BOECKMAN DIP PLANNING DESIGN NARRATIVE
for
Frog Pond Master Plan
City of Wilsonville, Oregon

May, 2014

OBEC Consulting Engineers

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APPENDICES

BOECKMAN DIP PLANNING DESIGN NARRATIVE
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Introduction

The City of Wilsonville (City) is currently preparing a Master Plan (MP) for the 175-acre Frog Pond area. Part of the MP is to eliminate the dramatic sag vertical curve on Boeckman Road between Canyon Creek and Wilsonville Road that does not comply with current design standards. This vertical curve is known as the Boeckman Dip. The roadway along the dip is very steep, results in poor sight distance, and creates a hazard for bicyclists and pedestrians. The City's Transportation System Plan (TSP) designates Boeckman Road as a Minor Arterial. The City recently constructed some temporary improvements along the south side of Boeckman Road to reduce conflicts between vehicular traffic and other modes of travel.

This narrative briefly addresses the planning-level design completed to provide the City with a cost estimate to remove existing fill and an overflow culvert, and span the dip with a bridge while improving the vertical curve to meet current design standards. Two alternatives were identified as follows:

1. Raise the vertical profile the minimum amount necessary to meet current design standards, and span over the dip with a bridge.
2. Raise the vertical profile to accommodate gravity sewer grades, which could reduce long-term demand on the Memorial Park pump station.

The findings in this narrative are based on survey data provided by others and preliminary alignments prepared by OBEC Consulting Engineers (OBEC). Shannon and Wilson (S&W) provided geotechnical consultation.

Design Standards and Assumptions

The alternatives developed in the planning effort are in accordance with the following design standards and project design assumptions.

Standards

- 2011 American Association of State Highway and Transportation Officials (AASHTO) *A Policy on Geometric Design of Highways and Streets*
- Americans with Disabilities Act (ADA) Accessibility Guidelines
- Wilsonville Transportation System Plan (TSP) 2013
- Wilsonville Public Works Standards (2006)
- *2012 AASHTO Load and Resistance Factor Design Bridge Design Specifications*

The design will also comply with the 2011 *Proposed Guidelines for Pedestrian Facilities in the Public Right-of-Way* (PROWAG). Roadway design criteria from the above standards are summarized in Appendix A.

Assumptions:

- Road and bridge typical sections are identified in Appendix B.
- All construction would occur during a full closure of Boeckman Road.
- Bridge aesthetic treatment and view platforms are not included.
- The existing flow control structure and lower culvert will remain in place.
- Hydraulics will not govern the vertical profile of the bridge and/or road.
- Seismic hazards such as liquefaction and lateral spread are not fully assessed in terms of risk or additional project cost.
- The existing access road north of Boeckman Road will be maintained but relocated east.
- The left turn lane taper for westbound Boeckman Road will not extend onto the bridge.
- Stormwater is not investigated, but is assumed to be conventional on-site treatment.
- Cost estimates are in 2013 dollars and assume federal-aid project delivery. Inflation to anticipated year of construction should be applied in MP.
- No traffic signals at nearby intersections are included.
- Utility conflicts and relocations were not considered.
- City utility replacement, relocation, or upgrades are not considered.
- Right-of-way acquisition costs were provided by the City.
- Reimbursable utility costs are not considered.
- All construction work can be accomplished without the use of work bridges.

Evaluation Summary

Roadway Design

Improving the substandard vertical profile will be accomplished by raising the low point and flattening the sag vertical curve, along with flattening and lengthening the adjoining crest vertical curves. Approximately 20 to 30 feet of existing roadway fill above the flow control structure and culvert will be removed in the area of the proposed bridge construction. There is an existing overflow culvert at the base of this fill that will be removed as well.

Two roadway vertical alignments (Options A and B) are presented in Appendices C and D. Each alignment essentially maintains the existing horizontal alignment while providing for the substantially wider Boeckman Road typical section. Approximately 18,000 cubic yards of fill will be removed in the dip to accommodate wildlife passage while restoring the area to a more natural setting. The approximate removal limits are depicted in the attachments. Jointed concrete pavement (PCC) will be the structural roadway section for Boeckman Road to match the west and east roadway sections that have been reconstructed in the last several years.

The respective vertical profile for each option is described below.

Option A

Appendix C presents the minimum sag vertical curve necessary to meet City and AASHTO standards. The resulting profile raises the low point of the road approximately 20-feet compared with the existing profile and ties into the crest vertical curves at each end. Grades were established to avoid reconstruction of existing PCC roadway and to minimize effects to side streets and driveways that intersect the road.

Option B

Appendix D presents a higher profile that accommodates a gravity sewer line that would run east to west along Boeckman Road. Layout and elevation information to establish a sewer line profile along Boeckman Road was provided by the City's Master Plan consultant. The information used is as follows:

- 24-inch sewer line at a basic slope of 0.12%
- Manholes located at 400-foot centers will drop the line 0.2 feet
- Resulting "net" slope is 0.17% which is used for the sewer line profile along Boeckman Road
- The controlling elevation is the existing manhole at STA 12+50 with a sewer invert of EL 207 feet

Compared with Option A, the profile increase is approximately 15 feet. Compared with the existing conditions, the profile increase is approximately 35 feet. The profile is high enough to accommodate the sewer line under the bridge, hung from the deck.

Structure Design

A conceptual multiple span bridge and retaining wall layout is included for each profile option to cross the dip with a standard sag vertical curve. The limits of the bridge are governed by the existing topography, depth of the dip, presence of the flow control structures, and the vertical profiles. Option A requires a bridge approximately 300 feet long with 500 feet of retaining wall. Option B requires a bridge approximately 425 feet long with 925 feet of retaining wall.

The bridge type could be steel or prestressed concrete girders supported on steel piles or concrete drilled shafts. Regardless of which option is selected for advancement to the City's next phase, conveying runoff across the bridge will require careful attention. The sag vertical curve creates a low point on the bridge and in the case of Option B, the very flat sag vertical curve will make it challenging to avoid ponding on the bridge.

Geotechnical

Local geology indicates that the project site consists of Willamette Silt and Hillsboro Formation above the Columbia River Basalt Group. Two borings, BH-1 and BH-2, were drilled at the approximate bridge abutment locations to a depth of 80 feet. The soils encountered were:

- **Fill** – Primarily includes the pavement section.
- **Willamette Silt** – Underlies the fill and consists 13.5 to 15.5 feet of loose to medium dense silt to silty sand with low to non-plasticity. The SPT N values range between 3 and 24 blows per foot with an average of 13 blows per foot.
- **Hillsboro Formation** – Underlies the Willamette Silt and consists of at least 63.5 feet of medium stiff to stiff Lean CLAY (CL). The SPT N values range between 4 and 13 blows per foot with an average of about 7 blows per foot.

The bridge will be supported by driven piles or drilled shaft. Due to presence of the deep clay deposit, the deep foundations will be designed primarily for skin friction. Based upon the explored subsurface conditions, the drilled shaft may be constructed by using uncased holes. The subsurface conditions are characterized as Site Class E for seismic hazards. The soils do not appear to be susceptible to liquefaction or related effects.

Construction of the MSE walls and the roadway embankments will result in settlement. While the majority of the settlement will occur during or shortly after construction, the Hillsboro Formation will experience some post-construction consolidation settlement. Therefore, a post-construction settlement period may be required prior to final paving, utility installation, constructing wall facing or other elements sensitive to settlement. The actual settlement period will be determined during final design.

Other Disciplines

Consideration of other design and permitting disciplines are outside the scope of this MP task. These include, but are not limited to, hydraulics and stormwater, full geotechnical analysis, traffic, signing, striping and illumination design, natural and cultural resources permitting, landscaping, mitigation and restoration, hazardous materials assessment, local permits, utility design and coordination, constructability, and public involvement. Right-of-way was only considered to provide a preliminary assessment of permanent acquisition costs without establishing a defined project footprint. Actual costs could be more than shown in this estimate. However, the cost will be approximately the same for either option and while raising the project cost, would not affect the cost difference between the two options.

Conclusion

Options A and B to address the Boeckman Dip are presented in this narrative and Appendices C and D. The planning-level cost estimates for each option are provided in Appendix E along with assumptions used to prepare the cost estimates. A summary of each option is provided below in Table 1.

Table 1: Options A and B Summary

Option	Cost	Summary
A	$13,100,000	This option provides the minimum profile improvement to comply with design standards. It results in the shortest bridge and is the least cost.
B	$17,900,000	This option provides a profile improvement to accommodate a future east-west gravity sewer line on the bridge. It results in a longer bridge and is the largest cost.

Each option includes building out Boeckman Road to accommodate bicycles and pedestrians on both sides of the road. The roadway section is PCC to match adjoining sections. The City will select the preferred option based on an overall cost assessment considering infrastructure and utility improvements associated with each option.

APPENDIX A

OBEC CONSULTING ENGINEERS

Design Standards Form
Roadway

Project: Boeckman Creek Bridge Date: 04/08/2014

Project Designer: Matthew Phillips, PE. Project No.: 0256-0023

Type of Project: (New Const., Reconst., 3-R) Reconst.

Functional Class: Minor Arterial

ADT:

Traffic	Year	ADT
Current (date ADT taken)	2014	3,374
Design ADT (20 years from const.)	2034	6,586

Note: If no design ADT is available, use growth rate for county or 2% growth rate if no other data is available.

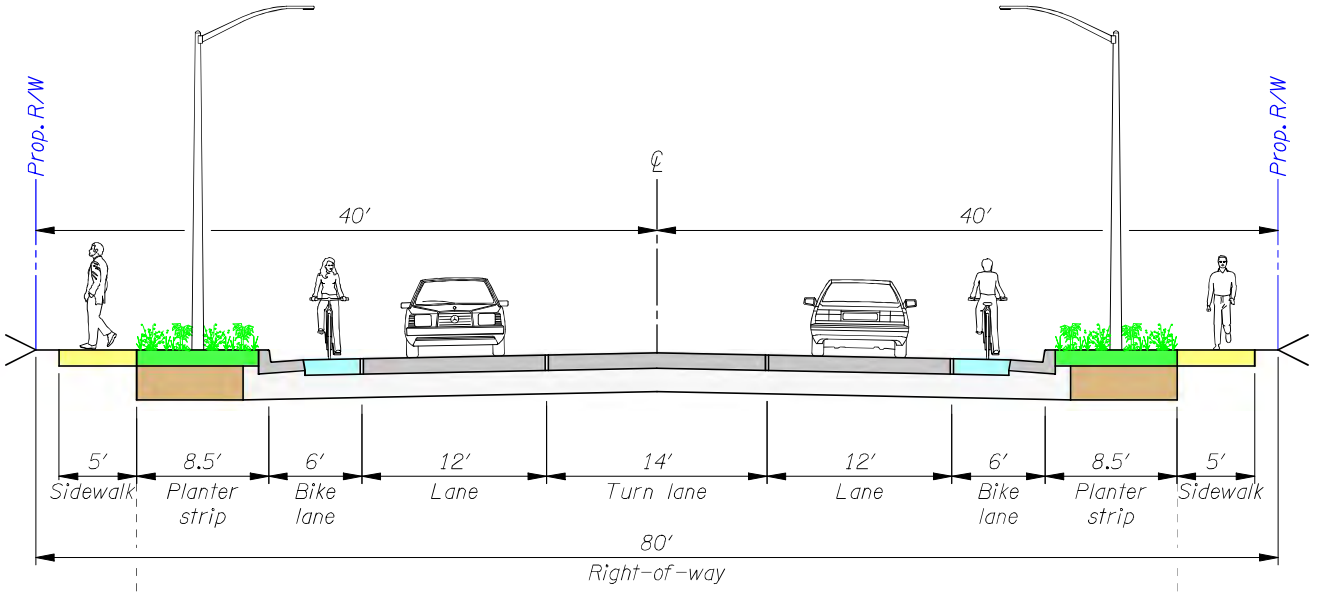
Design Standards: (ODOT, AASHTO, Other (name standard) (1) AASHTO 2011, 6th Ed, (2) Wilsonville TSP 2013 (3) City of Wilsonville Public Works Standards 2006, (4) ODOT Highway Design Manual 2012, (5) AASHTO RDG

Type of Terrain: Rolling

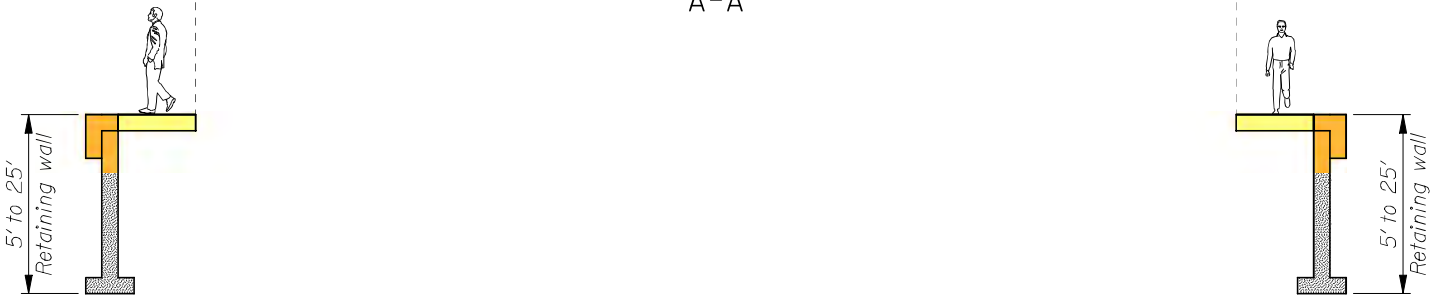
GEOMETRIC DESIGN STANDARD

	PAGE NO.	STANDARD	PROPOSED	EXCEPTION
Design Speed (mph)			40mph	
Traveled Way Width (ft.)	3-14 (2)	11' to 12'	12'	No
Shoulder Width (ft.)	3-14 (2)	6'	6'	No
Bike Lane Width (ft.)	3-14 (2)	6'	6'	No
Parking Width (ft.)	3-14 (2)	0'	0'	No
Sidewalk Width (ft.)	3-14 (2)	5' Min	5'	No
Bridge Width (ft.)	7-31 (1)	28' *	60’	No
Horizontal Curvature (min. radius)	3-45 (1) 60 (3)	4770' ** 855'	NA	No
Vertical Curvature (crest) (K value = L/A)	61 (3) 3-155 (1)	60 to 80 44	Opt. A: 80 Opt B: NA	No
Vertical Curvature (sag) (K value – L/A)	62 (3) 3-161 (1)	60 to 70 64	Opt. A: 64 Opt. B: 243	No
Grade (max. percent)	7-29 (1) 60 (3)	8% 6%	Opt. A: 6% Opt. B: 3.5%	No
Stopping Sight Distance (min.)	7-3 (1)	305'	Opt. A: 307’ Opt. B: 950’	No
Cross Slope (min. percent)	70 (3)	2%	2%	No
Superelevation (max. percent)	70 (3)	5%	2%	No
Vertical Clearance (ft.)	7-6 (1)	16'	NA	No
Superelevation Runoff (ft.) (@ max. e)	3-61 (1)	104'	NA	No
Clear zone	3-3 (5)	14’ to 18’	18’	No
	Comments: * Curb to Curb width ** Normal Crown			

APPENDIX B



BOECKMAN ROAD TYPICAL SECTION
A-A



City of WILSONVILLE OREGON

BOECKMAN CREEK BRIDGE
SW BOECKMAN ROAD
CITY OF WILSONVILLE

TYPICAL SECTION | 1 OF 2

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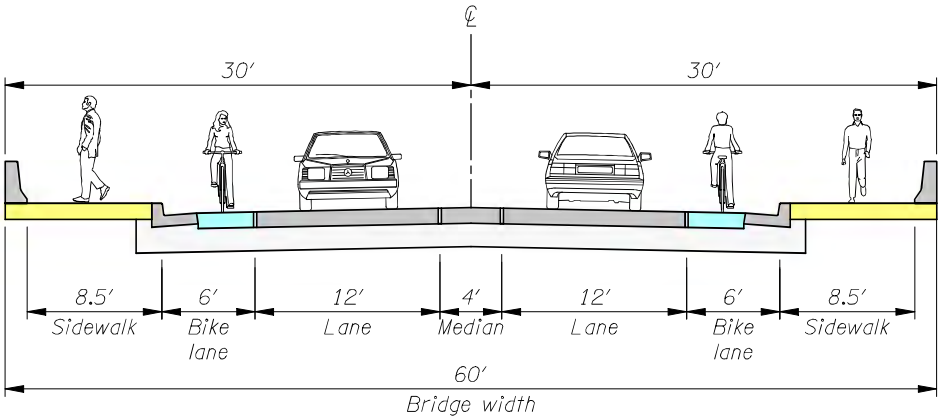

BOECKMAN BRIDGE TYPICAL SECTION
B-B

City of WILSONVILLE OREGON

BOECKMAN CREEK BRIDGE
SW BOECKMAN ROAD
CITY OF WILSONVILLE

TYPICAL SECTION	2 OF 2

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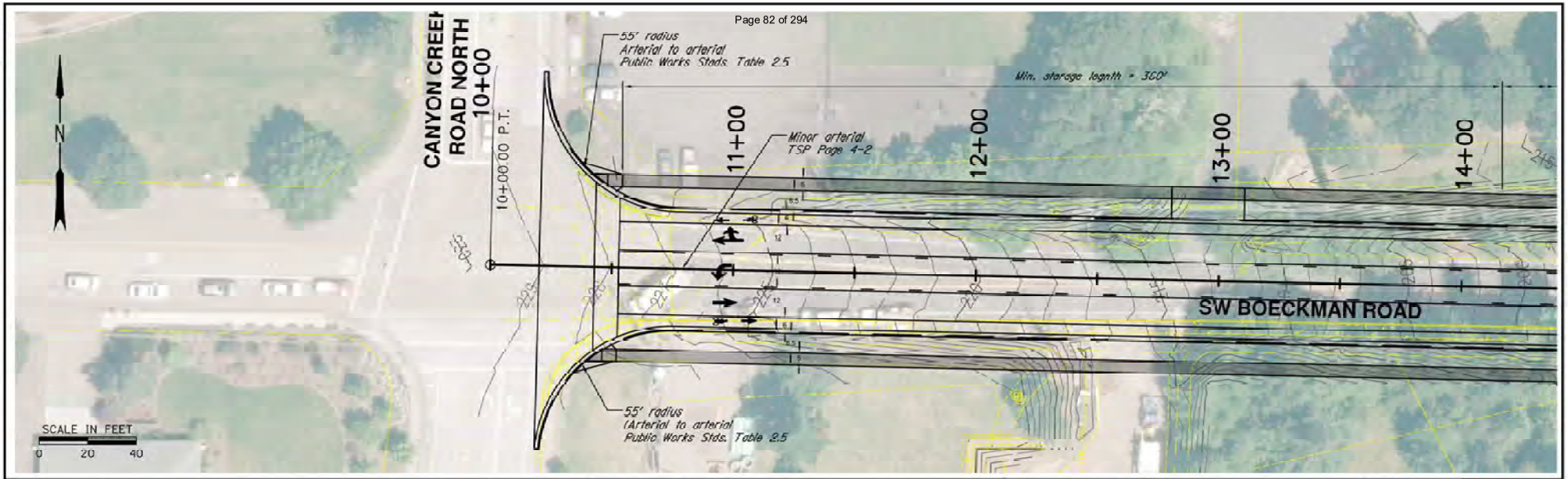
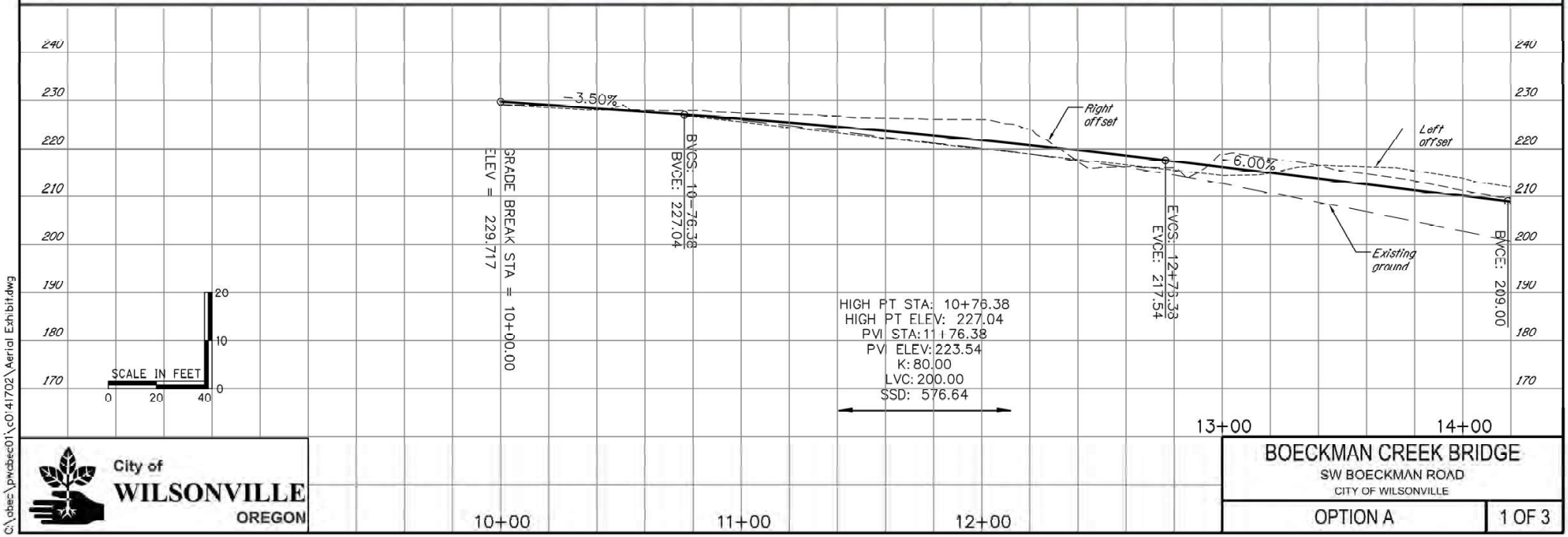
APPENDIX C





City of WILSONVILLE OREGON

BOECKMAN CREEK BRIDGE

SW BOECKMAN ROAD
CITY OF WILSONVILLE

OPTION A | 1 OF 3

04-10-2014

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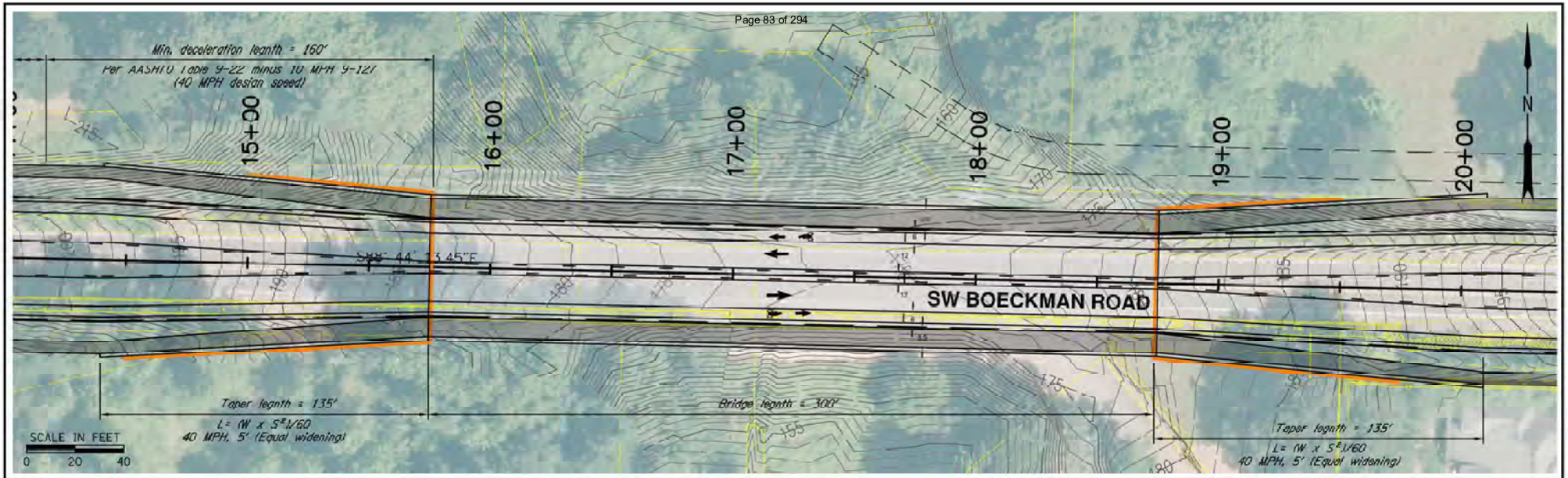
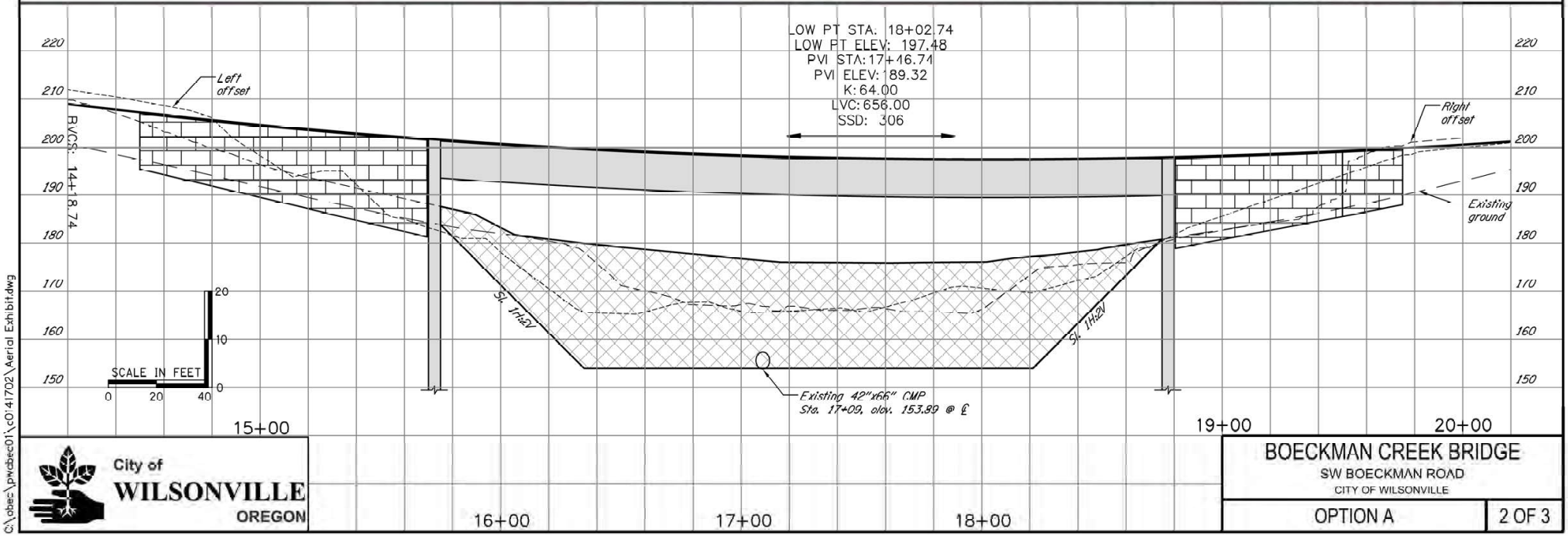




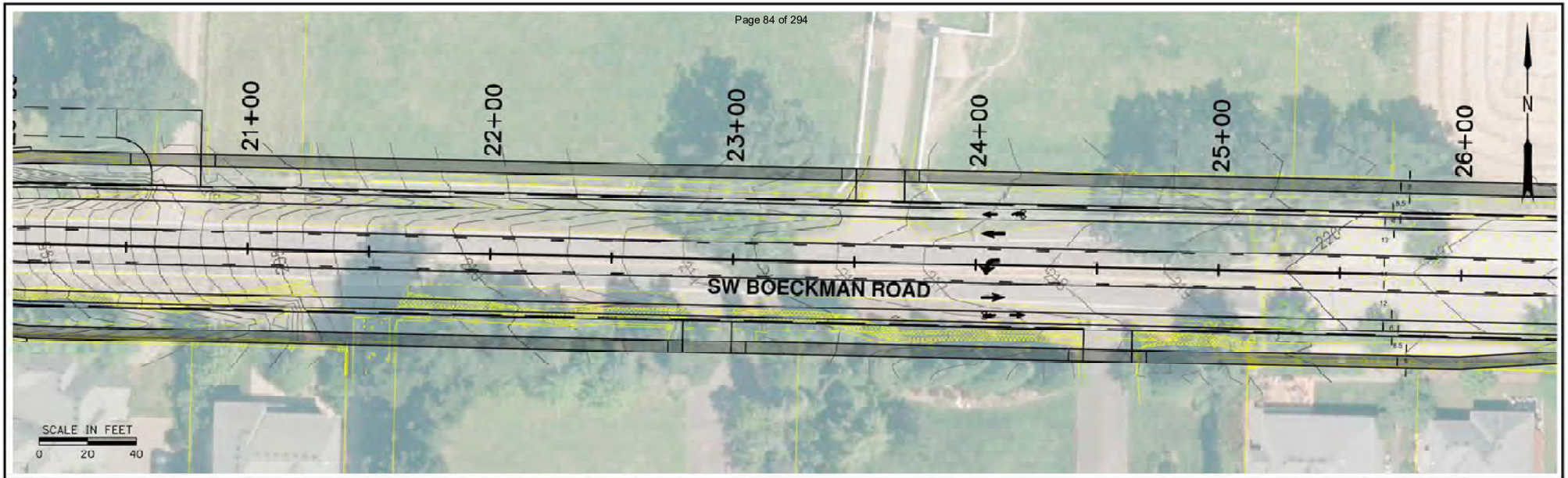
City of WILSONVILLE OREGON

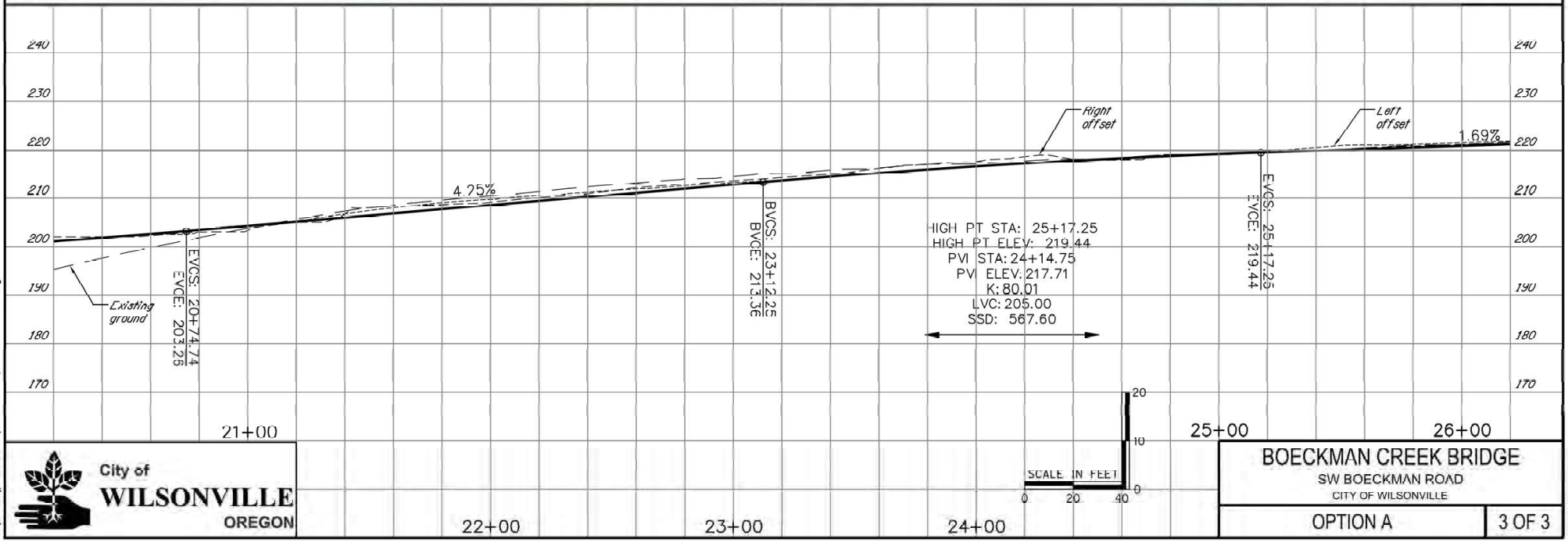
BOECKMAN CREEK BRIDGE

SW BOECKMAN ROAD
CITY OF WILSONVILLE

OPTION A | 2 OF 3

04-10-2014





City of WILSONVILLE OREGON

BOECKMAN CREEK BRIDGE

SW BOECKMAN ROAD
CITY OF WILSONVILLE

OPTION A | 3 OF 3

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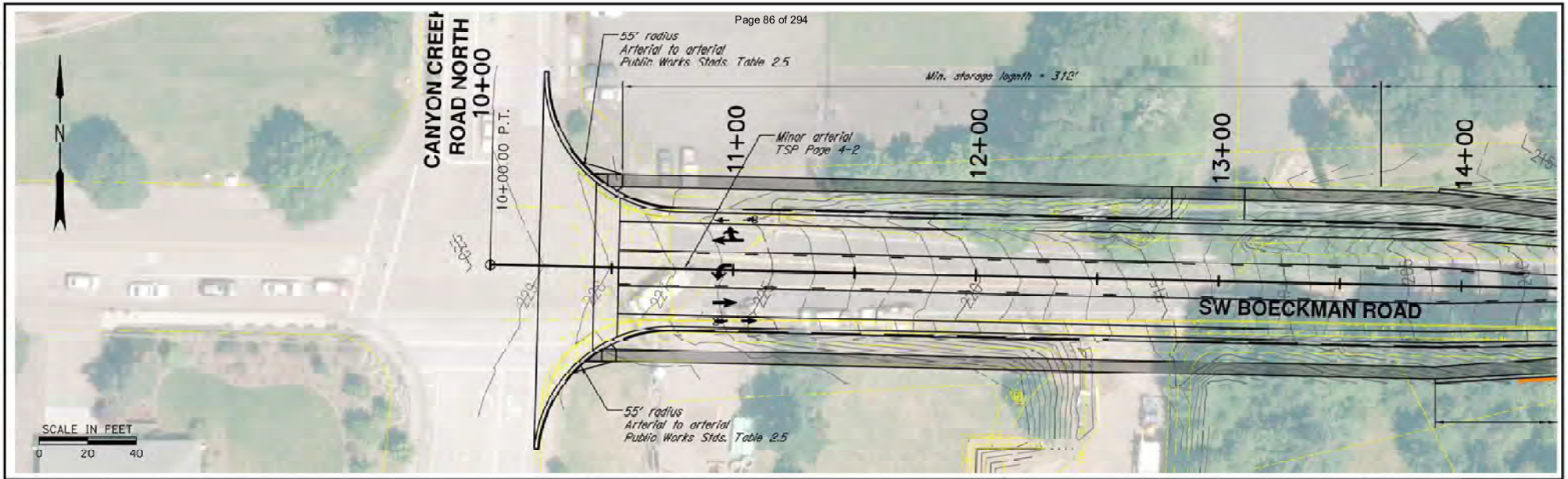
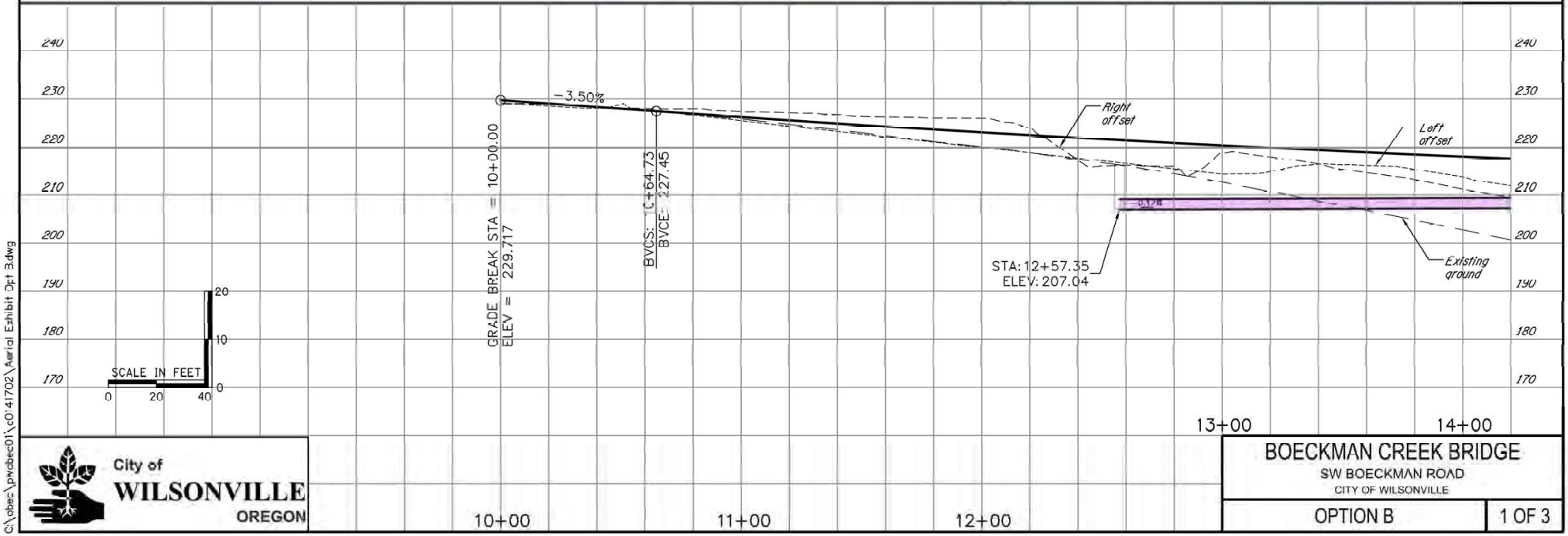
APPENDIX D





City of WILSONVILLE OREGON

BOECKMAN CREEK BRIDGE

SW BOECKMAN ROAD

CITY OF WILSONVILLE

OPTION B | 1 OF 3

04-10-2014

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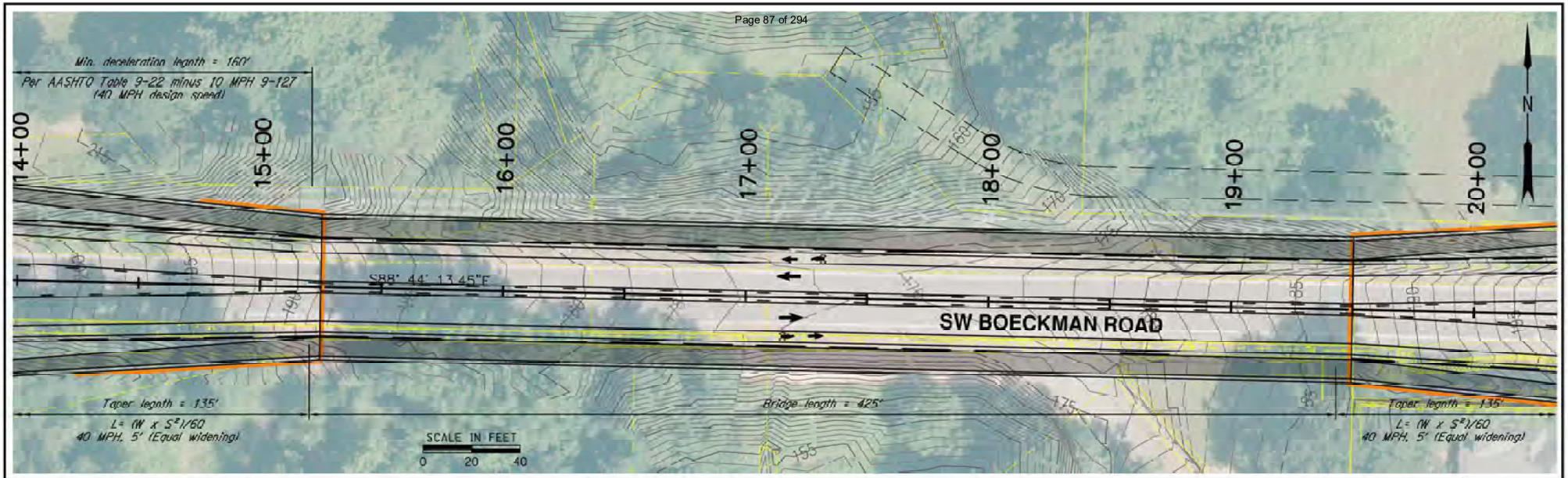

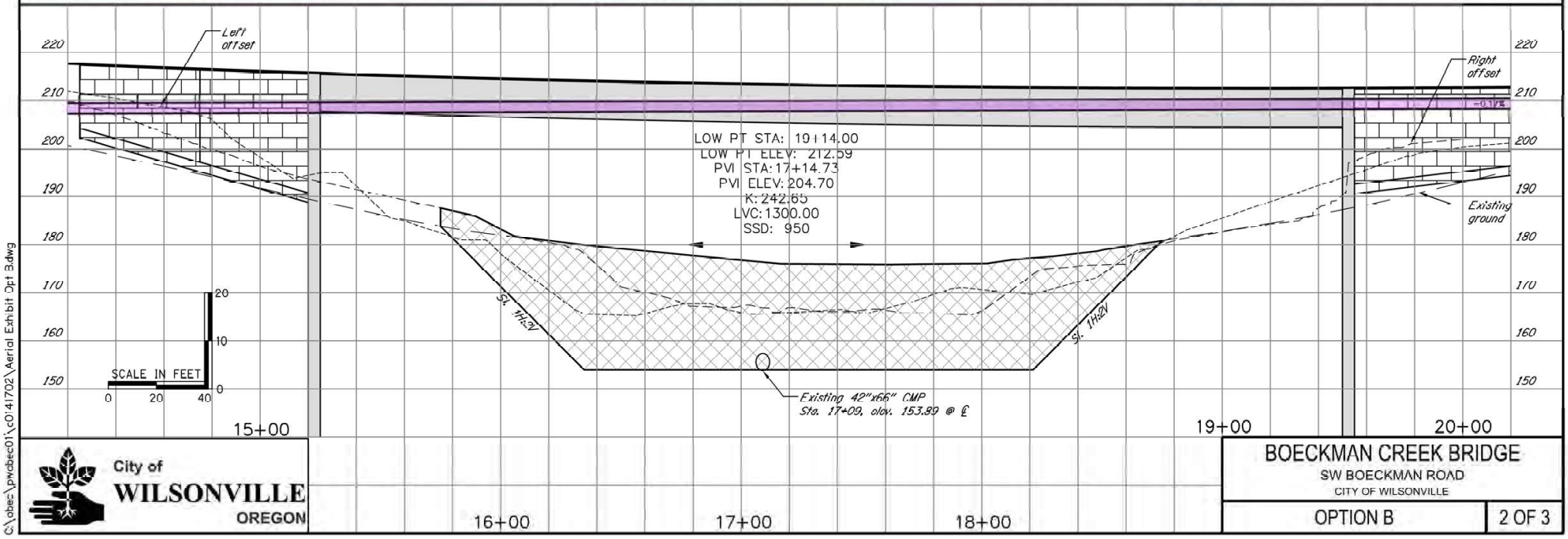

City of WILSONVILLE OREGON

BOECKMAN CREEK BRIDGE

SW BOECKMAN ROAD

CITY OF WILSONVILLE

OPTION B | 2 OF 3

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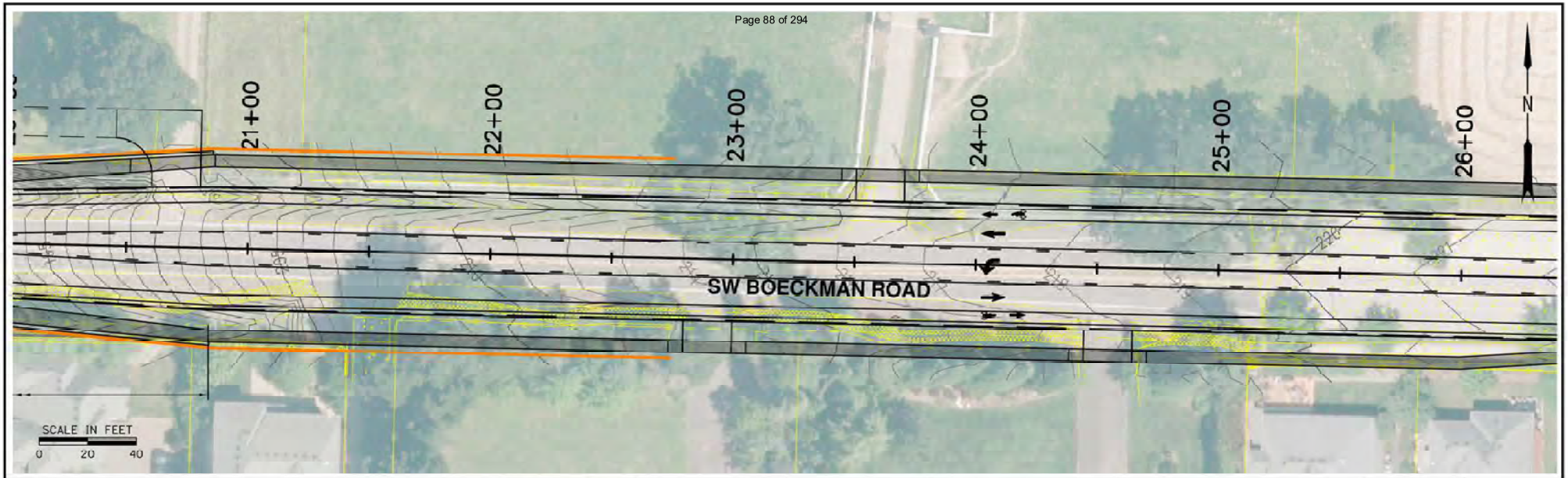

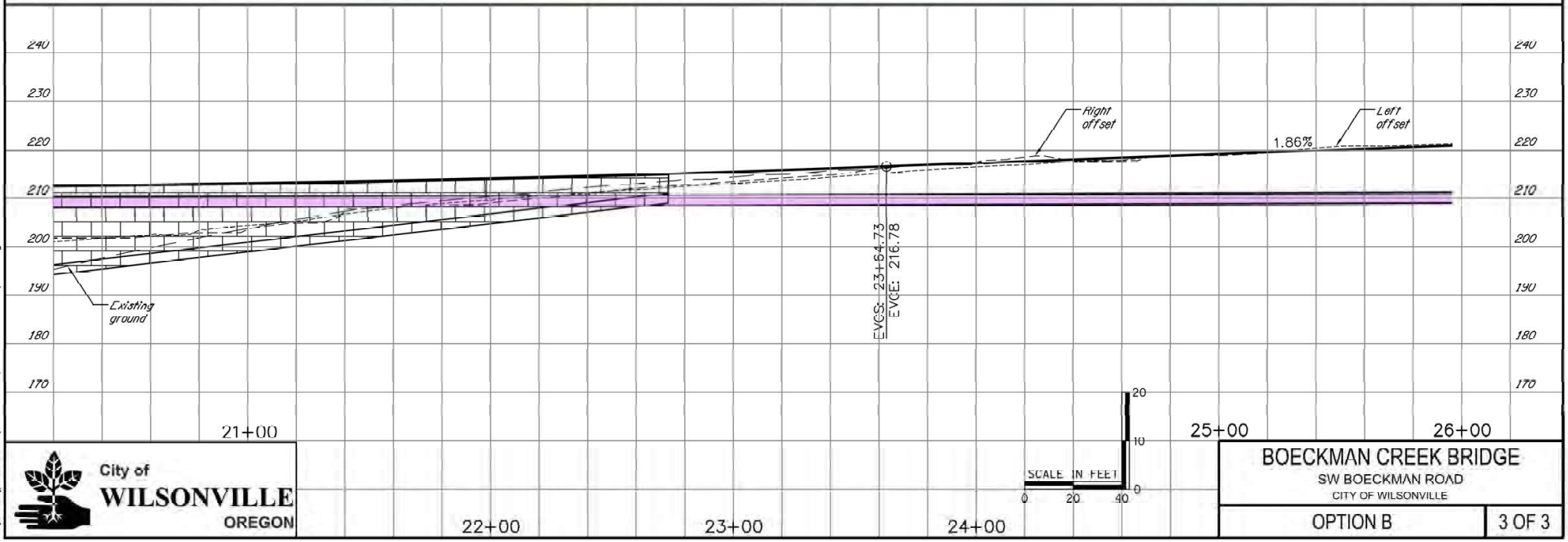

City of WILSONVILLE OREGON

BOECKMAN CREEK BRIDGE

SW BOECKMAN ROAD

CITY OF WILSONVILLE

OPTION B | 3 OF 3

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APPENDIX E

PRELIMINARY - COST ESTIMATE

City of Wilsonville

SECTION				COUNTY	
Boeckman Dip Reconstruction (Wilsonville) - Option A				Clackamas	
KEY NUMBER	KIND OF WORK	LENGTH	DATE	ROADWAY DESIGNER	
n/a	Structures, Grading, Paving, Illumination	0.31	5/28/14	OBEC	

ITEM NUMBER	ITEM DESCRIPTION	UNIT	AMOUNT	UNIT COST	TOTAL
MOBILIZATION AND TRAFFIC CONTROL					
0210.0100000A	MOBILIZATION	LS	All	$0	$632,000
0225-0100000A	TEMPORARY PROTECTION AND DIRECTION OF TRAFFIC	LS	1	$10,000	$10,000
ROADWORK					
0310.0100000A	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	All	1%	$69,400
0320.0100000A	CLEARING AND GRUBBING	AC	4	$1,000	$4,000
0330.0105000K	GENERAL EXCAVATION	CUYD	21,531	$10	$215,310
0350.0105000J	SUBGRADE GEOTEXTILE	SQYD	8,038	$1.00	$8,038
0640.0100000M	AGGREGATE BASE	CUYD	1,538	$30	$46,152
0756.0111000J	PLAIN CONCRETE PAVEMENT, DOWELED, 7 INCH THICK	SQYD	6,947	$55	$382,085
0759.0110000F	STANDARD CONCRETE CURB AND GUTTER	FT	2,716	$15	$40,740
0759.0128000J	CONCRETE WALKS 4"	SQFT	13,873	$5.00	$69,365
0759.0128000J	CONCRETE WALKS 6"	SQFT	1,410	$7.00	$9,870
00400's	Storm & drainage	LS	1	$100,000	$100,000
1012-0000000R	WATER QUALITY SWALE	LS	1	$25,000	$25,000
STRUCTURES					
0596-0104000J	RETAINING WALL, MSE - West Side	SQFT	3,975	$75	$298,125
0596-0104000J	RETAINING WALL, MSE - East Side	SQFT	3,600	$75	$270,000
00500's	STEEL OR CONCRETE BRIDGE	SQFT	18,000	$300	$5,400,000
SIGNING, STRIPING & ILLUMINATION					
00800's	Striping	LS	1	$15,000	$15,000
00900's	Signing	LS	1	$5,000	$5,000
00890's	Illumination	LS	1	$50,000	$50,000
SUBTOTAL, Construction Items					**$7,650,000**
	PRELIMINARY ENGINEERING			15%	$1,148,000
	RIGHT-OF-WAY				$900,000
	CONSTRUCTION ENGINEERING			12%	$918,000
	CONSTRUCTION SURVEY WORK			3%	$210,000
	CONTINGENCY			30%	$2,295,000
****PARTIAL PROJECT COST**					**$13,200,000**

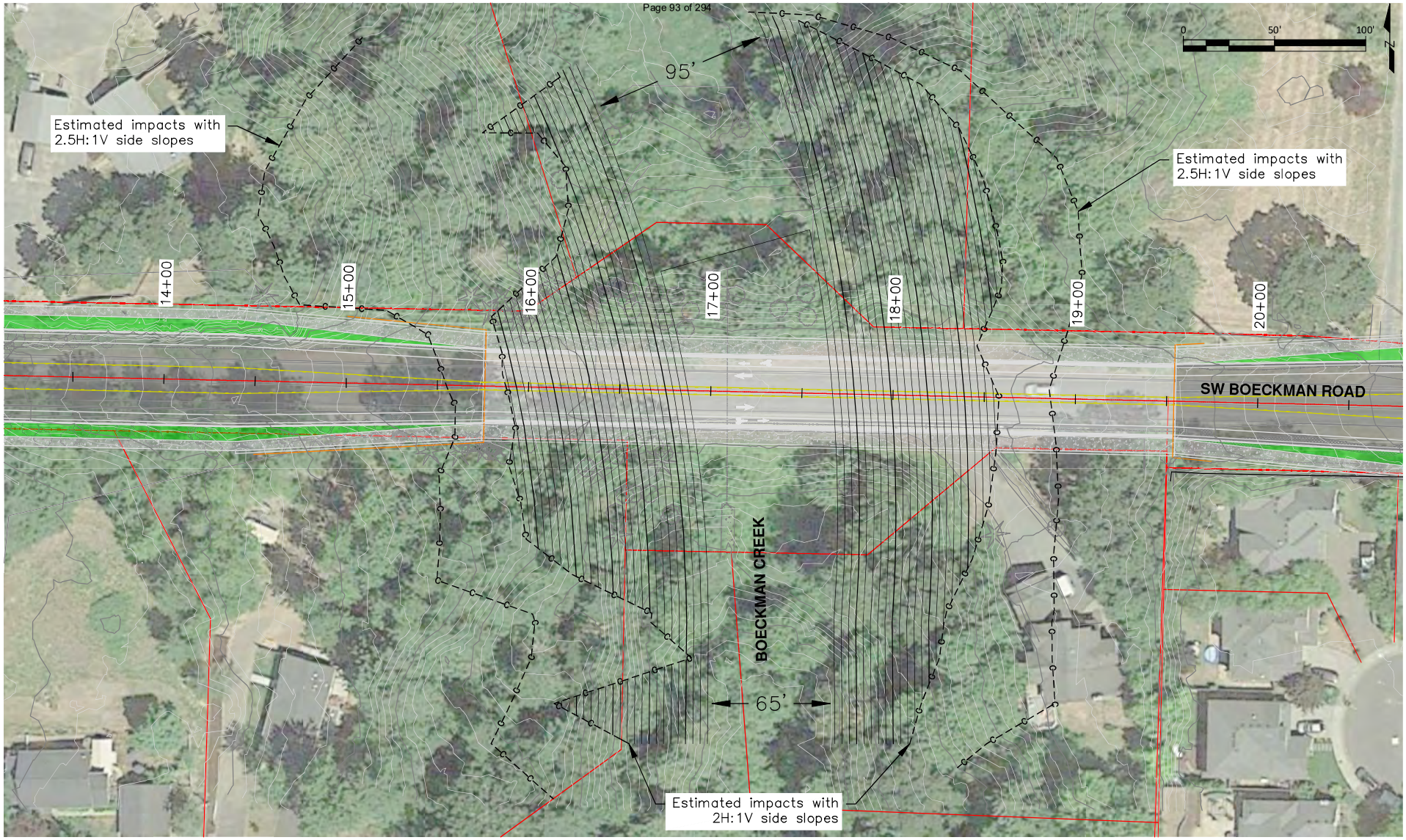
PRELIMINARY - COST ESTIMATE

City of Wilsonville

SECTION				COUNTY	
Boeckman Dip Reconstruction (Wilsonville) - Option B				Clackamas	
KEY NUMBER	KIND OF WORK	LENGTH	DATE	ROADWAY DESIGNER	
n/a	Structures, Grading, Paving, Illumination	0.31	5/28/14	OBEC	

ITEM NUMBER	ITEM DESCRIPTION	UNIT	AMOUNT	UNIT COST	TOTAL
MOBILIZATION AND TRAFFIC CONTROL					
0210.0100000A	MOBILIZATION	LS	All	$0	$877,000
0225-0100000A	TEMPORARY PROTECTION AND DIRECTION OF TRAFFIC	LS	1	$10,000	$10,000
ROADWORK					
0310.0100000A	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	All	1%	$96,400
0320.0100000A	CLEARING AND GRUBBING	AC	4	$1,000	$4,000
0330.0105000K	GENERAL EXCAVATION	CUYD	19,382	$10	$193,820
0350.0105000J	SUBGRADE GEOTEXTILE	SQYD	7,330	$1.00	$7,330
0640.0100000M	AGGREGATE BASE	CUYD	1,413	$30	$42,379
0756.0111000J	PLAIN CONCRETE PAVEMENT, DOWELED, 7 INCH THICK	SQYD	6,294	$55	$346,170
0759.0110000F	STANDARD CONCRETE CURB AND GUTTER	FT	2,466	$15	$36,990
0759.0128000J	CONCRETE WALKS 4"	SQFT	12,626	$5.00	$63,130
0759.0128000J	CONCRETE WALKS 6"	SQFT	1,410	$7.00	$9,870
00400's	Storm & drainage	LS	1	$100,000	$100,000
1012-0000000R	WATER QUALITY SWALE	LS	1	$25,000	$25,000
STRUCTURES					
0596-0104000J	RETAINING WALL, MSE - West Side	SQFT	4,515	$75	$338,625
0596-0104000J	RETAINING WALL, MSE - East Side	SQFT	10,010	$75	$750,750
00500's	STEEL OR CONCRETE BRIDGE	SQFT	25,500	$300	$7,650,000
SIGNING, STRIPING & ILLUMINATION					
00800's	Striping	LS	1	$15,000	$15,000
00900's	Signing	LS	1	$5,000	$5,000
00890's	Illumination	LS	1	$50,000	$50,000
SUBTOTAL, Construction Items					**$10,621,000**
	PRELIMINARY ENGINEERING			15%	$1,593,000
	RIGHT-OF-WAY				$900,000
	CONSTRUCTION ENGINEERING			12%	$1,275,000
	CONSTRUCTION SURVEY WORK			3%	$292,000
	CONTINGENCY			30%	$3,186,000
****PARTIAL PROJECT COST**					**$17,900,000**

Appendix G



City of WILSONVILLE OREGON

Note:
No ordinary high water was delineated when evaluating full channel restoration impacts. Impacts were derived from assumed wetland areas based on an existing ground LIDAR surface. Further evaluation of environmental impacts and a hydraulic analysis is required to better determine the impacts of full channel restoration.

BOECKMAN CREEK BRIDGE

SW BOECKMAN ROAD
CITY OF WILSONVILLE

FULL CHANNEL RESTORATION	G1

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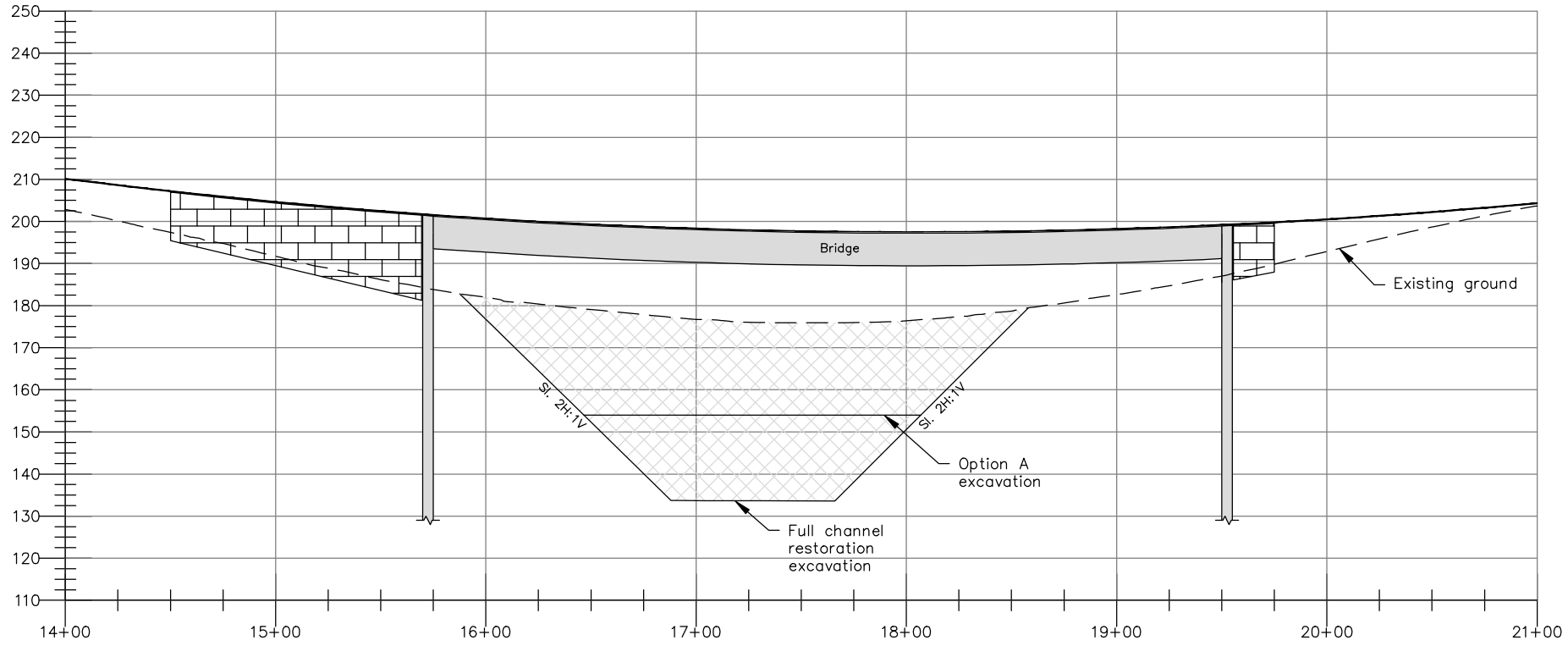

City of
WILSONVILLE
OREGON

BOECKMAN CREEK BRIDGE

SW BOECKMAN ROAD
CITY OF WILSONVILLE

FULL CHANNEL RESTORATION - PROFILE | G2

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PRELIMINARY - COST ESTIMATE

City of Wilsonville

SECTION				COUNTY	
Boeckman Dip Reconstruction (Wilsonville) - Extra for Full Channel Restoration				**Clackamas**	
KEY NUMBER	KIND OF WORK	LENGTH	DATE	ROADWAY DESIGNER	
n/a	**Grading, Structures, Paving, Signing, Illumination**	**0.31**	**12/13/19**	**OBEC**	
ITEM NUMBER	**ITEM DESCRIPTION**	**UNIT**	**AMOUNT**	**UNIT COST**	**TOTAL**
MOBILIZATION AND TRAFFIC CONTROL					
0210.0100000A	MOBILIZATION	LS	All	$0	$127,000
0225.0101000A	TEMPORARY WORK ZONE TRAFFIC CONTROL, COMPLETE	LS	All	3%	$50,000
0280.0100000A	EROSION CONTROL	LS	All	2%	$27,700
ROADWORK					
0310.0100000A	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	All	1%	$13,700
0320.0100000A	CLEARING AND GRUBBING	AC	2	$1,500	$3,000
0330.0105000K	GENERAL EXCAVATION	CUYD	22,600	$30	$678,000
STRUCTURES					
00500's	STEEL OR CONCRETE BRIDGE	SQFT	22,800	$25	$570,000
RIGHT OF WAY DEVELOPMENT AND CONTROL					
01000's	STREAM AND HABITAT RESTORATION	LS	All	$120,000	$120,000
SUBTOTAL, Construction Items					**$1,589,000**
	PRELIMINARY ENGINEERING			15%	$238,000
	PERMINANT SLOPE EASEMENTS	SQFT	12,382		$160,000
	CONSTRUCTION ENGINEERING			12%	$191,000
	CONSTRUCTION SURVEY WORK			3%	$42,000
	PLANNING COST RANGE (-20% TO +50%)				
**** LOW ADDITIONAL PROJECT COST IN 2019 DOLLARS**					**$1,800,000**
**** HIGH ADDITIONAL PROJECT COST IN 2019 DOLLARS**					**$3,400,000**
**** LOW ADDITIONAL PROJECT COST INFLATED TO 2021 CONSTRUCTION (4% ESCALATION PER YEAR)**					**$2,000,000**
**** HIGH ADDITIONAL PROJECT COST INFLATED TO 2021 CONSTRUCTION (4% ESCALATION PER YEAR)**					**$3,700,000**

** We are providing a range due to the uncertainty of the additional work. Added work may differ depending on which alternative is selected.