HDR-2020-016

DATE
MAY **2020**

H:\HDR\HDR-2020-016\DWG\SHDR-2020-016.dwg dblac Apr 21, 2020 - 3:46pm

STATE OF OREGON

GEOTECHNICAL HOLE REPORT

(as required by OAR 690-240-035)

MULT 59497

Received date 11/08/1999

(1) OWNER/PROJECT

Hole No.

Co.Job No. B-1

Name GARNER ANDERSON
EUGENE MITCH

Street 10761 N LOMBARD ST

City PORTLAND- State OR Zip 97233

(2) TYPE OF WORK

☒ New ☐ Alter (Recondition) ☐ Alter (Repair)

☐ Deepening ☒ Abandonment

(3) CONSTRUCTION

☐ Rotary Air ☐ Hand Auger ☒ Hollow Stem Auger

☐ Rotary Mud ☐ Cable Tool ☐ Push Probe Other

(4) TYPE OF HOLE

☒ Uncased Temporary ☐ Cased Permanent

☐ Uncased Permanent ☐ Slope Stability Other

(5) USE OF HOLE

GEOTECHNICAL INFORMATION

(6) BORE HOLE CONSTRUCTION

Special Standards ☐ Depth of completed well 90 ft.

HOLE

Diameter	From	To
8.00	0.00	90

SEAL

From	To	Material	Amount	Seal Grout Weight	Units
0.00	90.00	Bentonite	00.00		G

Backfill placed from ft. TO ft. Material

Filter pack placed from ft. TO ft. Size in.

(7) CASING/SCREEN

Screen ☐

(8) WELL TEST

Permeability Yield GPM

Conductivity PH

Temperature of water 52 °F/C Depth artesian flow found ft.

Was water analysis done? ☒

By Whom? HART CROWSER

Depth of strata to be analyzed. From ft. to ft.

Remarks

Name of supervising Geologist/Engineer

(9) LOCATION OF HOLE By legal description

County Multnomah Latitude Longitude

Township 1.00 N Range 1.00 W

Section 1 NW 1/4 NW 1/4

Tax lot 300 Lot Block Subdivision

Legal desc:

Street Address of Well (or nearest address)

SAME

MAP with location indentified must be attached

(10) STATIC WATER LEVEL

45.0 Ft. below land surface. Date 10/14/1999

Artesian Pressure lb/sq. in. Date

(11) SUBSURFACE LOG

Ground Elevation ft.

Material	From	To	SWL
SANDS	0	50	45
SANDS AND GRAVELS	50	54	
SANDS	54	90	

Date started 10/14/1999 Completed 10/14/1999

(12) ABANDONMENT LOG

Date started Completed

Professional Certification

(to be signed by a licensed water supply or monitoring well constructor, or registered geologist or civil engineer).

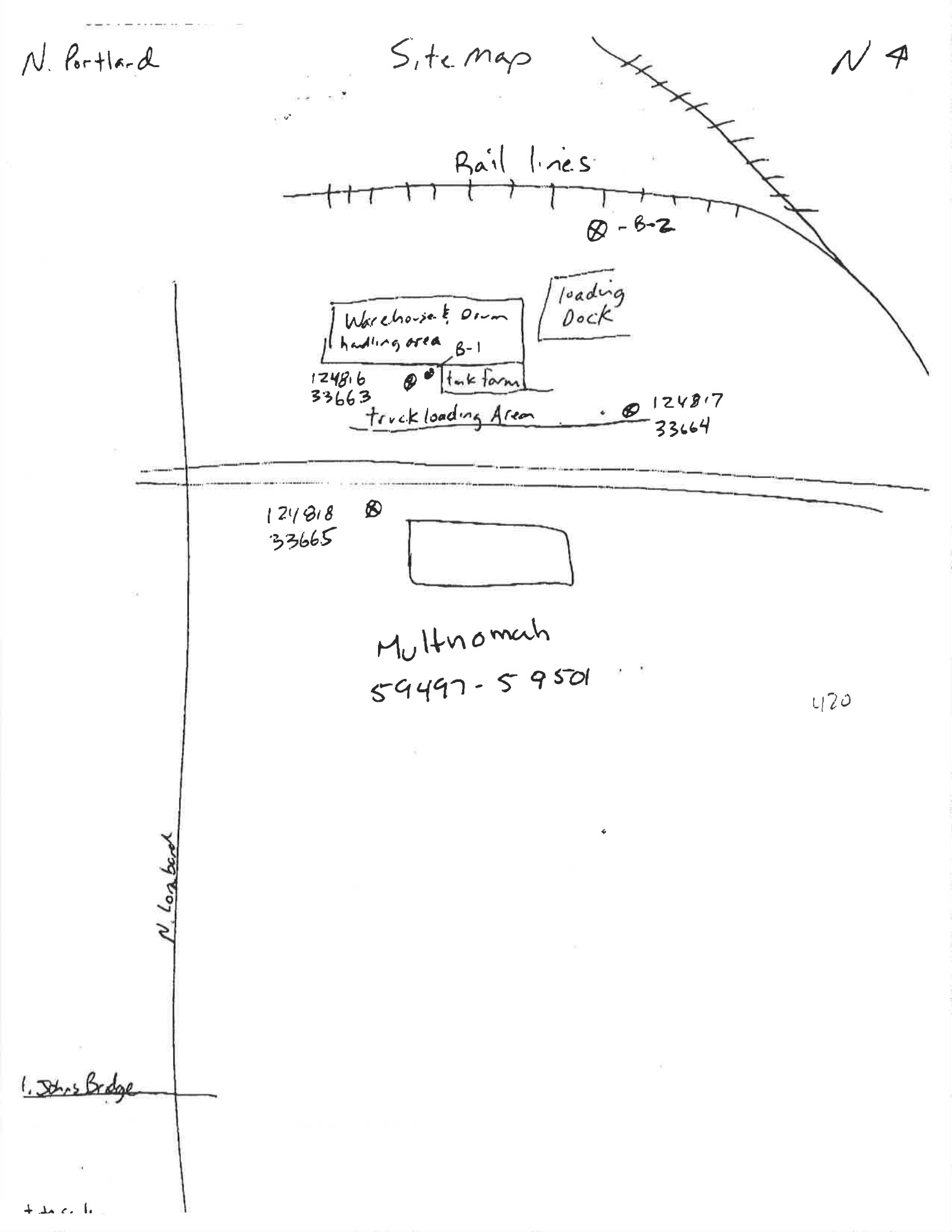
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon geotechnical hole construction standards. This report is true to the best of my knowledge and belief.

License or Registration Number 10408

Signed By PETE LARSEN Date

Affiliation GEO TECH EXPLORATIONS

THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK


N. Portland
Site map
N
Rail lines
B-2
Warehouse & Drum handling area
B-1
Loading Dock
tank farm
124816
33663
124817
33664
truck loading Area
124818
33665
Multnomah
59497 - 59501
420
N. Lombard
St. Johns Bridge

MONITORING WELL REPORT

(as required by ORS 537.765 & OAR 690-240-095)

Instructions for completing this report are on the last page of this form.

Well ID# L35111

Start Card # 121537

(1) OWNER/PROJECT

WELL NO. MW 27

Name CHEMCENTRAL CORP

Address 7050 WEST 71ST STREET

City BEDFORD PARK State Illinois Zip 60499

(2) TYPE OF WORK

☒ New construction ☐ Alteration (Repair/Recondition)

☐ Conversion ☐ Deepening ☐ Abandonment

(3) DRILLING METHOD

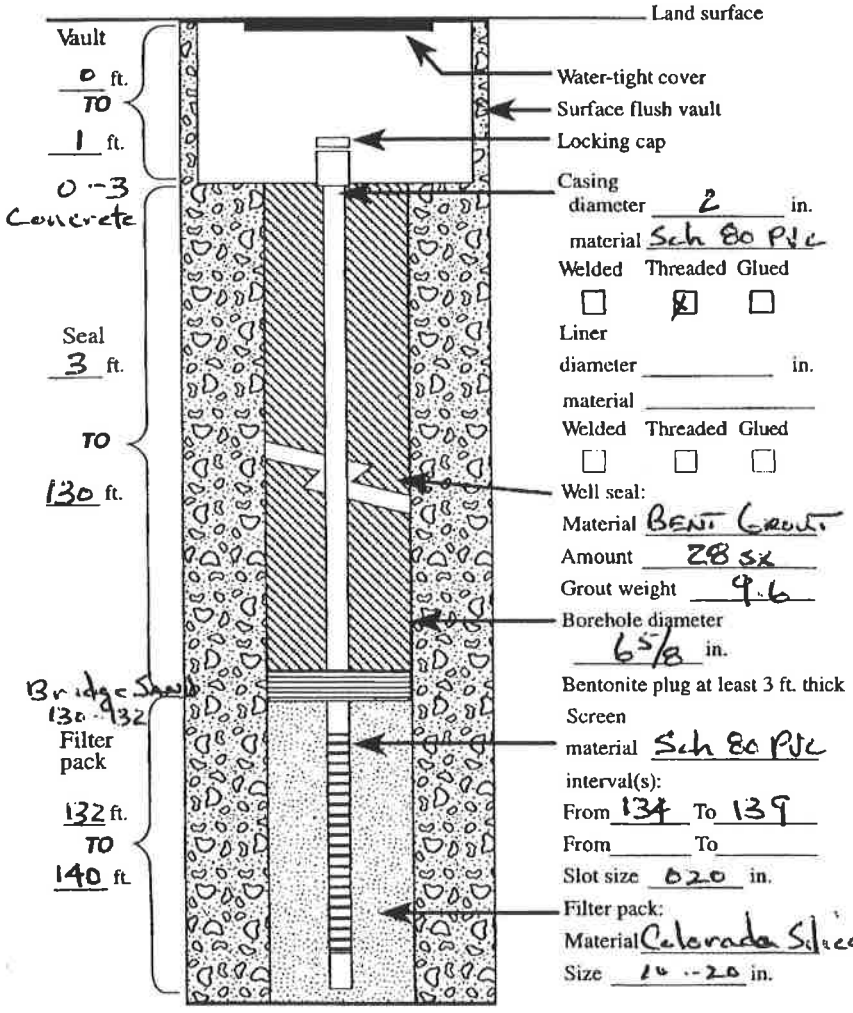
☐ Rotary Air ☐ Rotary Mud ☐ Cable

☐ Hollow Stem Auger ☒ Other dual wall percussion

(4) BORE HOLE CONSTRUCTION:

Special Standards ☐ Yes ☒ No

Depth of Completed Well 139 ft.



(5) WELL TESTS:

☐ Pump ☐ Bailer ☐ Air ☐ Flowing Artesian

Permeability Yield GPM

Conductivity PH

Temperature of water 49 °F/C Depth artesian flow found ft.

Was water analysis done? ☒ Yes ☐ No

By whom? HART CROWSER

Depth of strata to be analyzed. From ft. to ft.

Remarks:

Name of supervising Geologist/Engineer DEAN HAMILTON

(6) LOCATION OF WELL By legal description:

County Multnomah Latitude Longitude

Township 1 (N or S) Range 1 (E or W) Section 1

NW 1/4 of NW 1/4 of above section.

Street address of well location 1058 N. Lombard St. Portland, OR 97203

Tax lot number of well location 1N1W01BB-00100

ATTACH MAP WITH LOCATION IDENTIFIED. Map shall include approximate scale and north arrow.

(7) STATIC WATER LEVEL:

51.8 Ft. below land surface. Date 04/18/02

Artesian Pressure lb/sq. in. Date

(8) WATER BEARING ZONES:

Depth at which water was first found 52

From	To	Est. Flow Rate	SWL

RECEIVED

APR 25 2002

WATER RESOURCES DEPT
SALEM, OREGON

(9) WELL LOG:

Ground Elevation

Material	From	To	SWL
brown silty GRAVEL	0	3	
brown clayey SILT	3	14	
gray SILT	14	26	
Silt SILT	26	29	
brown very fine to coarse SAND	29	50	
brown, silty sandy GRAVEL	50	67	52
brown fine SAND	67	97	
gray sandy GRAVELS	97	140	

Date started 04/17/02 Completed 04/18/02

(unbonded) Monitor Well Constructor Certification:

I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon water supply well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

MWC Number

Signed Date

(bonded) Monitor Well Constructor Certification:

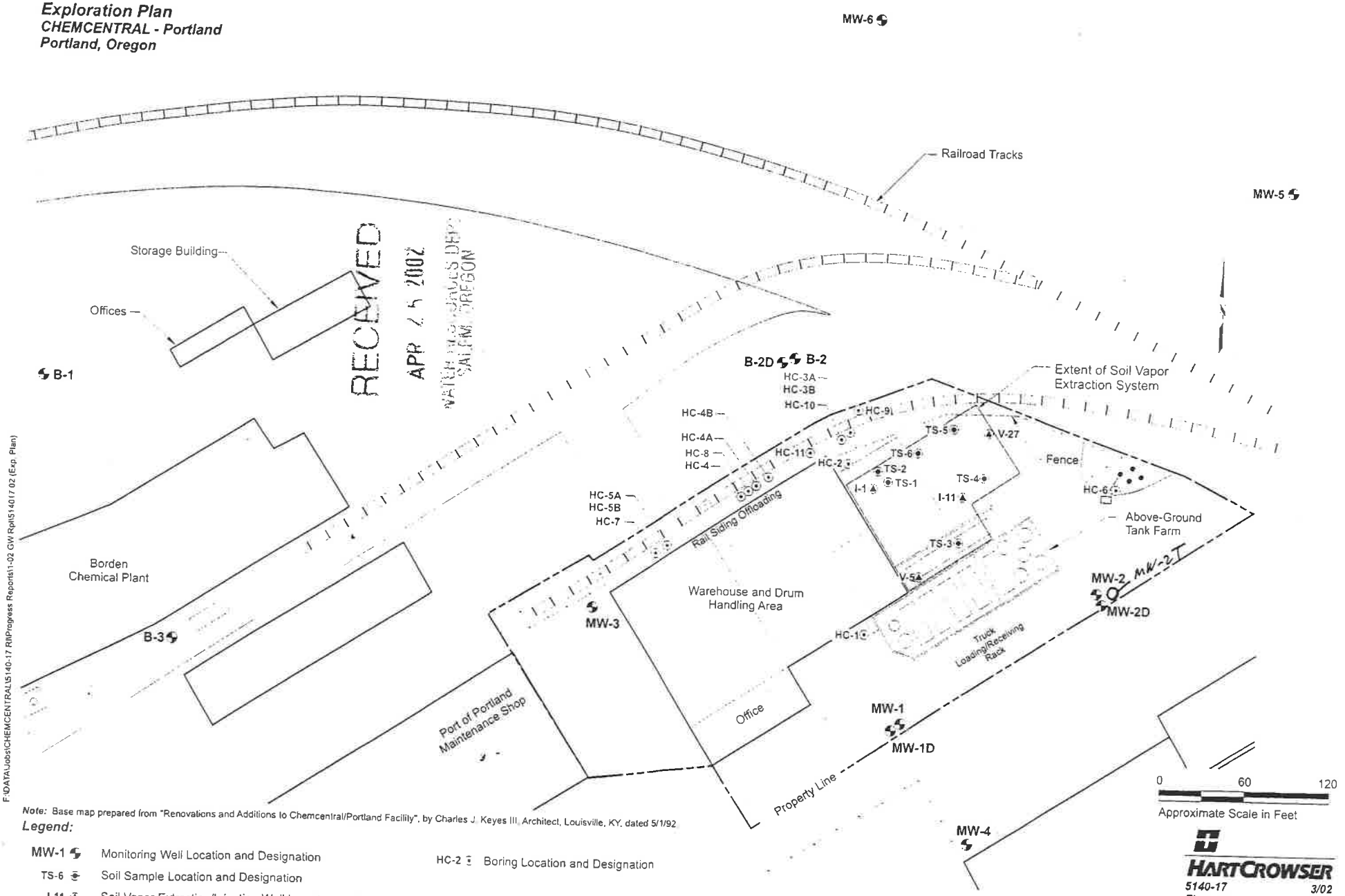
I accept responsibility for the construction, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon water supply well construction standards. This report is true to the best of my knowledge and belief.

MWC Number 1003

Signed Date 04/22/02

ORIGINAL COPY – WATER RESOURCES DEPARTMENT FIRST COPY – CONSTRUCTOR SECOND COPY – CUSTOMER

Exploration Plan
CHEMCENTRAL - Portland
Portland, Oregon



F:\DATA\Jobs\CHEMCENTRAL\5140-17 RI\Progress Reports\1-02 GW Rpt\5140I7 02 (Exp. Plan)

Note: Base map prepared from "Renovations and Additions to Chemcentral/Portland Facility", by Charles J. Keyes III, Architect, Louisville, KY, dated 5/1/92

Legend:

- MW-1 — Monitoring Well Location and Designation
- TS-6 — Soil Sample Location and Designation
- I-11 — Soil Vapor Extraction/Injection Well Location and Designation
- HC-2 — Boring Location and Designation

HARTCROWSER
5140-17 3/02
Figure 2

Appendix D. Burgard Bridge Cross Section Recommendations

TOOLE DESIGN

319 SW WASHINGTON STREET
SUITE 420
PORTLAND, OR 97204

503.205.4607
TOOLEDESIGN.COM

MEMORANDUM

To:	Travis Kruger, P.E. and Eric Rau, P.E.
From:	Adrian Witte, P.E., Toole Design
Date:	May 22, 2020
Project:	McLoughlin Boulevard and Burgard Road Bridge Studies
Subject:	Burgard Bridge Cross-Section Recommendations
CC:	Sharon Daleo, P.E. and Gwen Shaw, EIT, Toole Design

Toole Design developed cross-section recommendations for the proposed replacement of the Burgard Bridge on N. Lombard Street in Portland, OR. The structure is city-owned and crosses the Union Pacific Railroad to connect N. Lombard Street and the St. John's neighborhood with N. Burgard Road and N. Columbia Boulevard.

The bridge is listed as ID Number 001 by the City of Portland and as ID Number 25B01 by the State of Oregon. Replacement of the bridge structure is included in the Transportation System Plan (TSP) and listed as TSP Project Number 30068: "Burgard St Viaduct Replacement – Replace the existing N Burgard St Viaduct over the UPRR tracks. Include pedestrian and bicycle facilities. Project design will consider freight movement needs, consistent with policies, street classification(s) and uses."

Bike and Pedestrian Network

Figure 1 shows the City of Portland's TSP Classifications for the bike network in the vicinity of the bridge. N. Lombard Street in the vicinity of the bridge is identified as a "City Bikeway".

North of the bridge, the bikeway consists of a variety of facilities. Immediately north of the bridge, the facility is a two-way protected bikeway on the east side of the street. Further north it transitions to a sidewalk-level separated bike lane and eventually to a multi-use path that continues as the road curves east and becomes N. Burgard Road. The multi-use path continues to the intersection at Columbia Boulevard and connects bicyclists to bike lanes on N Lombard Street and further north to the Lombard Trail (a multi-use path adjacent to N Lombard Street) that accesses Kelly Point Park.

South of the bridge, there is a relatively well-connected network of bike lanes, shared lanes, multi-use paths, and neighborhood greenways. Immediately south of the bridge, the facility is a two-way separated bikeway on the east side of the street. This facility starts at N. Bruce Avenue, which connects to the Central Street Neighborhood Greenway.

Figure 2 shows the TSP Classifications for the pedestrian network in the vicinity of the bridge. N Lombard Street in this area is designated a "City Walkway" and connects to the St. Johns neighborhood to the south and multi-use pathways and trails to the north.

Figure 1. TSP Classifications for the Bicycle Network

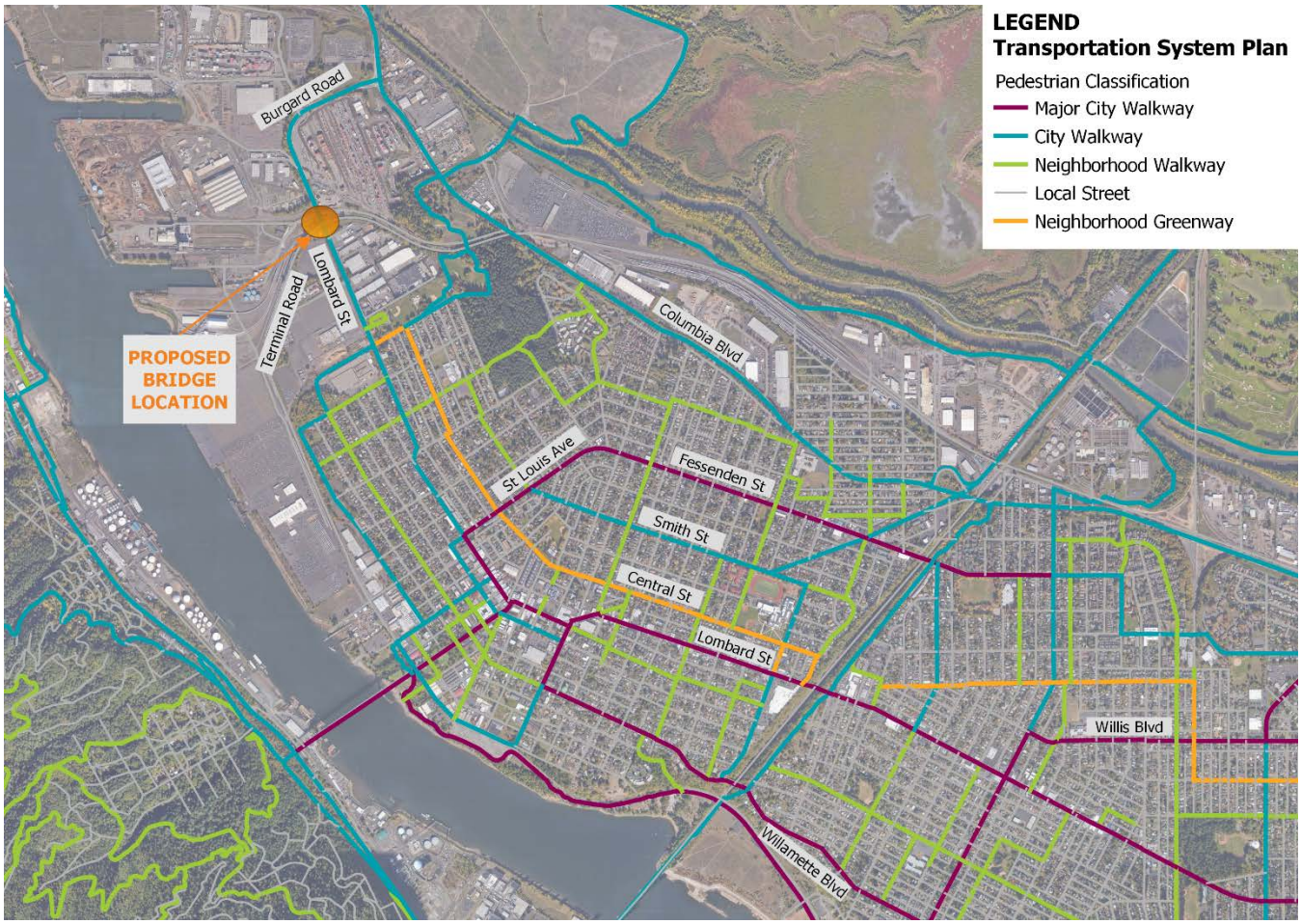


Figure 2. TSP Classifications for the Pedestrian Network

Currently the bridge has sidewalk on only the east side of the structure. Immediately south of the bridge there is sidewalk on both sides of the street and the bridge is the only gap in the westside sidewalk between the N. Bruce Avenue and the N. Terminal Road intersections. The N. Terminal Road intersection is signalized and provides the nearest signalized crossing in the area. Filling this sidewalk gap would allow pedestrians walking on the westside of the street to safely cross the street at N. Terminal Road and continue their trip. North of the structure there is sidewalk on only the eastside of the street for most of the way to the N. Columbia Boulevard intersection.

Freight Network

Figure 3 shows the TSP Classifications for the freight network in the vicinity of the bridge. The bridge is part of a route designated by the City of Portland and the State of Oregon as a Priority Truck Street and by the National Highway System (NHS) as an NHS Connector. It is signed as the US-30 Bypass and is intended to facilitate freight movement around the St. Johns neighborhood.

A review of previously adopted plans for the area shows that while there is a predominate freight presence, N. Lombard Street also serves residential and commercial land uses south of the bridge. The bridge also connects the St. Johns neighborhood to recreational trails and Kelly Point Park. Previous plans identified a number of short- and long-term roadway projects aimed at reducing potential conflicts between users.

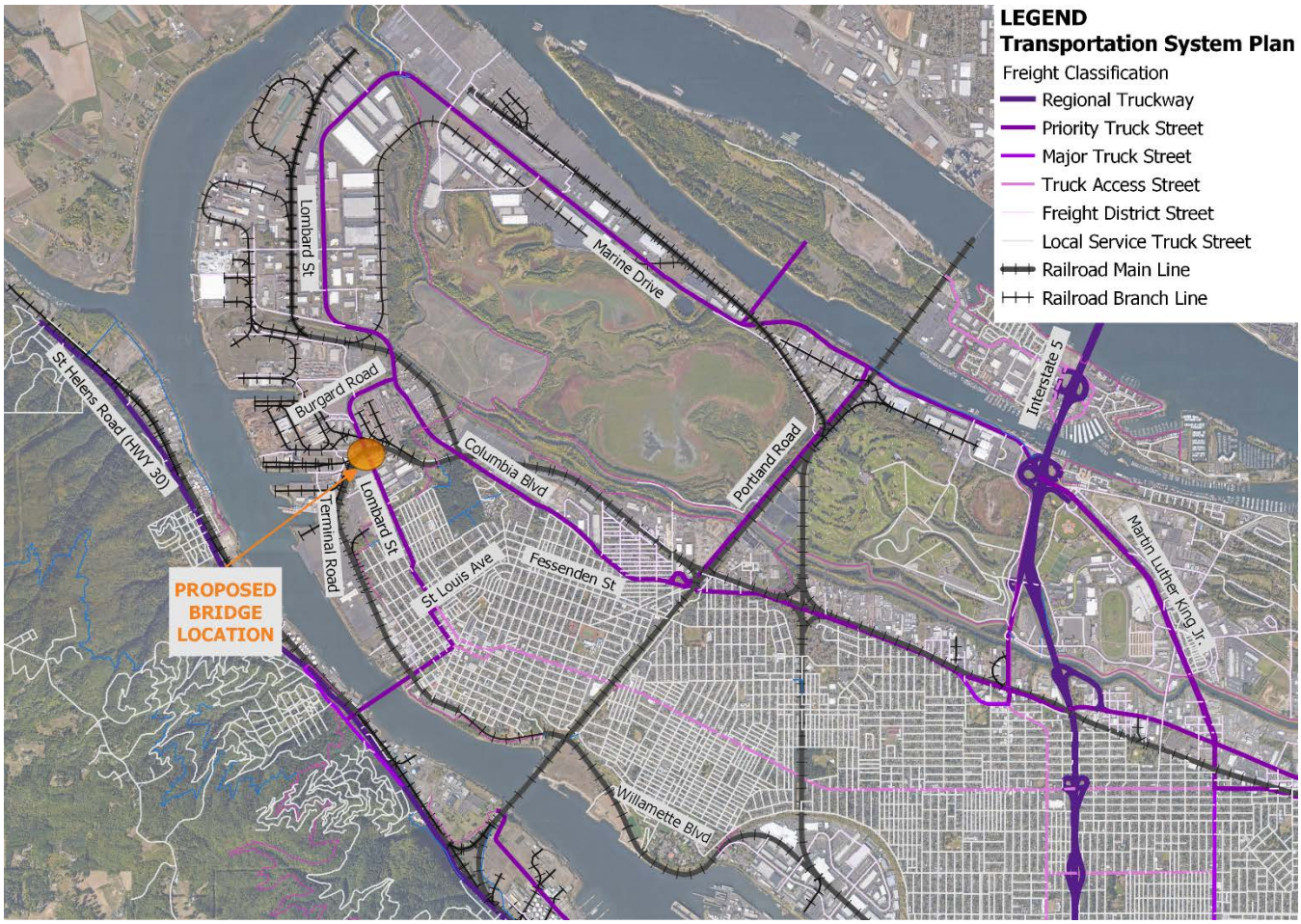


Figure 3. TSP Classifications for the Freight Network

The Priority Truck Street identified in the TSP is the route including N. Columbia Boulevard, N. Burgard Road, and N. Lombard Street to access the St. Johns Bridge (see Figure 3). Truck traffic often used N. Fessenden Street and N. St. Louis Avenue as an alternative route to connect to the St. Johns Bridge and as such bike lanes, enhanced pedestrian crossings, and other speed calming treatments were constructed to manage conflicts between users along that route. It is important that N. Lombard Street be designed to serve as the Priority Truck Street in the area and that conflicts with other users of the street be managed so as not to impact that function.

Since 2001, the Portland Bureaus of Transportation and Planning and Sustainability have worked with community stakeholders to develop a truck strategy and a neighborhood plan. Figure 4 shows the recommended improvement project locations identified in the 2001 St. John's Truck Strategy. The 2004 St. Johns/Lombard Plan was developed to provide additional context and support for the 2001 Truck Strategy as well as identify additional projects for the community which are unrelated to the scope of the current bridge evaluation. Over the past two decades, nearly all of the projects identified in the St. John's Truck Strategy have been completed with the exception of numbers 4 and 7, which are currently in progress at PBOT in some form.

The reconstruction of the Burgard Bridge was not explicitly identified as one of these improvement projects given that those projects were intended to be short term implementation strategies, but the bridge replacement was supported. It is a key element of the St. Johns Truck Strategy and overall network and is one of the final improvements identified in these plans.

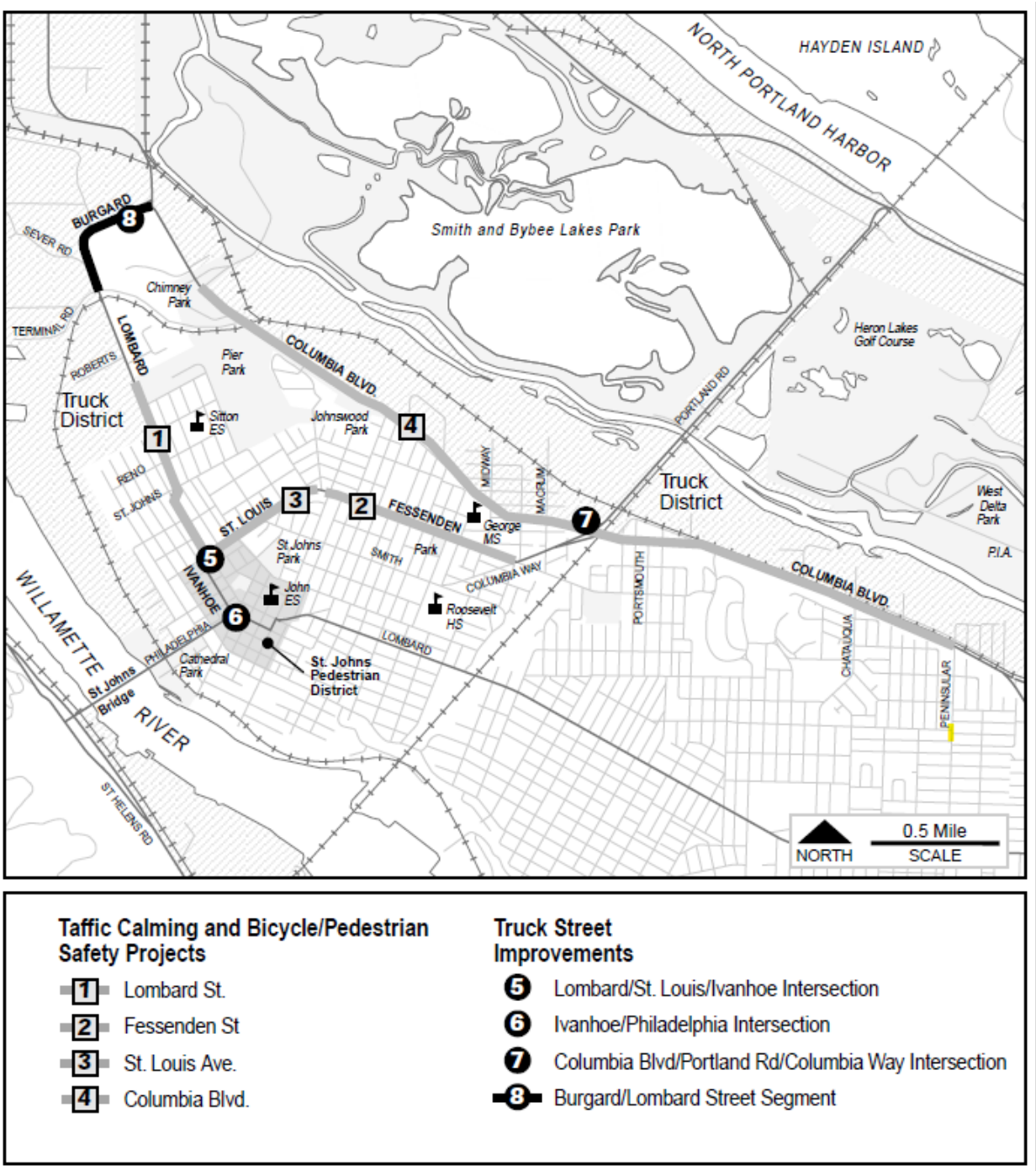


Figure 4: Recommended Projects Map from the 2001 St. John Truck Strategy.

Recommended Bicycle and Pedestrian Facilities

Existing Cross-Section Details

North of the bridge, the existing bike facility is an 8-foot wide two-way protected bikeway on the east side of the street. The bikeway is separated from vehicular traffic by a 3-foot wide painted buffer with a 1-foot wide concrete traffic separator with flexible delineators attached. The street is constructed with stormwater, landscaping, and concrete curb and gutter.

On the structure itself and south of the bridge, the existing bike facility is a 10-foot wide two-way protected bikeway on the east side of the street. It is separated from vehicular traffic by a 4-foot wide painted buffer and flexible delineators. From Google Streetview and aerial imagery, it appears that the flexible delineators on the structure were installed but have since been dislodged and not replaced.

Both of these bike facilities are consistent with the Portland Protected Bike Lane Guide. A 10-foot two-way protected bikeway is the minimum recommended width and an 8-foot two-way protected bikeway is acceptable for use over short lengths where constrained conditions apply.

The eastside of N. Lombard Street includes a continuous sidewalk north and south of the bridge. However, the sidewalk on the westside is discontinuous and ends approximately 120’ south of the bridge. There is no sidewalk on the west side of the existing structure or through to the intersection with N. Terminal Road. The sidewalk picks up for approximately 300’ on the recently re-built structure north of these intersections but is missing in other segments up to N. Columbia Boulevard.

Recommended Facility and Cross Section

It is recommended that the bridge be designed with a two-way protected bikeway on the east side of the street to be consistent with the facilities north and south of the bridge and with sidewalks on both sides of the structure. The bridge should also be designed to accommodate the freight needs of the street.

The majority of destinations are on the east side of the street, so an east-side bikeway will facilitate these movements and is consistent with the facilities adjacent to the bridge. However, sidewalks should be constructed on both sides of the bridge to allow pedestrians using the westside of the street to access the signalized crossing at N. Terminal Road and safely cross the street to continue their trip further north on the sidewalks that are only provided on the eastside of the street. Designing the structure with sidewalks on both sides will ensure that the bridge does not become a constraint in the future completion of the sidewalk network. Pedestrian network improvements in the area should also include reconstructing the southwest corner of the intersection with N. Terminal Road to add curb ramps and other treatments to make the intersection ADA accessible.

This recommendation is compatible with and meets the objectives of the TSP and other local plans. Additional alignments were briefly evaluated, but identified as unreasonable given the considerations noted above. Providing a separate structure for pedestrians was also considered but determined unnecessary.

Recommended Cross-Section

The recommended cross-section is 55-feet wide and includes sidewalks on both sides of the street and a sidewalk-level two-way protected bikeway on the east side of the street. The cross-section elements should be designed as follows:

- Sidewalks: 8-feet width consistent with PBOTs preferred minimum.

- Bikeway: a 10’ wide two-way bikeway is consistent with the preferred width in the Portland Protected Bike Lane Guide and expecting that the bicyclist volume will be less than 150 per hour. The bikeway should be provided at sidewalk level to reduce the maintenance and street sweeping needs. The bikeway will be at

the same grade as the sidewalk and separated by a flush and traversable buffer strip. This will identify separate space for bicyclists and pedestrians, but also allow the other to cross-over into the other's space if needed to avoid conflicts or temporary blockages. The bikeway can be designed curb-tight to the roadway.

- Travel Lanes: the bridge is part of a Priority Truck Street and consistent with the City of Portland's Street Design Guidelines for Trucks, 12-foot wide lanes are recommended. Though this is part of the Over Dimensional Load network, there is no guidance suggesting travel lane widths need to be widened to accommodate those loads. Over Dimensional Load permits will continue to be required and pilot vehicles may be needed to traverse the corridor. The bridge is part of the National Highway System and is designated as an NHS Connector route by the Federal Highway Administration (FHWA) and Oregon Department of Transportation (ODOT). FHWA guidance such as Flexibility in Highway Design and the 2016 update to the controlling criteria for design for roadways with speeds under 50mph allows flexibility for designing streets with NHS designations and refers to local guidance to inform design decisions. The travel lanes should be designed with 18" shy distance between the edgeline and the face of curb.

The proposed cross section is shown on Figure 5.

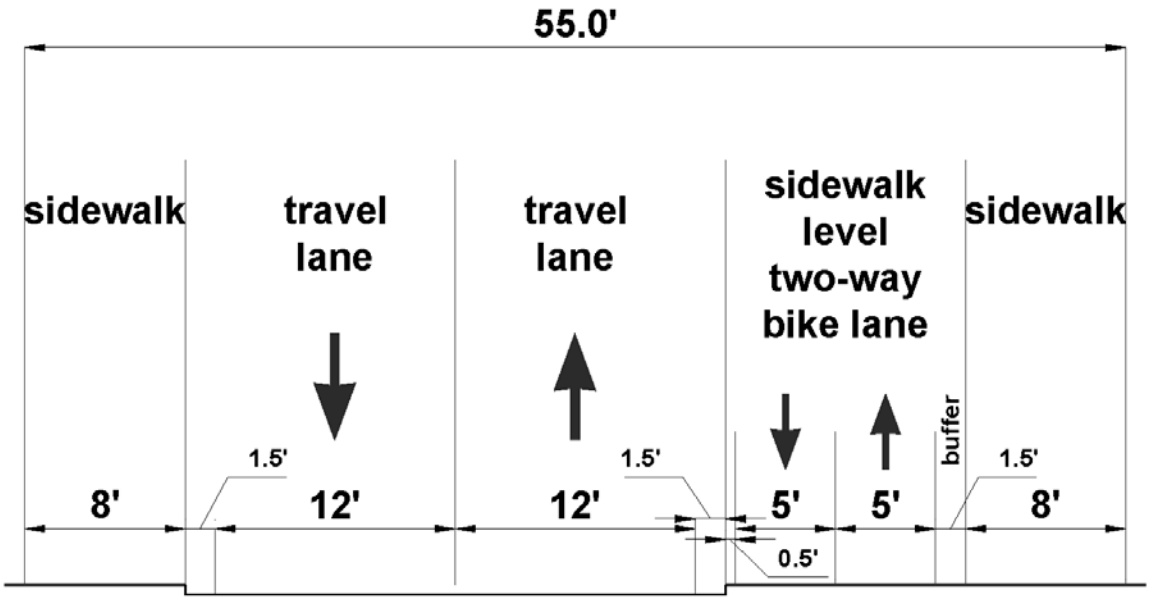


Figure 5: Recommended Cross-Section for the Burgard Bridge.

Appendix E. Site Research and Design Files Memorandum

Memo

Date:	Friday, June 12, 2020
Project:	PBOT McLoughlin Boulevard and Burgard Road Bridge Studies
To:	Zef Wagner, PBOT
From:	**Eric Rau, HDR and Evan Sinn, HDR**
Subject:	**Burgard Road Bridge Feasibility Study** **Task 6.1: Site Research and Design Files**

1.0 Objective and Purpose

The overall objective of this project is to assess the feasibility of replacing the Burgard Road Bridge (PBOT Bridge No. 001, NBI Bride No. 25B01) that carries vehicular and pedestrian traffic of North Lombard Street (Burgard Street) over Union Pacific Railroad (UPRR) in accordance with the project scope of work (SOW).

The feasibility study is primarily a desktop study to evaluate available information/data necessary to develop a preliminary concept level recommendation for bridge replacement that can be used by the City of Portland Bureau of Transportation (PBOT) for future planning and project development. The recommendation will establish a preliminary cost estimate for the project based on a proposed configuration that includes bridge type, roadway cross-section, horizontal and vertical alignments, and overall extents of the project.

Intended to become part of the overall feasibility report, the purpose of this memorandum is to summarize and characterize the site pertaining to the available data assessed and meet the requirements of SOW Task 6.1. By establishing a digital site map which integrates relevant right of way (ROW) limits with topography and other site features, site-specific constraints are used to identify a preliminary project configuration to allow general locations of landing/tie-in points of the modified roadway and bridge bent locations to be established for further analysis in the subsequent phases of the feasibility study.

The overall extents of the project and associated improvements required for North Lombard Street, defined by the landing/tie-in points, are an important aspect of the project. The general location of these point are established herein based on a preliminary assessment of expected horizontal and vertical alignments based on the site specific constraints. The result of this initial investigation summarized on the site map provide as Attachment A to this memorandum.

2.0 Methodology

An objective of SOW Task 6.1 is to establish a digital CAD base-map for the site location and identify available data sources to subsequently import and align with the State Plane coordinates to generate a digital map with aerial views, complete with road and building outlines, property/tax lot limits, and other applicable features.

The approach taken to build the site-specific data necessary to identify constraints and impacts the new structure would create on the proposed project location includes digital data sources listed in Table 1 and information-based (other) sources as listed in Table 2.

Provision of a preliminary site survey assisted in building the digital base-map by providing a site surveyed topographical surface identifying key terrain features, and helping to verify limited GIS data such as property limits. Tax lot data including ownership and land value for the project site was accessed, filtered, and included in building the digital base-map; although not shown on the aerial map, it can be made available for further analysis or discussion as needed.

Generally, the proposed project site is relatively flat overall, however, the site is challenged by a nearby intersection, adjacent property access driveway, and vertical and horizontal clearance envelopes over the UPRR. Establishing the clearance envelope over UPRR and identifying the required vertical profile based on expected bridge structure depth is a critical factor as the increase of grade elevation of Lombard Street extends the project extents and leads to potential impacts to the adjacent intersection and private property.

Table 1: Base-map Data Source References

Digital Mapping		
Source Location	**Website URL**	**Content**
City of Portland Open Data Site	https://gis-pdx.opendata.arcgis.com/	Various data categories, ranging from Publicly Owned Parcels to Heritage Trees, sidewalks, and curbs.
Metro's Regional Land Information System	https://www.oregonmetro.gov/tools-partners/data-resource-center/rlis-live	Tax lot and land parcel boundaries and property values.
Preliminary Site Survey		Determination of TriMet rail and embankment elevations, Three-dimensional digital ground surface. Verification of ROW limits.

Table 2: Other Data Source References

Applicable Physical Constraints		
Source Location	**Website URL**	**Content**
Draft Toole Design Memorandum dated, May 22nd, 2020		Burgard Bridge Cross-Section Recommendations
ODOT Highway Design Manual	https://www.oregon.gov/odot/Engineering/Documents_RoadwayEng/HDM_04-Cross-Sections.pdf	Roadway horizontal and vertical clearance envelopes. Railroad horizontal and vertical clearance envelopes.
Union Pacific Railroad Guidelines for Railroad and Grade Separated Projects		Railroad horizontal and vertical clearance envelopes
ADA – Americans with Disabilities Act		Accessible ramp and slope requirements for approach structures in accordance with ADA - 28 Code of federal Regulations Part 35, as revised September 15, 2010 and 23 CFR Part 652, Pedestrians and Bicycle Accommodations and Projects
As-built plans Burgard Road Bridge PBOT Br. No. 001 (NBI Br. No. 25B01), North Lombard Street over UPRR		Existing bridge and roadway geometry, existing railroad horizontal and vertical clearance envelopes

3.0 Site-Specific Constraints and Preliminary Project Configuration

The project limits define both the required improvements of North Lombard Street and identify potential impact to adjacent properties and existing infrastructure, and are therefore key considerations of the proposed bridge replacement project. In order to allow for detailed evaluation in subsequent phases of the feasibility study, the general location of these landing / tie-in points of North Lombard Street to the north and south of the existing bridge are preliminarily established based on an initial high-level assessment of the assembled site-specific data and constraints. This assessment considers the recommended roadway cross-section, horizontal vertical clearance requirements over UPRR, preliminary span and structure depth of the replacement bridge, and proposed horizontal and vertical alignment required to accommodate the project. The modification of the vertical alignment, which is raised from existing to accommodate a deeper structure required to meet the UPRR clearance requirements, define the overall limits of the project.

Attachment A to this memo provides key site constraints, horizontal alignment, and preliminary locations of bents and landing/tie-in points of North Lombard Street.

3.1 Roadway Cross Section

The recommended roadway cross-section of the bridge was established in the Toole memo (Table 2). This recommendation, shown in Figure 1, provides a 55-foot wide cross-section for vehicular and pedestrian traffic at the project site. A raised sidewalk for both pedestrian and two-way bicycle traffic was recommended based on feedback from PBOT, which must comply with Americans with Disabilities Act (ADA) regulations and be accounted for when the proposed vertical alignment is established.

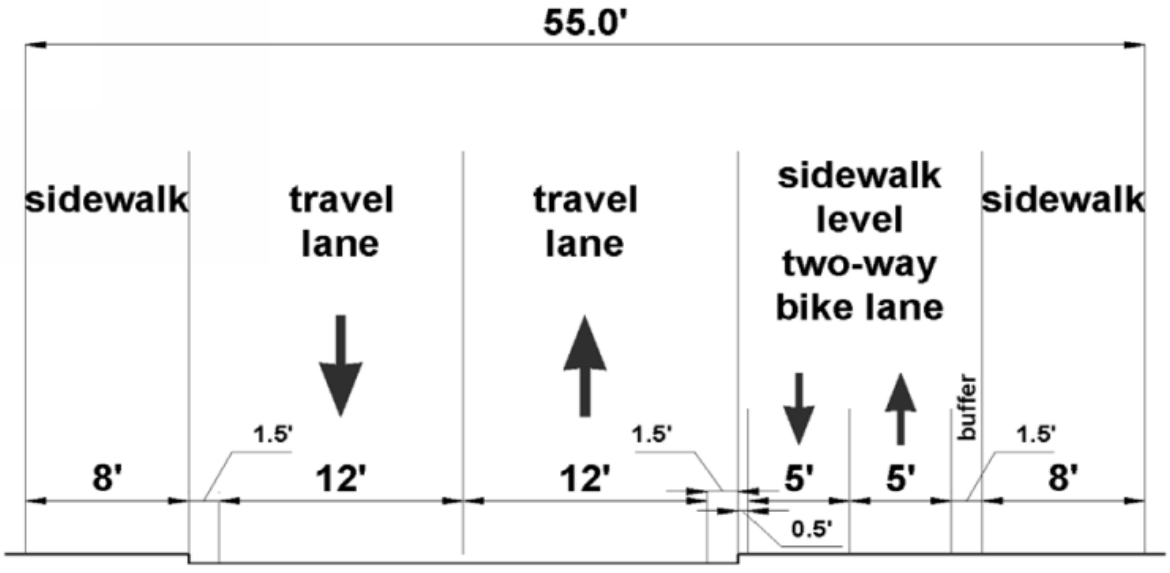


Figure 1 Recommended Cross-Section.

The recommended cross-section provides an overall width that is generally similar to 48-feet-8-inches provided by the existing bridge in its current configuration. As shown in the as-built plans (Table 2), previous versions of the bridge included a widened portion to the west of the current edge of deck.

3.2 UPRR Clearance Requirements

Vertical and horizontal clearance requirements over UPRR are key site constraints and are defined in the UPRR Guidelines for Railroad and Grade Separated Projects (Table 2). Given the possibility of future work to establish new or additional track alignments by UPRR, the feasibility study is based on the assumption that the replacement bridge must clear span the UPRR ROW, as established by resource Metro and City of Portland GIS data (Table 1).

The horizontal clearance envelope is based on a future configuration of the UPRR allowing for the current two tracks and a future additional track to be built. UPRR ROW was shown to be 100-feet, resulting in at an expected minimum replacement bridge length of approximately 110-feet when offset for retaining walls and fill slopes.

The UPRR requirement for vertical clearance is 23-feet-6-inches. The vertical clearance envelope was established based on this requirement, and considers an additional or future track within the horizontal clearance envelope.

3.3 Preliminary Bridge Structure Depth

A preliminary structure overall depth of 5-feet-6-inches was established for the purpose of establishing an upper bound on project extents at this initial high-level assessment. This depth accounts for the span length required to accommodate the UPRR clearance requirements and the recommended cross-section. The preliminary structure depth is based on a concrete or steel beam depth of 4-feet, a concrete bridge deck, and the roadway cross-section which includes cross-slope and the raised sidewalk.

3.4 Horizontal Alignment

The proposed horizontal alignment for the replacement structure is parallel to the existing horizontal alignment based on matching existing conditions, driven by the pedestrian and bicycle sidewalk on the east side of the bridge. The Toole memo (Table 2) identified that alternative horizontal alignments were “identified as unreasonable given the considerations”.

3.5 Vertical Alignment

The proposed vertical alignment for the replacement structure must be raised approximately 5-feet-4-inches from the current condition based on the previously identified site constraints and consideration. The maximum allowed grade based on ADA compliance for the pedestrian sidewalks is 5 percent, while recommendations of the feasibility study will be based on a design value of 4.5 percent.

3.6 Project Limits

The extents of the project, defined by the general location of the landing / tie-in points of North Lombard Street based on the initial high-level assessment of the necessary vertical alignment grade changes, are approximately 400-feet to the north and 300-feet to the south of the existing bridge measured from the center of the UPRR ROW. The project extends through the intersection with North Terminal Road to the north while impacting multiple access driveways to the south.

Attachment A. Site Map

Property ROW MAP

Owner: WMR LLC

Grade Tie-in

Owner: 12005 Burgard Equities LLC

NORTH

Owner: WMR LLC

Owner: Port of Portland

345'-0"

Grade Build-up

WMR Total

30'

30'

N. TERMINAL RD.

30'

Owner: Marx Investments LLC

Bridge Abutment

Owner: O.W.R & N. CC. Railroad

Bridge

55'-0"

110'-0"

100'-5 1/2" RR ROW LIMITS

Bridge Abutment

Owner: O.W.R & N. CC. Railroad

Owner: Blackford Ray E

245'-0"

Grade Build-up

Grade Tie-in

Owner: Null

City ROW

Owner: 10839 N. Lombard LLC

N. LOMBARD

Owner: Port Properties LLC

Dimensions are approximate.
Lot coloring is approximate.
ROW is approximate.

Appendix F. Bridge Replacement Construction Staging Considerations

Memo

Date:	Tuesday, August 18, 2020
Project:	PBOT North Burgard Road Bridge Feasibility Study
To:	Zef Wagner, PBOT
From:	Travis Kruger, HDR and Eric Rau, HDR
Subject:	**Task 6.2: Bridge Replacement Construction Staging Considerations**

1.0 Objective and Purpose

The overall objective of Task 6.2 was to establish a Basis of Design (BOD) memorandum and provide a proposed concept for the bridge replacement as defined in a plan, elevation, and typical section engineering drawing. This proposed bridge replacement concept incorporates background information collected and summarized in Task 6.1, site research, design files, and the criteria and constraints identified in the BOD memorandum to define the preliminary cross-section, bent locations, bridge type, structure depth, and both vertical and horizontal alignments in the permanent as-constructed configuration.

Another key component of Task 6.2, and the overall feasibility study, is to consider construction staging options of the replacement bridge. The objective of this evaluation is to establish a reasonable construction sequence for the feasibility study, with the goals of minimizing impact to vehicular and pedestrian traffic through the site during construction and providing a cost-effective solution. Consideration of construction staging options evaluates alternatives for both staged construction with partial removal of the existing and partial construction of the replacement bridge along with an option that utilizes on-site temporary detour bridge. A preliminary recommendation for the proposed construction sequence is provided, which will be the basis of final feasibility report pending PBOT concurrence.

2.0 Methodology

The digital basemap built in Task 6.1 included site-specific topographic features and locations of property and right-of-way (ROW) for clearance envelopes defined and generated based on associated vertical clearance requirements.

For the purpose of the feasibility study, the layout and configuration of the proposed replacement bridge was established. A key consideration was maintaining the location of the east edge of the structure and corresponding pedestrian sidewalk, which provides connectivity for pedestrians and bicyclists to existing features to the north and south of the project site.

With both the east side of bridge and overall cross-section fixed, a range of staging options were evaluated. The following geometric constraints and criteria were considered as part of this evaluation:

- All bridge construction work must be within the 80 feet-0inches City of Portland ROW, including an on-site temporary detour bridge.
- The minimum cross-section width of the replacement bridge is 55 feet-0 inches, not including bridge rails.
- The existing bridge width is 45feet-11inches, not including bridge rails.
- The minimum vehicular travel lane width is 11feet-0 inches.
- The minimum pedestrian sidewalk width is 5 feet-0inches, which must be protected from vehicular lanes.
- A single vehicular travel lane is required for all stages of construction, but there is a strong preference for maintaining a vehicular lane in both direction. If a single vehicular travel lane is provided, it must be signalized.
- A single pedestrian sidewalk shall be provided, while a dedicated bicycle lane is not required.

The evaluation of construction staging identified three alternatives which are presented herein, and generally envelop the range of viable alternatives. Although not discussed in detail, these alternative all require staged construction of the approach roadway embankment and relocation of the existing utilities attached to the west side of the structure. With the exception of the removal of the existing bridge, construction of the replacement bridge will take place outside of Union Pacific Railroad ROW so the alternatives are similar from that perspective.

3.0 Construction Alternatives

Three construction alternatives considering various existing bridge removal and replacement sequences are shown in Attachment A as exhibits that illustrate the major stages of construction, and which are described in this section.

3.1 Alternative A

This alternative primarily uses a two-stage construction approach that removes and replaces the existing bridge in two halves. The primary drawback of this option is that only a single vehicular lane can be provide through much of construction, which reduces functionality and adds cost for temporary signalization. This could be mitigated by overbuilding the replacement structure to the west, however this would also increase project cost. Another possible drawback of this alternative is the need for pedestrians to be located on the west side of the replacement structure during construction. This configuration is not compatible with the approaches to the north and south and requires pedestrians to cross Lombard Road to access the west side sidewalk, which presents an increased safety risk.

3.2 Alternative B

This alternative has more construction stages than Alternative A, specifically requiring three stages of removal but has the benefit of providing two lanes of vehicular traffic and locates the

pedestrian sidewalk on the east side throughout construction. The primary disadvantage of this alternative is the need for additional stages of construction, which will require additional mobilizations for similar work such as bridge removal, foundation (pile or shaft), and beam (steel or concrete) erection.

3.3 Alternative C

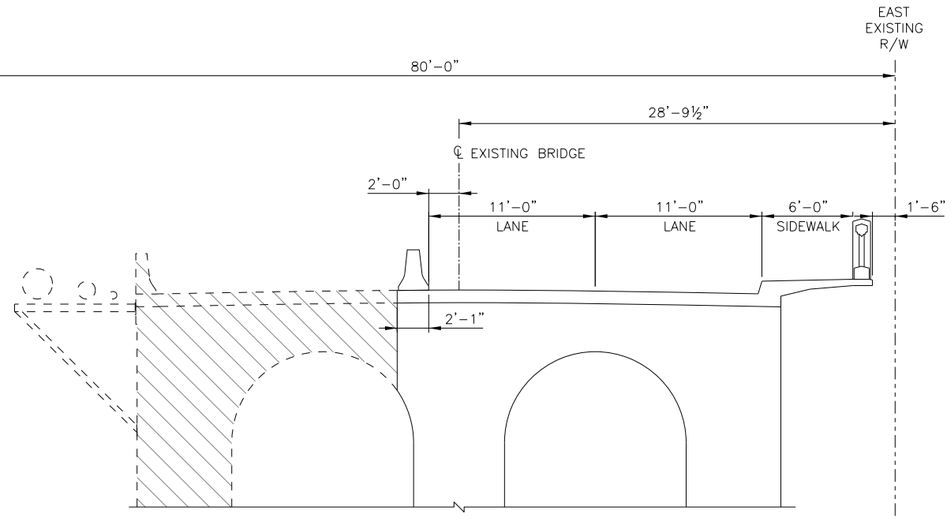
This alternative utilizes an on-site temporary detour bridge during construction. The primary drawback of this option is that although the detour bridge is located against the west ROW line, and the replacement bridge is located against the east ROW line, the required widths still result in staged construction of the replacement bridge. This could be mitigated by reducing the travel lane width or number during construction, or by attaining a temporary easement to locate the detour bridge outside of the City of Portland ROW.

4.0 Recommendation

Alternative B is recommended as the staged construction sequence for the basis of the feasibility study. This alternative provides the least impact to vehicular and pedestrian traffic during construction, and is expected to be cost-competitive as temporary signalization and overbuilding of the replacement structure are not required.

Attachment A. Construction Exhibits

PRELIMINARY REVIEW
08/2020



STAGE 1 DEMO
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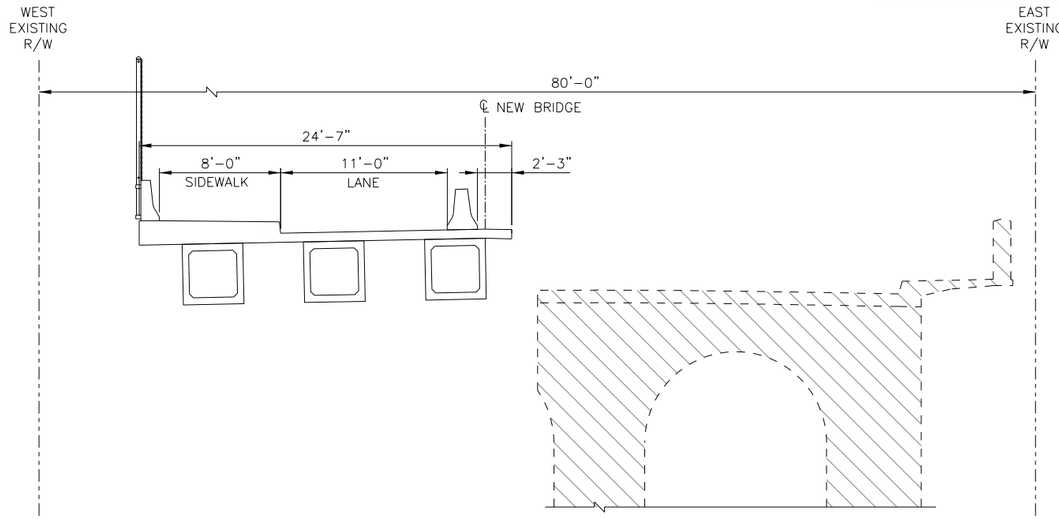

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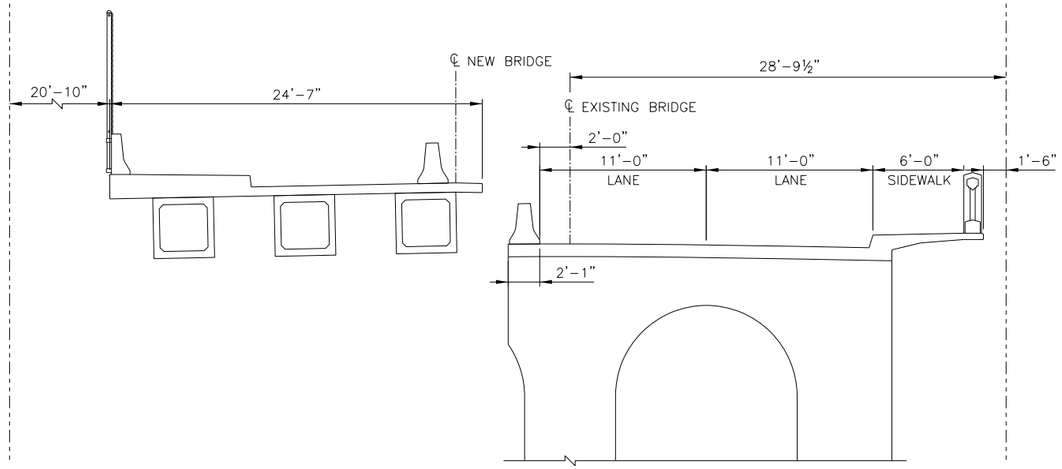

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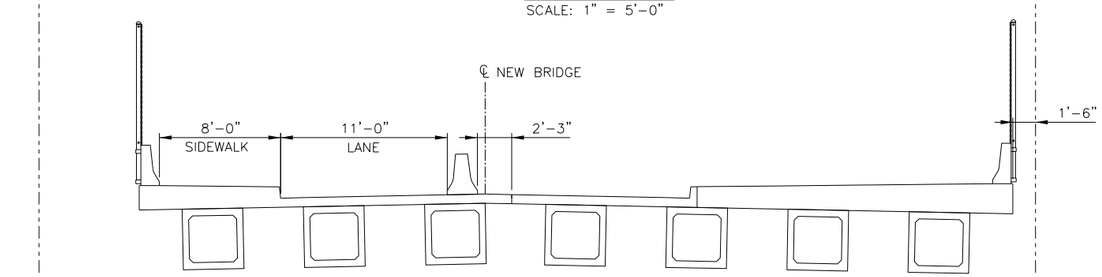

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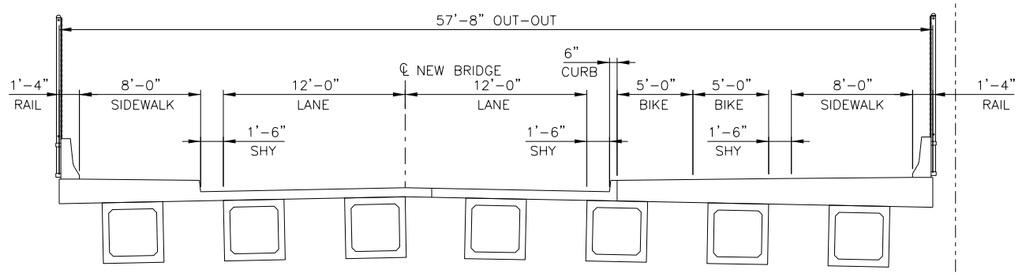

FINAL STAGE
SCALE: 1" = 5'-0"

WARNING
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IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

HDR

NO.	DATE	DESCRIPTION	DESCRIPTION	APPD.
		REVISION	REVISION	

DESIGNED BY: ER
DRAWN BY: HG
CHECKED BY: ES
DATE APPROVED:
DIV. ENGINEER: --

FEASIBILITY STUDY

NOT FOR CONSTRUCTION

APPROVALS:

SUPERVISING ENGINEER

CITY ENGINEER — REG. PROF. ENGR. NO. 51538PE

PBOT
PORTLAND BUREAU OF TRANSPORTATION
CHLOE EUDALY, COMMISSIONER
STEVE TOWNSEN, P.E., CITY ENGINEER

CITY OF PORTLAND OREGON 1851

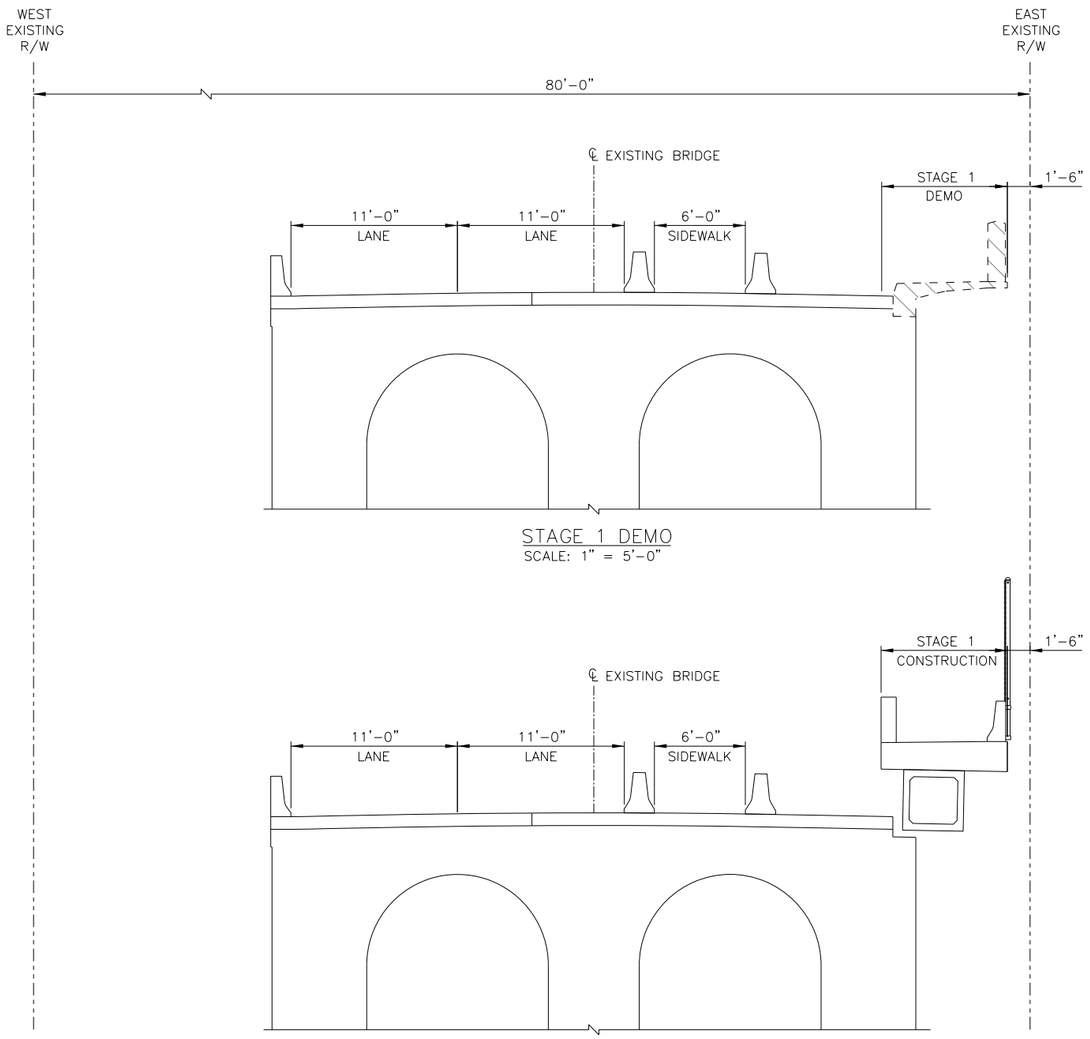
McLoughlin Blvd and Burgard Road Bridge Studies

LOMBARD ST BRIDGE OVER UPRR CONSTRUCTION STAGING ALTERNATIVE A

1/4 SECTION: ---
PROJECT NO.: *310001599* --
SHEET NO.: *Exhibit A-1*

Plot Date: $DATE$ $TIME$ Filename: $FILE$

PRELIMINARY REVIEW
08/2020



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STAGE 1 CONSTRUCTION
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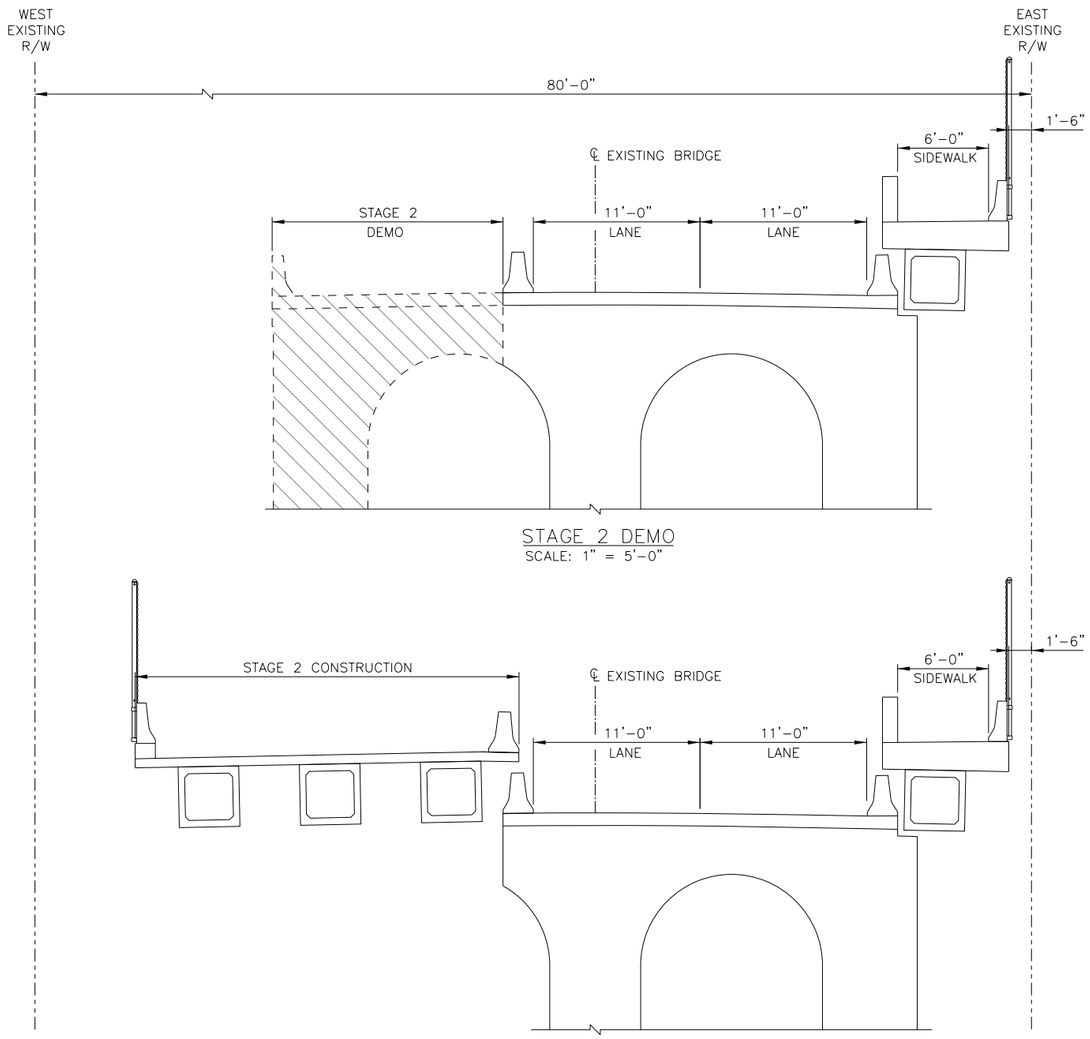

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STAGE 2 CONSTRUCTION
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WARNING
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IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

HDR

Plot Date: $DATE$ $TIME$ Filename: $FILE$

NO.	DATE	DESCRIPTION	DESCRIPTION	APPD.
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ES	

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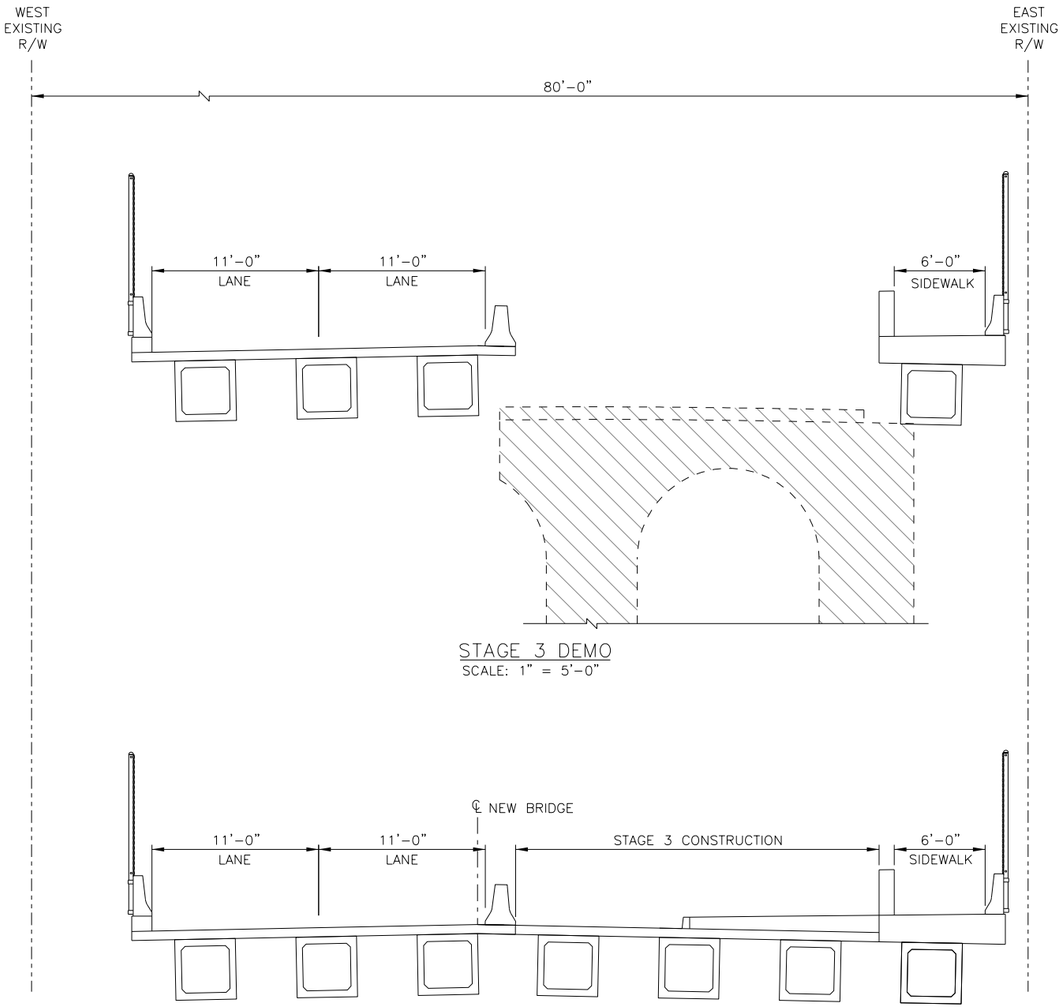
LOMBARD ST BRIDGE OVER UPRR CONSTRUCTION STAGING ALTERNATIVE B

1/4 SECTION	---
PROJECT NO.	*310001599* --
SHEET NO.	*Exhibit B-1*

PRELIMINARY REVIEW
08/2020



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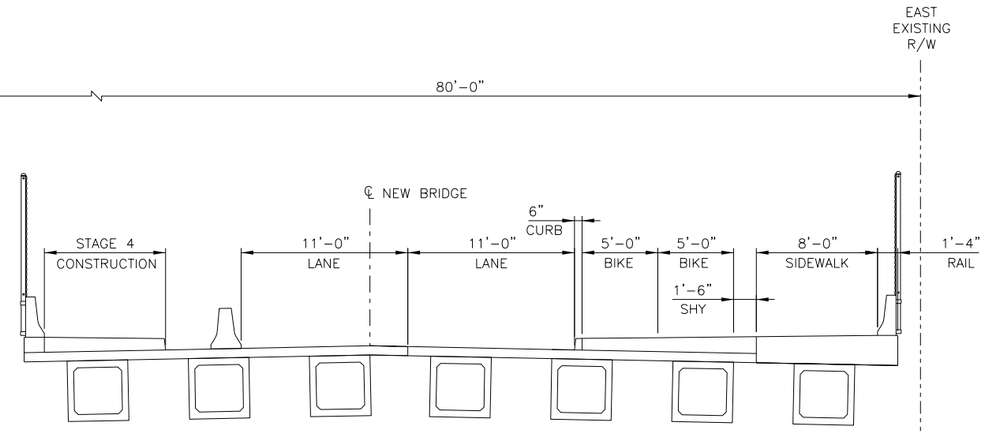
STAGE 3 CONSTRUCTION
SCALE: 1" = 5'-0"



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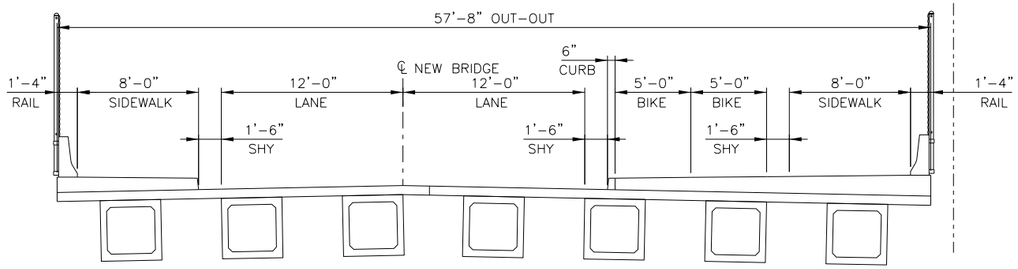

FINAL STAGE
SCALE: 1" = 5'-0"

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NO.	DATE	DESCRIPTION	DESCRIPTION	APPD.
		REVISION	REVISION	

DESIGNED BY	DATE APPROVED
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FEASIBILITY STUDY

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WARNING
0 1/2 1
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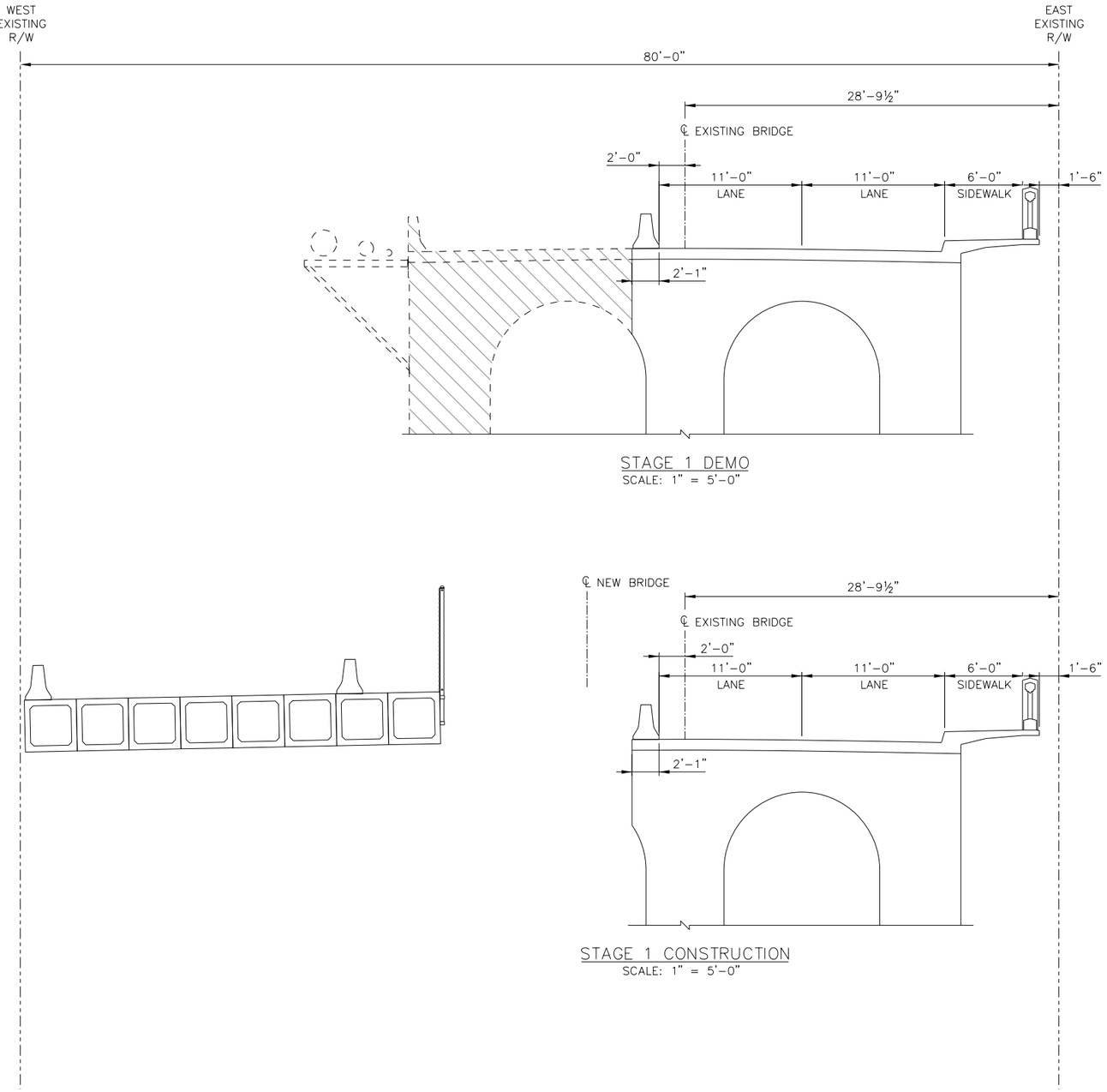
LOMBARD ST BRIDGE OVER UPRR CONSTRUCTION STAGING ALTERNATIVE B

1/4 SECTION ---
PROJECT NO. *310001599* --
SHEET NO. *Exhibit B-2*

PRELIMINARY REVIEW
08/2020



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STAGE 1 CONSTRUCTION
SCALE: 1" = 5'-0"

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DATE APPROVED	
DIV. ENGINEER	--

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WARNING
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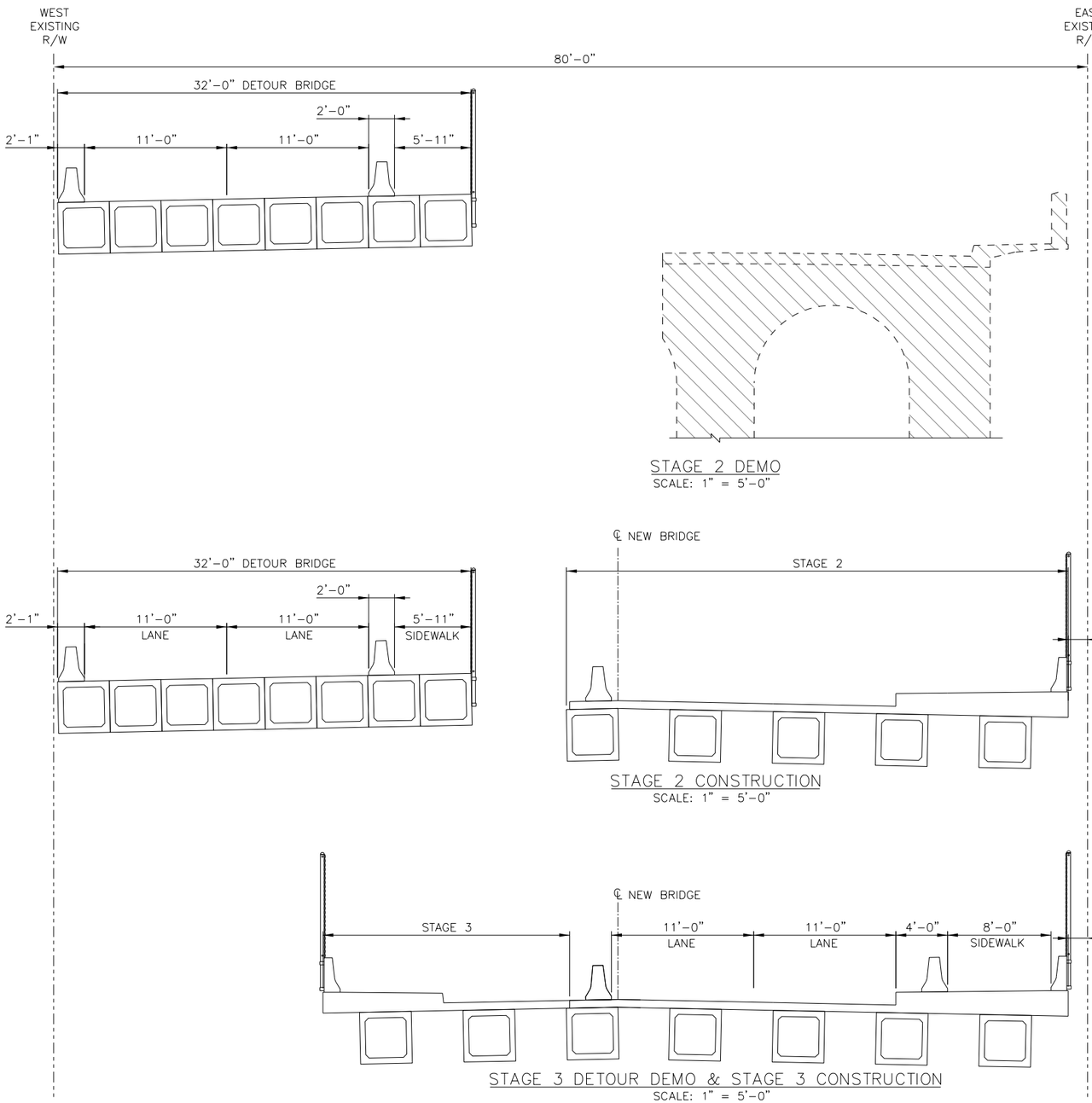
LOMBARD ST BRIDGE OVER UPRR CONSTRUCTION STAGING ALTERNATIVE C

1/4 SECTION	---
PROJECT NO.	310001599 --
SHEET NO.	Exhibit C-1

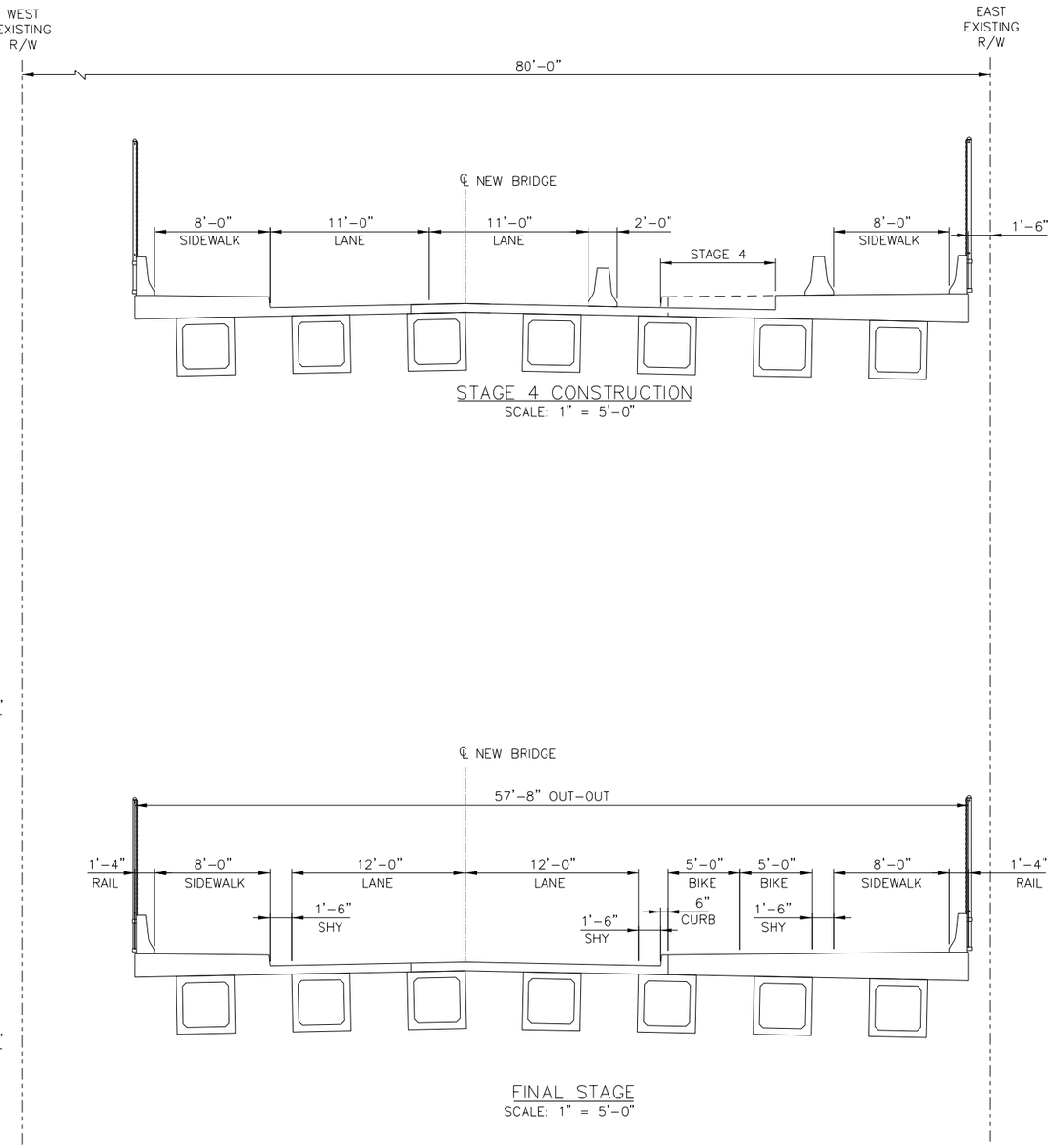
PRELIMINARY REVIEW
08/2020



STAGE 2 DEMO
SCALE: 1" = 5'-0"

STAGE 2 CONSTRUCTION
SCALE: 1" = 5'-0"

STAGE 3 DETOUR DEMO & STAGE 3 CONSTRUCTION
SCALE: 1" = 5'-0"



STAGE 4 CONSTRUCTION
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FINAL STAGE
SCALE: 1" = 5'-0"

WARNING
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IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

HDR

Plot Date: $DATE$ $TIME$ Filename: $FILE$

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LOMBARD ST BRIDGE OVER UPRR CONSTRUCTION STAGING ALTERNATIVE C

1/4 SECTION	---
PROJECT NO.	310001599 --
SHEET NO.	Exhibit C-2