

Beal Slough Relief Trunk Sewer Alignment Study Report

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1. Introduction

The purpose of this alignment study report is to provide the Lincoln Wastewater System (LWWS) with information pertaining to advantages and disadvantages of three potential alignments for the Beal Slough Relief Trunk Sewer Phases I & II and to identify a recommended alignment for preliminary design. This study includes a description of the proposed alignments, findings and evaluation of alignment selection factors, and development of opinion of probable project costs for each alignment. The conclusions and recommendation section identifies the recommended alternative. Based on the recommended alternative, an analysis for replacing the existing sewer was conducted.

The existing Beal Slough Trunk Sewer is located along Highway 2 from 56th Street to the State Penitentiary, shown on Figure 1-1. It is overloaded during wet weather events and is not sized for anticipated future development. To resolve these issues, LWWS intends to design and construct a parallel relief sewer to convey peak wastewater flow for ultimate development of the Beal Slough drainage basin. The Beal Slough Relief Trunk Sewer will be constructed in two phases: Phase I from Salt Valley-Phase IV to 27th Street and Phase II from 27th Street to 56th Street.

2. Description of Proposed Alignment Alternatives

Field investigations were conducted to review potential alignments for the Beal Slough Relief Trunk Sewer. Existing information on utilities, railroads, wetlands, soil conditions, and proposed improvements was reviewed to determine potential alignments. All potential alignments were then reviewed and the best three alignments were selected for further evaluation. Information pertaining to the factors utilized in selecting the alignments is provided in the Findings and Evaluation of Alignment Selection Factors section. Each alignment is broken into Phase I and Phase II to indicate where the alignments will be divided, as indicated on Figures 2-1 through 2-5.

Alignment No. 1 (brown-north alignment). Phase I begins at the connection to the Salt Valley-Phase IV Trunk Sewer south of Pioneers Blvd and west of Beal Slough. It extends east along Pioneers Blvd., parallels the north side of the existing Salt Valley Trunk Sewer and State Penitentiary. The sewer then tunnels beneath the Burlington Northern Santa Fe Railroad (BNSFRR) tracks and the 14th Street and Highway 2

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intersection and parallels the north side of Highway 2 to 27th Street. Two additional 30 inch sewers are required to convey flow from the existing sewers to the relief sewer at 14th Street and 27th Street. The total length of Phase I is 9,987 feet with 6 tunnels of 1,355 feet in total length. Phase II continues from 27th Street on the north side of Highway 2 to 56th Street. It connects to the existing 18 inch and 24 inch sewers on the northwest corner of 56th Street and Highway 2. The total length of Phase II is 12,126 feet with 5 tunnels of 1,170 feet in total length.

Alignment No. 2 (red-middle alignment). Phase I begins at the connection to the Salt Valley-Phase IV Trunk Sewer south of Pioneers Blvd and west of Beal Slough. It extends east along the LES easement and crosses Beal Slough east of the BNSFRR bridge. It parallels the north side of Beal Slough and then proceeds north along the east side of Fleming Foods to Pioneers Blvd. From Pioneers Blvd, the sewer parallels the BNSFRR to 27th Street. The total length of Phase I is 9,411 feet with 6 tunnels of 815 feet in total length. Phase II continues from 27th Street on the north side of the BNSFRR tracks to 40th Street and tunnels beneath 40th Street and Highway 2 and extends to 56th Street. The total length of Phase II is 11,694 feet with 2 tunnels of 290 feet in total length.

Alignment No. 3 (green-south alignment). Phase I begins at the connection to the Salt Valley-Phase IV Trunk Sewer south of Pioneers Blvd and west of Beal Slough. It extends east along the LES easement and south side of Beal Slough to 27th Street, with intermittent crossings. The total length of Phase I is 8,853 feet with 6 tunnels of 2,105 feet in total length. Phase II continues from 27th Street paralleling the LES easement and south side of Beal Slough to 40th Street. From 40th Street to 56th Street, the sewer parallels the north side of the BNSFRR tracks. The total length of Phase II is 11,315 feet with 2 tunnels of 260 feet in total length.

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3. Findings and Evaluation of Alignment Selection Factors

This section presents the findings and evaluation of alignments selection factors used to compare each alternative alignment. The evaluation to select a preferred alignment was based on the selection factors listed below. Each of the factors was placed into a matrix to evaluate a preferred alignment alternative.

- Length of Sewer
- Length of Tunnel Crossings
- Geotechnical
- Existing Utilities
- Railroad Impacts
- Pavement and Traffic Impacts
- Proposed Road Improvements
- Proposed Stormwater Improvements
- Connections with Existing Sewers
- Public Relations
- Impacts and Disruptions to Existing Businesses
- Wetlands
- Hazardous Substances
- Cultural Resources
- Construction Techniques
- Hydraulic Design
- Constructibility Requirements
- Construction Impacts on Existing Sewer
- Potential Risks During Construction
- ROW and Land Acquisition
- Permits and Approvals

Multiple field reconnaissance trips were conducted by Black & Veatch personnel with assistance from Olsson Associates to determine topographic features and define alignment alternatives. A reconnaissance trip was also conducted with LWWS staff and other City department staff to review alignment issues.

Table 3-4 provides a summary of the route alignment selection factors and their rankings. The table indicates that Alignment No. 2 is the most favored alternative with a score of 67 for the factors discussed in this section. Alignment No. 1 is the second with a score of 51, and Alignment No. 3 is third with a score of 43. These scores reflect both non-cost and cost issues that may impact each alignment, but do not include the project cost for each alignment.

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4. Project Costs for Alternatives

Capital costs developed for the sewer alignments were based on opinions of cost for previous Black & Veatch projects as well as cost curves for projects of similar size. All lengths for pipelines and tunnels were scaled from the 1998 aerial photographs obtained from the City's GIS department. All project costs are provided in October 2003 dollars. Twenty-five percent of the direct construction cost was added to each alignment alternative as an allowance for unknowns that can be expected at this level of estimating and for project contingencies. Twenty percent of the direct construction cost plus contingencies was allocated for engineering, legal, and administrative costs associated with each alignment.

The opinion of probable project costs for each alternative is listed in Table 4-1. A complete breakdown of the capital costs for each alignment is located in Appendix A.

Table 4-1. Preliminary Opinions of Probable Project Cost

Alignment	Cost
Alignment No. 1	\$12,365,000
Alignment No. 2	\$10,005,000
Alignment No. 3	\$11,333,000

5. Conclusions and Recommendation

Alignment No. 2 (Red Alignment) has the lowest opinion of probable project cost for the Beal Slough Relief Trunk Sewer Phases I & II. The ranking of alternative alignments by project cost is shown below.

Ranking by Opinion of Probable Project Cost

<u>Ranking</u>	<u>Alignment</u>	<u>Project Cost</u>	<u>Δ% from Alternative No. 2</u>
1	Alignment No. 2	\$10,005,000	--
2	Alignment No. 3	\$11,333,000	13.3%
3	Alignment No. 1	\$12,365,000	23.6%

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The ranking table provided in the Findings and Evaluation of Alignment Selection Factors indicated that Alignment No. 2 is the most favored alternative with a score of 66. Alignment No. 1 is second with a score of 52, and Alignment No. 3 is third with a score of 43. Advantages of Alignment No. 2, compared to the other alignments, include: a reduced length of tunnels; capable of connecting to existing sewer lines from the southern portion of the drainage basin; proximity to existing Beal Slough Trunk Sewer for interconnections; construction of a grade check on Beal Slough; fewer impacts to existing utilities; and no conflict with future widening of Highway 2.

Alignment No. 2 (Red Alignment) is the best and most cost effective alternative for the LWWS, will provide the greatest compatibility with the existing sewer, and will minimize impacts to planned improvements along the alignment. Opportunities for joint projects along this alignment, including the installation of a grade check southwest of the State Penitentiary and replacement of the parking lot in Peterson Park will allow additional entities with the City to work together to improve the Beal Slough drainage basin. The grade check will stabilize the BNSF railroad bridge and the Correctional Services access road bridge while protecting LWWS siphon on the existing Salt Valley Trunk Sewer.

6. Replacement Sewer

Alignment No. 2 (Red Alignment) is located adjacent to the existing Beal Slough Sewer from 17th Street and Pioneers Blvd to 56th Street and Highway 2. Therefore, this reach of sewer provides an opportunity to evaluate the cost of replacing the existing sewer with a larger pipeline versus providing a parallel relief sewer and Insituform lining the existing Beal Slough sewer.

Insituform lining of the existing sewer would minimize infiltration through the joints and provide additional structural reinforcement for damaged areas of the sewer. Based on the bury depth of the existing sewer, manhole spacing, and overall condition of the sewer, Insituform indicated a cost of \$6 per diameter-inch which is typical for most

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sewer projects of this type and size. This unit cost is representative of other Black & Veatch projects in the Midwest.

The opinion of probable project cost for Insituform lining the existing sewer from 17th Street and Pioneers Blvd to 56th Street and Highway 2 is \$2,290,000 in 2003 dollars. A detailed breakdown of this alternative is included in Appendix C. It is assumed that the Insituform lining will be installed 10 years in the future, the present worth cost of this work is \$1,547,000. This cost is in addition to the \$10,005,000 project cost for the relief sewer with Alignment No. 2. Therefore, the total present worth cost for the relief sewer and the Insituform lining of the existing sewer is \$11,552,000.

Two options are available for replacement of the existing sewer. The first involves paralleling the existing sewer from 17th Street to 56th Street with 48 inch, 42 inch, and 36 inch sewer as indicated in the Red Alignment. After the parallel sewer is installed, the existing sewer would be abandoned in place. The second option would involve removing and replacing the sewer in the existing right-of-way utilizing by-pass pumping. At 17th Street the flow would be split between the existing sewer to the northwest and the new sewer extending to the south.

The opinion of probable project cost for replacement and abandoning the existing sewer in-place is \$11,293,000. The opinion of probable project cost for removal and replacement of the existing sewer with a larger pipeline is \$11,036,000. A detailed breakdown of these alternative is included in Appendix C.

Replacement of the existing sewer would eliminate any potential concerns pertaining to damage occurring to the existing pipeline during installation of the relief sewer. Based on this evaluation, it is recommended that a parallel replacement sewer be constructed along the proposed Alignment No. 2 (Red Alignment) and then abandon the existing sewer in-place by demolishing to top eight feet of the manholes and backfill the manholes and sewer with flowable fill. This option will eliminate potential difficulties associated with by-pass pumping systems.