Final Report

US 97/Murphy Road: Brookswood - Parrell (Bend) Project

Type, Size, and Location for Murphy Road Bridge, 3rd Street Bridge and Retaining Walls

Prepared for

City of Bend, Oregon
Oregon Department of Transportation Region 4

May 2011

Prepared by

CH2MHILL

Donald E. Wagner, P.E.

Printed on Recycled and Recyclable Paper

Contents

Appendixes

Tables

Acronyms and Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
CIP	cast-in-place
DAP	Design Acceptance Package
g	acceleration due to gravity
GDM	Geotechnical Design Manual
H	height; horizontal
LRFD	Load Resistance Factor Design
MSE	mechanically stabilized earth
ODOT	Oregon Department of Transportation
psi	pounds per square inch
RQD	Rock Quality Designation
TS&L	type, size, and location
V	vertical

1.0 Introduction

This type, size, and location (TS&L) report documents design decisions related to the preliminary design of the proposed bridges and retaining walls for the US 97/Murphy Road: Brookswood — Parrell (Bend) Project. The US 97/Murphy Road project includes an extension and realignment of Murphy Road from Parrell Road across US 97 to Brookswood Boulevard; a new bridge on Murphy Road that crosses over US 97 (Bend Parkway); a new southbound flyover bridge from 3rd Street (business US 97) to US 97; a realignment of the existing northbound exit from US 97 to 3rd Street; and roundabout intersections at Murphy Road and 3rd Street, Murphy Road, and Brookswood Boulevard, and Murphy Road and Parrell Road. Bridge and retaining wall TS&L drawings are included in Appendix A of the Design Acceptance Package (DAP). Cost estimates are included as Appendix A of this report.

2.0 General Background

2.1 Project Development and Justification

The purpose of the project is to improve safety and connectivity by constructing an east–west arterial on the south end of Bend and eliminating the traffic signals at the intersections of US 97 at Pinebrook Boulevard and US 97 at 3rd Street.

US 97 is a statewide priority expressway and designated as a primary freight and travel route through central Oregon. Murphy Road is an arterial road and a strategic corridor for the City of Bend's overall transportation system. The elimination of the signalized intersections at 3rd Street and Pinebrook Boulevard on US 97 will alleviate congestion, increase mobility in the corridor, and improve safety.

The US 97/Murphy Road project is a high priority for the City of Bend, Bend Metropolitan Planning Organization, Oregon Department of Transportation (ODOT) Region 4, and the Central Oregon Area Commission on Transportation. This project has been identified in the South Parkway Refinement Plan, Murphy Crossing Refinement Plan, and the US 97: South Parkway/Murphy Interchange Area Management Plan.

2.2 Right-of-Way Restrictions

The bridges and retaining walls generally use property currently within the ODOT and City of Bend right-of-way with some additional right-of-way required for the 3rd Street Bridge and retaining walls. Construction easements will also be necessary.

2.3 Permits and Restrictions

Permits required to construct the project may include construction permits from the City of Bend and local utility provider permits, if needed. Specific permitting for the project will be investigated during final design.

2.4 Utility Conflicts and Restrictions

Several existing utilities will be relocated to construct the proposed bridges. The following subsections present a brief summary of the affected utilities. For additional description of these

and other utilities impacted by the project, see the Utility Conflict Analysis in Section 3 – Proposed Design of the DAP.

2.4.1 Water

An existing 12-inch-diameter waterline that crosses beneath the east end of the proposed Murphy Road Bridge will be relocated. Another existing 12 inch-diameter waterline that crosses beneath the proposed Murphy Road immediately adjacent to retaining walls located at the west end of the proposed bridge will be relocated.

2.4.2 Storm Sewer

Several storm sewer lines and inlets are located within US 97 near the proposed Murphy Road Bridge and 3rd Street Bridge. These lines will remain and be protected in place as needed.

2.4.3 Sanitary Sewer

An existing 15-inch-diameter sanitary sewer line that crosses beneath the west end of the proposed 3rd Street Bridge will be relocated.

2.5 Clearances and Restrictions

2.5.1 Horizontal Clearances

A minimum horizontal clearance of 34 feet will be provided for the existing US 97 northbound and southbound roadways by the proposed Murphy Road Bridge and 3rd Street Bridge. In addition, the proposed Murphy Road Bridge will accommodate the future addition of 16-foot-wide ramps in each direction.

During construction, the minimum horizontal clearance will be reduced to 28 feet for the US 97 northbound and southbound roadways at the proposed Murphy Road and 3rd Street bridges. Columns and footings for the proposed bridges will be constructed within the existing 20-foot-wide median. To accommodate construction of the columns, footings and shoring, and falsework for the cast-in-place (CIP) concrete box girder superstructure options, temporary traffic barriers and shifting traffic to the outside of the existing roadways is required. Following construction of the columns and footings and removal of shoring and falsework, permanent traffic barriers will be constructed within the median providing at minimum 4-foot-wide shoulders on each side within the 20-foot-wide median.

2.5.2 Vertical Clearances

A minimum vertical clearance of 17 feet 7 inches at the inside edge of left shoulders for the US 97 northbound and southbound roadways will be provided by the proposed Murphy Road Bridge and 3rd Street Bridge. In addition, a minimum vertical clearance of 17 feet 11 inches will be provided for the right travel lanes for the US 97 northbound and southbound roadways at the proposed bridges.

During construction, the minimum vertical clearance will be reduced to 15 feet 7 inches for the CIP concrete box girder superstructure option, but will not be reduced for the precast concrete box beam or girder options. Vehicles exceeding this height will need to temporarily detour around the Murphy Road Bridge and 3rd Street Bridge construction areas for the CIP concrete box girder superstructure option. The detour for US 97 northbound traffic will turn right at 3rd

Street, turn left at Pinebrook Boulevard, and turn right to rejoin northbound US 97. The detour for US 97 southbound traffic will turn left at Pinebrook Boulevard, turn right at 3rd Street, and turn left to rejoin southbound US 97.

3.0 Geometry and Layout

3.1 Typical Cross-Section

3.1.1 Murphy Road Bridge

The Murphy Road Bridge width is 53 feet 3 inches which includes two 11-foot-wide traffic lanes, a 4-foot-wide median, two 6-foot-wide bike lanes/shoulders, two 6-foot-wide sidewalks, and two 1-foot 7 1/2-inch-wide 3-tube curb mount rails. The bridge roadway is on a crown with 2 percent down-slopes toward the sidewalks. Sidewalks slope 2 percent down toward the roadway. See Drawings S-1 thru S-5 in Appendix A of the DAP for plan, elevation, and typical sections.

3.1.2 3rd Street Bridge

The 3rd Street Bridge width is 31 feet 7 1/2 inches which includes a 12-foot-wide lane, a 4-foot-4 1/2-inch-wide left shoulder, a 6-foot-wide right shoulder, and two 1-foot-7 1/2-inch-wide 3-tube curb mount rails. A 4-foot-4 1/2- inch-wide left shoulder is provided to accommodate possible widening of the structure in the future so that the joint with the widened bridge will be located within the center of a future 12-foot-wide travel lane. The bridge roadway slopes down 2 percent toward the sidewalk on the right. The sidewalk slopes 2 percent down toward the roadway.

The 3rd Street Bridge is anticipated to be widened 55 feet 7 1/2 inches in the future which will result in an overall width of 87 feet 3 inches. The widened bridge will include four 12-foot-wide traffic lanes, a 12-foot-wide median, two 6-foot-wide shoulders, two 6-foot-wide sidewalks, and two 1-foot-7 1/2 –inch-wide 3-tube curb mount rails. The widened bridge roadway is on a crown with 2 percent down-slopes toward sidewalks. Sidewalks slope 2 percent down toward the roadway. See Drawings S-5 through S-10 in Appendix A of the DAP for plan, elevation, and typical sections.

3.2 Horizontal and Vertical Alignment

3.2.1 Murphy Road Bridge

The proposed Murphy Road Bridge is located on an approximate west-to-east horizontal tangent alignment crossing the existing US 97 northbound and southbound roadways at an approximately 65 degree angle. The proposed bridge begins on a 0.5 percent up grade with a vertical curve that begins approximately 55 feet from the east end of the bridge.

3.2.2 3rd Street Bridge

The proposed 3rd Street Bridge is located on an approximate east-to-west horizontal tangent alignment crossing the existing US 97 northbound and southbound roadways at an approximately 65 degree angle. The proposed bridge is located on a 0.5 percent up grade.

For additional description of the horizontal and vertical alignments, see Section 3 – Proposed Design of the DAP.

3.3 Bridge Rails

Standard ODOT 3-tube curb mount rails are provided on each side of the proposed Murphy Road and 3rd Street bridges. The rail and post members are weathering steel.

3.4 Bridge and Retaining Wall Aesthetic Treatments

Aesthetic treatments will be incorporated into the proposed Murphy Road and 3rd Street bridges and retaining walls that are similar to other bridges and retaining walls located along the US 97/Bend Parkway. Bridge columns, abutments, and wingwalls will be textured, scored, and stained with a gray/brown pigmented sealer. Slope paving at abutments will consist of lava rock and curb stained with a gray/brown pigmented sealer. Bridge superstructure side and underside surfaces will be stained with light brown/beige pigmented sealer. Retaining walls will be textured, scored, and stained with gray/brown pigmented sealer.

4.0 Geotechnical Data and Foundations

Field explorations for the project consisted of drilling 20 borings and excavating 9 test pits. The borings were drilled in September and November 2010 and the test pits were excavated in September 2010. Rock coring and sampling techniques were utilized to provide detailed information about rock quality and type including depth to rock and "Recovery" and "Rock Quality Designation (RQD)." Recovery is the ratio of the sample length obtained to the depth interval drilled, expressed as a percent. RQD is the percentage of the length of core recovered which has intact core segments four or more inches long compared to the total length of run. Groundwater was not encountered in the borings or test pits.

Subsurface conditions encountered in the borings consisted of the following layers, beginning from the ground surface downward:

- **Asphalt Roadway and Gravel Base Course:** The material generally consisted of asphalt roadway pavement with a crushed gravel base course. Approximately 2 to 6 inches of asphalt pavement and up to 10 inches of gravel base course were observed where pavements were encountered.
- **Fine Sandy Silt with Gravel and Cobbles:** The overburden layer of soil ranged in composition from sandy silt to fine sand with silt. Some gravel and cobbles were present at some exploration locations. This layer was observed to have a maximum depth of 7 feet 6 inches, but was generally less than 3 feet 6 inches. The soil is generally brown to light brown in color, dry to moist, fine-grained sand with occasional medium and coarse-grained sand. The gravel and cobbles encountered were fractured pieces of basalt rock. This material generally was noted to become more gravelly with depth, increasing in gravel content until weathered rock was ultimately encountered. Standard Penetration Test samples N-values ranged from 8 to 31 blows per foot. One sample resulted in an N-value of 58. However, this test was performed near the bedrock interface, and therefore is not considered representative of the density of the soil.

- **Basalt:** Basalt bedrock was encountered in all the borings and test pits at the site. It is generally gray in color with occasional brownish gray and reddish-gray zones. The basalt is generally vesicular with vesicles up to 1 ½ inches in diameter. The basalt is typically fresh and hard, and was encountered to the maximum depth explored. Core recovery was generally high (95 to 100 percent), except in higher fractured zones where broken cores were observed or where voids were infilled with soil or sediment. In two borings, sediment infilled voids were encountered between depths of 26 feet and 31 feet in one boring and 24 feet 6 inches and 27feet 7 inches in the other boring. These voids were infilled with clayey sand with gravel. The measured RQD of the basalt rock varied from 0 to 100 percent but was more often between 40 and 80 percent. Laboratory unconfined compression testing on selected rock core samples ranged from a minimum of 4,550 pounds per square inch (psi) to a maximum of 14,370 psi.

For additional discussion of the soil and foundation conditions for the project, see the Geotechnical Foundation Report and Geotechnical Data Report in Appendixes E1 and E2, respectively, of the DAP.

4.1 Bridge Foundations

Spread footings founded in basalt are the recommended foundation type for the proposed Murphy Road and 3rd Street bridges. Bearing capacity for the basalt rock is 30 kips per square foot ultimate. Estimated foundation loads and bottom of footing elevations for the proposed bridges are shown in Table 1. The foundation dead loads are for the CIP concrete post-tensioned box girder option for the bridges.

TABLE 1
Bent Foundation Loads

Bent No.	Dead Load (DC) (kips)	Live Load Maximum (kips)	Total (Unfactored) (kips)	Bottom of Footing Elevation (feet)
Murphy Road Bridge				
1	3,000	330	3,330	3,780
2	1,400	370	1,770	3,780
3	3,150	350	3,500	3,781
3rd Street Bridge				
1	1,750	200	1,950	3,788
2	1,200	400	1,600	3,788
3	1,750	200	1,950	3,789

4.2 Retaining Walls

CIP concrete retaining walls and mechanically stabilized earth (MSE) retaining walls with precast concrete panels generally are proposed for the project where retaining wall heights exceed 4 to 5 feet.

The ODOT Geotechnical Design Manual (GDM) (2010) defines the following basic retaining wall categories, which are categorized by location and height:

- **Bridge Abutment**: A structural element at the end of the bridge that supports the end of the bridge span, and provides lateral support for fill material on which the roadway rests immediately adjacent to the bridge.
- **Bridge Retaining Wall**: A retaining wall that is located partially or entirely within the bridge zone (100 feet of approach fill from abutment face) and does not meet the definition of bridge abutment.
- **Highway Retaining Wall**: A retaining wall that is located entirely outside of the bridge zone and does not fully meet the definition of a minor wall.
- **Minor Retaining Wall**: A retaining wall that is located entirely outside of the bridge zone, does not exceed a wall height (H) of 4.0 feet at any point along the wall, wall fore slope and back slope are both flatter than 1V:4H within a horizontal distance of H, and surcharge loading is not allowed on the retaining wall back slope within a horizontal distance of H.

CIP concrete retaining walls are proposed adjacent to the bridge abutment wingwalls at each end of the proposed Murphy Road and 3rd Street bridges. The footings for these walls will be founded either on basalt or in suitable overburden above the basalt a minimum of 2 feet below the existing ground surface.

Retaining Wall W1 is proposed adjacent to and parallel with the northbound US 97 off-ramp to 3rd Street located to the south of the 3rd Street Bridge. The north portion of Retaining Wall W1 provides the footing and backwall for the abutment for the future bridge widening. A MSE retaining wall is proposed south of the CIP retaining wall portion. The CIP portion of the retaining wall will be founded on basalt. The MSE retaining wall will be founded 2 feet below existing ground. See Drawings RW-1 and RW-2 in Appendix A of the DAP for plan, elevation, and typical sections.

4.3 Settlement

Because of the soil conditions, settlement generally is not a concern for the proposed bridges and retaining walls.

4.4 Seismic Site Classification

The following accelerations apply to the proposed bridges and retaining walls. These accelerations are interpolated from American Association of State Highway and Transportation Officials (AASHTO) acceleration maps for 500-year and 1,000-year events. The AASHTO site classification is B.

4.4.1 500-Year Return Period Event

- PGA = 0.07 g
- S (0.2 sec) = 0.17 g
- S (1 sec) = 0.07 g
- Where g is acceleration due to gravity

For this return period event, the design performance objective is for the structure to remain operational with little, if any, damage. The substructure is expected to remain essentially elastic with minimal damage. The maximum concrete strains are expected to remain low enough to

prevent spall of the concrete cover at maximum bending moment locations in the columns above ground.

4.4.2 1,000-Year Return Period Event

- PGA = 0.11 g
- S (0.2 sec) = 0.26 g
- S (1 sec) = 0.11 g
- Where g is acceleration due to gravity

For this return period event, the design performance objective is for the structure to experience some damage, but not collapse. The substructure is expected to remain essentially elastic with minimum damage. The column concrete and steel strains are such that concrete cover may spall and yielding of the steel may occur at maximum bending moment locations. All damage is intended to occur in inspection-accessible locations.

5.0 Bridge Features

5.1 Design Standards

Design criteria for the bridge and retaining wall structures are included in Section 2 – Design Approach in the main narrative of the DAP.

Design of the bridge and retaining wall structures will conform to the following design criteria documents:

- *ODOT Bridge Design and Drafting Manual*, 2004 edition including updates
- *AASHTO LRFD Bridge Design Specifications*, 5th edition, 2010 with Interims
- *AASHTO Guide Specifications for LRFD Seismic Bridge Design*, 1st edition, 2009 with Interims

5.2 Recommended Spans and Arrangement

5.2.1 Murphy Road Bridge

The proposed Murphy Road Bridge is a two-span bridge 185 feet long with span lengths of 90 feet and 95 feet. The intermediate bent is centered within the existing US 97 median between the northbound and southbound roadways. The span lengths are unequal as a result of future proposed ramps that have different configurations for the northbound and southbound roadways. In addition, the proposed span lengths accommodate 22-foot-wide clear zones normal to the future ramp roadways.

5.2.2 3rd Street Bridge

The proposed 3rd Street Bridge is a two-span bridge 140 feet long with two equal span lengths of 70 feet. The intermediate bent is centered within the existing US 97 median between the northbound and southbound roadways. The proposed span lengths accommodate 22-foot-wide clear zones normal to the northbound and southbound roadways.

5.3 Recommended Typical Sections

CIP post-tensioned concrete box girder, precast prestressed concrete box beam, or precast prestressed concrete girder superstructure types are recommended for the proposed bridges. CIP post-tensioned box girder and precast prestressed box beam superstructures will have variable depths similar to existing bridges located on the US 97 Bend Parkway. Precast prestressed concrete box beams and girders require minimal shoring to be installed, which maximizes construction clearances and eliminates the need for temporary detours during construction. Precast prestressed concrete girders will have shallower superstructure depths thus providing either greater minimum vertical clearances or the ability to lower the roadway profile grade. In addition, precast prestressed concrete girders will provide the lowest construction costs.

CIP post-tensioned box girder superstructures will have exterior webs with 3 vertical to 1 horizontal (3V:1H) slopes and deck slab overhangs 3 feet 8 inches wide. Superstructure depth will vary in a parabolic manner from 6 feet 6 inches at bents to 4 feet at midspan for the proposed Murphy Road Bridge and from 5 feet 9 inches at bents to 3 feet 6 inches at midspan for the proposed 3rd Street Bridge. The deck slab will have an 8 inch minimum thickness. Box girder interior webs will be 12 inches wide minimum, exterior webs will be 13 inches wide minimum, and the bottom slab will be 6 inches thick minimum.

Precast prestressed concrete box beam superstructures will have variable width exterior box beams with 4V:1H exterior side slopes and deck slab overhangs 2 feet 3 inches wide. Interior box beams will have a constant width of 4 feet. Superstructure depth will vary in a parabolic manner from 6 feet 6 inches to 4 feet 3 inches at midspan for the proposed 3rd Street Bridge. In order to utilize the same custom-made precast formwork for both bridges, the box beams for the proposed Murphy Road Bridge will utilize the same parabolic depth transition as for the proposed 3rd Street Bridge. As a result, the proposed Murphy Road Bridge will have constant depth sections of 20 or 25 feet at midspan. As an alternative, custom formwork could be made for each bridge which will increase the overall cost for the box beam option by $100,000. The deck slab will have an 8 inch minimum thickness.

Precast prestressed concrete girder superstructures will have deck slab overhangs 2 feet 3 inches wide from the exterior face of the girder top flange. Superstructure depth will be 6 feet maximum at bents for the proposed Murphy Road Bridge and 5 feet maximum at bents for the proposed 3rd Street Bridge. The superstructure depth will be slightly less at midspan because of the girder camber. The deck slab will have an 8 inch minimum thickness.

A summary of the advantages and disadvantages for the recommended options follows.

5.3.1 CIP Post-tensioned Concrete Box Girder

Advantages:

- Variable depth and appearance from side and underneath matches other bridges within US 97/Bend Parkway corridor
- Intermediate bent has integral raised crossbeam and matches appearance of other bridges within US 97/Bend Parkway corridor

Disadvantages:

- Requires falsework for construction which restricts vertical clearance during construction and requires a detour
- Longest construction time
- Highest construction cost

5.3.2 Precast Prestressed Concrete Box Beam

Advantages:

- Variable depth and appearance from side matches other bridges within US 97/Bend Parkway corridor
- Falsework not required for construction thus eliminating the need for detour during construction
- Shorter construction time than CIP post-tensioned concrete box girder
- Lower construction cost than CIP post-tensioned concrete box girder

Disadvantages:

- Intermediate bent has partial drop crossbeam
- Spaces between box beams results in different appearance than full width box girder soffit

5.3.3 Precast Prestressed Concrete Girder

Advantages:

- Falsework not required for construction thus eliminating the need for detour during construction
- Shallower depth results in greater vertical clearances or the ability to lower the Murphy Road and 3rd Street profile grade lines
- Shortest overall construction time
- Lowest construction cost

Disadvantages:

- Intermediate bent has partial drop crossbeam
- Appearance does not match the other bridges within the US 97/Bend Parkway corridor

5.4 Recommended Bent Locations and Type

The bent locations for the proposed bridges are shown in Table 2. The locations are shown relative to the alignment and profile grade lines for Murphy Road and 3rd Street, respectively.

The recommended bent types are CIP concrete abutments at end bents and CIP columns and crossbeams at intermediate bents. The abutment seat front face and faces of wingwalls for end bents will batter toward the US 97 northbound and southbound roadways with a slope of 3V:1H similar to other bridges located within the US 97/Bend Parkway corridor. Columns will be rectangular in shape 4 feet 3 inches thick by 6 feet 6 inches wide for the lower portion which flares to 9 feet 6 inches wide for the upper portions similar to other bridges located within the US 97/Bend Parkway corridor.

CIP post-tensioned concrete superstructures will have raised crossbeams constructed integrally with the box girder. Precast prestressed concrete box beams and girders will have partial drop crossbeams. The lower drop portions of the crossbeams will be constructed, the box beams or girders set in place, and the remaining upper portions of the crossbeams constructed integrally with the girders.

TABLE 2
Bent Locations

Structure	Bent	Station
Murphy Road Bridge	1 (abut)	733+57.55
	2	734+47.55
	3 (abut)	735+42.55
3rd Street Bridge	1 (abut)	201+46.90
	2	202+16.90
	3 (abut)	202+86.90

5.5 Construction Shoring and Staging Requirements

Northbound and southbound US 97 traffic must be maintained during construction of the proposed bridges. Temporary construction openings 28 feet wide by 15 feet 7 inches high minimum will be provided for each roadway for the CIP post-tensioned concrete superstructure. Vehicles exceeding this height will be provided a temporary detour route as indicated in Section 2.5.2. Precast superstructures will not require falsework, thus there will be no reduction in vertical clearance during construction. Construction staging to maintain traffic will not be required.

5.6 Bridge Drainage

Inlets will be provided on each side of the roadway at the beginning of the bridge end panels at the west end of the proposed Murphy Road Bridge. An inlet will be provided on the right side of the roadway at the beginning of the bridge end panel at the east end of the proposed 3rd Street Bridge. No storm sewer piping will be provided on the proposed bridges.

For a discussion of drainage requirements for the project, see the Storm Water Management Plan included as Appendix I of the DAP.

5.7 Alternative Structure Type Comparisons

Seven bridge superstructure options were identified for the proposed Murphy Road and 3rd Street bridges as presented in the following subsections.

5.7.1 Cast-in-Place Post-Tensioned Concrete Box Girder

CIP post-tensioned concrete box girder options with either variable depth similar to existing bridges located on the US 97/Bend Parkway or constant depth can accommodate the span length and depth limit requirements for the bridges. Falsework is required to construct CIP post-tensioned concrete box girder structures which will reduce vertical clearance during construction. In addition, CIP post-tensioned concrete box girder structures require the longest construction time to complete.

5.7.2 Side-by-Side Precast Prestressed Concrete Box Beams

Standard 48-inch-wide-by-48-inch-deep or variable depth precast, prestressed concrete box beams placed side by side can accommodate the span length and depth limit requirements for the bridges. Side-by-side box beams reduce the required deck slab thickness from 8 to 5 inches and eliminates the need for forming deck slab soffits except for the slab overhangs on each side of the structures. Side-by-side box beam structures will not reduce vertical clearance during construction and require the shortest onsite construction time to complete.

5.7.3 Side-by-Side Precast Prestressed Concrete Box Beams with Sloped Exterior Sides

These are similar to side-by-side precast, prestressed concrete box beams except that the exterior box beams have exterior sides that slope 4V:IH.

5.7.4 Spread Precast Prestressed Concrete Box Beams

Standard 48-inch-wide-by 48-inch-deep or variable depth precast, prestressed concrete box beams placed with 3 foot minimum clear spaces between them can accommodate the span length and depth limit requirements for the bridges. Spread box beams require a deck slab 8 inches thick and require forming deck slab soffits between box beams and for the slab overhangs on each side of the structures. Spread box beam structures will not reduce vertical clearance during construction and require longer onsite construction time to complete than side-by-side box beams, but less than CIP concrete box girder bridges.

5.7.5 Spread Precast Prestressed Concrete Box Beams with Sloped Exterior Sides

These beams are similar to spread precast, prestressed concrete box beams except that exterior box beams have exterior sides that slope 4V:1H.

5.7.6 Precast Prestressed Concrete Bulb-T Girders

Standard bulb-T precast, prestressed concrete girders can accommodate the span length and depth limit requirements for the bridges. BT60 (5 foot deep) girders are provided for the Murphy Road Bridge and BT48 (4 foot deep) girders are provided for the 3rd Street Bridge. Bulb-T girders require an 8 inch deck slab thickness and require forming deck slab soffits between girders and for the slab overhangs on each side of the structure. Bulb-T girder structures will not reduce vertical clearance during construction, require shorter onsite construction time to

complete than CIP post-tensioned concrete box girders, and are the lowest cost structure type to construct.

5.7.7 Steel Plate Girders

Fabricated steel plate girders with constant or variable depth and a CIP concrete deck can accommodate the span length and depth limit requirements for the bridges. Steel plate girders require an 8 inch deck slab thickness. They also require more forming for deck slab soffits between girders and for the slab overhangs because the girder top flange widths will be approximately half the box beam and bulb-T girder flange widths. In addition, one less girder line is required for steel plate girders as compared to box beams and bulb-T girders. Steel plate girder structures will not reduce vertical clearance during construction and require shorter onsite construction time to complete than CIP concrete box girders, but cost more to construct than spread concrete box beam and bulb-T girder bridges.

5.7.8 Estimated Construction Costs

A summary of the estimated construction costs, including mobilization and 30 percent contingencies, for the recommended CIP post tensioned concrete, spread precast prestressed concrete box beam with sloped exterior sides, and bulb-T precast prestressed concrete box girder structure options is provided in Table 3. Estimated construction costs are based upon 2010 ODOT cost data with escalation and engineering judgment. For a breakdown of the construction cost estimates see Appendix A.

TABLE 3
Estimated Bridge Alternative Construction Costs

Structure	CIP PT Concrete Box Girder	Spread Precast Prestressed Concrete Box Beam	Precast Prestressed Concrete Girder
Murphy Road Bridge	$2,360,000	$2,270,000	$2,050,000
3rd Street Bridge	$1,264,000	$1,274,000	$1,134,000
Retaining Wall W1	$326,000	$326,000	$326,000
Subtotal	$3,950,000	$3,870,000	$3,510,000
Mobilization (10%)	$395,000	$387,000	$351,000
Subtotal	$4,345,000	$4,257,000	$3,861,000
Contingencies (25%)	$1,085,000	$1,063,000	$964,000
Total	$5,430,000	$5,320,000	$4,825,000

5.8 Bridge Type Decision

Following the submittal of the draft DAP, the City and ODOT decided to eliminate the CIP post-tensioned box girder from further consideration. Eliminating this bridge type reduces the project cost and removes the need to consider falsework restrictions on vertical clearance and the resulting construction detours. Further review of the spread precast prestressed concrete

box beam and precast prestressed concrete girder bridge types will be conducted. Alternatives that modify the precast prestressed concrete girder bridge type to include a variable depth fascia that mimics an arched girder in elevation view will be developed. Aesthetics and cost will be used to make a final decision on bridge type, to facilitate commencement of the final design phase of the project.

APPENDIX A

Cost Estimates