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# Final Design Memorandum

**Lincoln Wastewater System**

**West "O" Street Trunk  
Sewer Extension  
Lincoln, Nebraska**

*October, 2004*

HDR Project No. 12733

Table of Contents

EXECUTIVE SUMMARY ..... ES-1
I. INTRODUCTION..... 1
A. Project Background and Description ..... 1
B. Project Team Organization ..... 2
C. Alignment Selection ..... 2
II. GENERAL..... 4
A. Site Description..... 4
B. Geotechnical Investigations ..... 4
C. Topographic Survey, Easements, and Material Laydown Areas ..... 5
D. Documents ..... 6
E. Applicable Standards and Guidelines ..... 6
F. Project Approval Requirements ..... 7
III. SEWER DESIGN..... 8
A. Design Flows ..... 8
B. Sewer Modeling..... 8
C. Pipe Design..... 13
D. Manholes..... 14
E. Connections to Existing and Future Sewer Facilities ..... 15
F. Special Construction ..... 15
G. Restoration..... 15
H. Utility/Railroad/NDOR Coordination..... 15
IV. PROJECT COSTS..... 16
A. Basis of Project Costs ..... 16
B. Construction and Engineering Costs..... 16
C. Easement Acquisition Costs ..... 17
D. Present Value Opinion of Probable Project Cost ..... 17

TABLES
1. Existing 36-Inch Trunk Sewer Flow Conditions based on Submergence..... 10
2. Assuming Existing Basin 70% and 2.5% Growth Development..... 11
3. Assuming Existing Basin 70% and 6.5% Growth Development..... 11
4. Summary of Existing Conveyance System Capacities ..... 12
5. Opinion of Probable Project Cost ..... 16

Follows Page

FIGURES
1. Drainage Basins ..... 8
2. Projected Flow Curve ..... 8
3. Profiles ..... 12
4. SW 40th Street Viaduct..... 15

APPENDICES
A Preliminary Plan and Profile Drawings
B Opinion of Probable Project Cost
C Modeling Graphics
D Alignment Study Figures and Cost Estimate
E Wastewater Availability Figure

## **EXECUTIVE SUMMARY**

### **1. INTRODUCTION**

Lincoln Wastewater System (LWWS) proposes to extend the existing West 'O' Street Trunk sewer to provide service to the general area of NW 48<sup>th</sup> Street and West 'O' Street and north beyond Interstate 80. These areas are identified in the Facility Plan and in the City of Lincoln Planning Department as Tier I-A (12 year) and Tier I-B (25 year) growth areas. Tier I-A development is located north of the BNSFR right-of-way and south of Interstate 80. Tier I-B development is located north of Interstate 80 and south of Holdrege Street. These areas are shown in the Planning Department figure located in Appendix E.

The existing trunk sewer conveys wastewater flow from the West 'O' Street drainage basin east and north into the 'P' Street Lift Station. From there, the wastewater is pumped under Salt Creek via an 8 inch diameter force main into a 12 inch gravity sewer. The 12 inch sewer is connected to the existing Salt Valley Trunk Sewer to convey wastewater flow into the Theresa Street WWTF.

The goals of this project include the following:

- Identify alignment for the Trunk Sewer extension west of SW 40<sup>th</sup> Street,
- Determine alignments for subbasin sewers to convey flow from the three main subbasin areas, and
- Analyze the existing facilities and develop the best plan to deliver the wastewater from the 36 inch trunk sewer to either the existing Salt Valley Trunk Sewer or Salt Valley Relief Trunk Sewer.

The report includes an analysis of the capacity of the 'P' Street Lift Station, 12 inch VCP gravity sewer conveying flow to the lift station, 8 inch DIP force main, and 12 inch VCP gravity sewer conveying flow into the Salt Valley Trunk Sewer. The plan will not only meet the current needs, but provide a solution that enables the Tier I-A and Tier I-B growth areas identified in the Comprehensive Plan to be served as well. No Tier II growth areas were identified in the Comprehensive Plan for the West 'O' Street Basin.

Two alignment studies were conducted to identify the most effective route to convey flow from the three identified subbasins to the existing 36 inch Trunk Sewer near SW 40<sup>th</sup> Street. Based on the identified areas for growth, the Trunk Sewer was identified to extend west on the north side of the Burlington Northern and Santa Fe Railway (BNSFR) right-of-way from SW 40<sup>th</sup> Street to SW 63<sup>rd</sup> Street. Subbasin sewers extend north and west from the Trunk Sewer at approximately SW 42<sup>nd</sup> Street, SW 44<sup>th</sup> Street, and SW 58<sup>th</sup> Street.

### **2. Sewer Design**

The Tier I service areas identified in the *Lincoln Wastewater Facilities Plan Update* (October 31, 2002, by Brown and Caldwell) were used as the basis for service areas for the preliminary evaluations. The document indicates an existing area of 1,042 acres and additional areas for Tier I growth of 1,900 acres. This equates to flow of 7.6 cfs and a future flow of 12.9 cfs for a combined Tier I total flow of 19.1 cfs (2,942 acres) [using the City of Lincoln design flow equation and assuming cumulative acres]. LWWS indicated that at MH A5-129, a normal peak flow was recorded at 2.63 cfs. At MH A5-38, a normal peak flow was recorded at 0.48 cfs. This data was utilized as a basis of modeling and design of the new outfall sewer. See Figure 2 for design flows.

JEO surveyed the existing sewer inverts and the existing Trunk Sewer was modeled to reflect submergence conditions including: no submergence, 1-foot of submergence, and 2-feet of submergence. Based on the modeled results, a maximum submergence of 2-feet in the existing Trunk Sewer with a corresponding contribution of 2,650 acres (17.4 cfs) was selected for the trunk sewer extension design capacity.

The existing 36 inch trunk sewer, 12 inch VCP sewer, 'P' Street Lift Station, 8 inch force main, and 12 inch sewer conveying flow into the Salt Valley Trunk Sewer were also modeled to determine available capacity to convey flow for the Trunk Sewer extension. The results of the modeling of the existing conveyance system are presented in Table ES-1. The modeling indicated that the existing gravity outfall sewer has already exceeded capacity and requires paralleling or replacement. The 12 inch trunk sewer, 'P' Street Lift Station, and 8 inch force main are nearing capacity and will require replacement between 2005 and 2009 based on the rate of growth for the West 'O' Street Basin.

Component	Capacity	Year Capacity Exceeded (2.5% Growth)	Year Capacity Exceeded (6.5% Growth)
12 Inch Trunk Sewer	4.28 cfs	2008	2006
'P' Street Lift Station	4.41 cfs	2009	2005
8 Inch Force Main	4.41 cfs	2009	2005
12 Inch Gravity Sewer	3.30 cfs	2003	2003

The acceptable pipe materials for this project include CCFRPMP-Hobas, FWFRPMP-Flowtite, solid and profile wall PVC, and RCP. Manholes will consist of City of Lincoln standard manholes constructed of concrete or fiberglass, with an internal plastic liner for all concrete manholes. Tunneling will have a smooth steel casing, thus allowing any of the approved carrier pipes. A casing pipe with piers will be installed by excavation for the SW 40<sup>th</sup> Street crossing, in the location of the proposed bridge over the BNSFR.

### 3. Project Costs

Capital costs developed for the sewer alignments were based on opinions of cost for previous HDR projects and invoices from previous LWWS projects. The opinion of probable project costs for each alternative is listed in Table ES-2. A complete breakdown of the capital costs for each alternative is located in Appendix B. The project cost for each alternative includes capital costs, general requirements, and contingencies. Engineering, legal, and administrative costs and easement acquisition costs are excluded from these project costs.

Growth Tier and Segment	Capital Cost
Tier 1-A: Trunk Sewer to Segment 5, Segments 3 & 5	\$3,239,000
Tier 1-A: Segment 1	\$574,000
Tier 1-B: Segments 2 & 4	\$627,000
<b>Total Cost</b>	<b>\$4,440,000</b>

## **I. INTRODUCTION**

### **A. Project Background and Description**

Lincoln Wastewater System (LWWS) proposes to extend the existing West 'O' Street Trunk sewer to provide service to the general area of NW 48<sup>th</sup> Street and West 'O' Street and north beyond Interstate 80. These areas are identified in the Facility Plan and in the City of Lincoln Planning Department as Tier I-A (12 year) and Tier I-B (25 year) growth areas. Tier I-A development is located north of the BNSFR right-of-way and south of Interstate 80. Tier I-B development is located north of Interstate 80 and south of Holdrege Street. These areas are shown in the Planning Department figure located in Appendix E.

The extension of the West 'O' Street Trunk Sewer is the next step in opening an area of Lincoln that will likely become a commercial and industrial development cluster. As currently projected in the Comprehensive Plan, the area south of I-80 will develop as 'Commercial' and 'Industrial' land uses. This coincides with current development activities in this area. The area north of I-80 is projected to be 'Urban Residential,' according to the Comprehensive Plan.

The existing trunk sewer conveys wastewater flow from the West 'O' Street drainage basin east and north into the 'P' Street Lift Station. From there, the wastewater is pumped under Salt Creek via an 8 inch diameter force main into a 12 inch gravity sewer. The 12 inch sewer is connected to the existing Salt Valley Trunk Sewer to convey wastewater flow into the Theresa Street WWTF.

The 'P' Street Lift Station was designed to accommodate growth in the existing basins east of West 40<sup>th</sup> Street. There are two pumps currently installed that provide a capacity of 900 gpm each (4.41 cfs total), which is adequate to convey existing flows. The 12 inch sewer that conveys flow into the lift station throttles flow during peak events and surcharges portions of the existing 36 inch trunk sewer.

The goals of this project include the following:

- Identify alignment for the Trunk Sewer extension west of SW 40<sup>th</sup> Street,
- Determine alignments for subbasin sewers to convey flow from the three main subbasin areas, and
- Analyze the existing facilities and develop the best plan to deliver the wastewater from the 36 inch trunk sewer to either the existing Salt Valley Trunk Sewer or Salt Valley Relief Trunk Sewer.

The report includes an analysis of the capacity of the 'P' Street Lift Station, 12 inch VCP gravity sewer conveying flow to the lift station, 8 inch DIP force main, and 12 inch VCP gravity sewer conveying flow into the Salt Valley Trunk Sewer. The plan will not only meet the current needs, but provide a solution that enables the Tier I-A and Tier I-B growth areas identified in the Comprehensive Plan to be served as well. No Tier II growth areas were identified in the Comprehensive Plan for the West 'O' Street Basin.

The West 'O' Street Trunk Sewer Extension project, as proposed, includes the preparation of Contract Documents for the construction of approximately 15,800 linear feet of gravity sewer.

**B. Project Team Organization**

The Lincoln Wastewater System (LWWS) is an integral partner in the development of the concepts, design, and construction of all project elements. Mr. Brian Kramer is the designated Project Representatives for LWWS.

HDR is the Engineer and JEO Consulting Group Inc. and HWS Consulting (HWS) are subconsultants to HDR for this project. HDR is providing preliminary design and final design of the sewer. JEO Consulting Group Inc., is providing the field surveying. HWS is providing geotechnical investigation services during preliminary/final design phase and compaction testing during the construction phase for the project.

**C. Alignment Selection**

An alignment study was conducted to identify the most effective route to convey flow from the general area of NW 48<sup>th</sup> Street and West 'O' Street and north beyond Interstate 80 to the existing trunk sewer. The study also included alignments for future trunk sewer extension to provide for Tier I-A and Tier I-B development in the West 'O' Street basin (See Appendix D-Figure 4). Tier I-A development is identified as an area north of the Burlington Northern and Santa Fe Railway (BNSFR) right-of-way, south of Interstate 80, west of West 40<sup>th</sup> Street and east of West 63<sup>rd</sup> Street. Tier I-B development is identified as an area north of Interstate 80, south of Holdrege Street, west of Northwest 40<sup>th</sup> Street and east of Northwest 63<sup>rd</sup> Street. The Planning Department has not identified any areas in the West 'O' Street basin as Tier II growth areas. Tier III growth areas are tentatively identified as areas west of West 63<sup>rd</sup> Street and north of West 'O' Street (Highway 6).

A property owner's meeting was held on July 22, 2004 at the Engineering Services Building. Discussions with property owners indicated that the priority for sewer service is to the west of NW 48<sup>th</sup> Street. Crete Carrier and Shoemaker's Truck Stop each have a lagoon system that would be abandoned if sewer service were provided. Schwisow Construction, Lincoln Poultry, and Nebraska Machine Company (Caterpillar) are interested in developing properties west of NW 56<sup>th</sup> Street on the north and south side of West 'O' Street. To serve the area west of NW 56<sup>th</sup> Street, the trunk sewer would need to be extended along the BNSFR right-of-way, west to approximately NW 60<sup>th</sup> Street, then north to the properties.

Alignment No. 1 [Yellow Alignment (Appendix D-Figure 1)] includes an 800-foot extension of the 36-inch trunk sewer and a common 18-inch subbasin sewer that proceeds north approximately 600 feet from the trunk sewer. From this location, the sewer splits into east and west subbasin sewers and extends north and northwest across West 'O' Street and Interstate 80. The total project cost for Alignment No. 1 is \$2,563,000.

Alignment No. 2 [White Alignment (Appendix D-Figure 1)] includes an 1,800-foot extension of the 36-inch trunk sewer and a common 18-inch subbasin sewer that proceeds north approximately 600 feet. From this location, the sewer splits into east and west subbasin sewers and extends north and northwest across West 'O' Street and Interstate 80. The total project cost for Alignment No. 2 is \$2,910,000.

Alignment No. 3 (Blue Alignment (Appendix D - Figure 1)) includes an 1,800-foot extension of the 36-inch trunk sewer and two separate subbasin sewers that proceed north and northwest across West 'O' Street and Interstate 80. The total project cost for Alignment No. 3 is \$2,712,000.

Alignment No. 1 has the least total project cost, but it includes only 800 LF of the 36-inch trunk sewer extension. Alignment No. 2 has the greatest total project cost, because of the construction of 1,800 LF of the 36 inch trunk sewer and an additional 1,000 LF of 15 inch sewer which extends east along the north side of West 'O' Street to serve property north of Interstate 80. Alignment No. 3 has a higher total project cost than Alignment No. 1, because of the additional 1,000 LF of 36-inch trunk sewer. Since development will occur in the near future west of NW 48<sup>th</sup> Street, Alignment No. 3 provides the best value considering present development and future extension of the trunk sewer.

Upon providing a recommendation for Alignment No. 3, a second alignment study was requested for the project area. Schwisow Construction, Lincoln Poultry, and Nebraska Machine Company have requested sewer service near NW 60<sup>th</sup> Street as a portion of the proposed West 'O' Street Trunk Sewer Extension project. To serve these areas, the trunk sewer was extended to approximately West 60<sup>th</sup> Street and an alternative subbasin sewer alignment proceeding north from the trunk sewer near West 54<sup>th</sup> Street was examined. This new alignment is designated as Alignment B. Alignment No. 3 was changed to Alignment A for comparison purposes. The only difference between each alignment is the differentiation of Segment 3A and 3B. Alignment A is shown on Figure 2 in Appendix D and Alignment B is shown on Figure 3 in Appendix D.

Alignment A – Segment 3A connects to the trunk sewer approximately 800 feet west of SW 40<sup>th</sup> Street. The segment proceeds north and west paralleling a small drainage ditch to 'O' Street. Segment 3A has 1,620 LF of 18-inch sewer and 3,110 LF of 15-inch sewer, as indicated on Figure 4. In addition to serving Crete Carriers and Shoemaker Truck Stop, the sewer proceeds through 85 acres of land south of 'O' Street that has begun to be platted for construction. The total construction cost for Segment 3A is \$694,000. A detailed description of the total construction cost is provided in Appendix D.

Alignment B – Segment 3B connects to the trunk sewer approximately 4,000 feet west of SW 40<sup>th</sup> Street. The segment extends north from the trunk sewer, up a 20-foot embankment, and parallels a ravine to 'O' Street. Segment 3B has 3,540 LF of 18-inch sewer. The land surrounding the sewer will have little potential for development and future connections would be restricted to the sewer. The ravine has steep banks and is heavily vegetated; thus construction activities may lead to future erosion problems through this reach. Since the sewer will convey flow into the trunk sewer for an additional 3,200 LF, the trunk sewer would need to be increased in size from 30 to 36 inches. The size was verified with the final modeling of the existing trunk sewer, 'P' Street Lift Station, and the force main beneath Salt Creek. The total construction cost for Segment 3B is \$626,000. This cost does not include \$77,000 for increasing the size of the trunk sewer from 30 to 36 inches over 3,200 LF. Therefore, the revised total construction cost for Segment 3B is \$703,000. A detailed description of the total construction cost is provided in Appendix D.

Based on the alignments evaluated and the planned development which is to occur, Alignment Segment 3A is the recommended alignment. This alignment will not require an increase in size for the trunk sewer, will not involve erosion issues through the ravine, and is the least cost of the two alternatives.

## **II. GENERAL**

### **A. Site Description**

#### 1. Location

The trunk sewer extension begins at the connection to the existing trunk sewer north of the Burlington Northern and Santa Fe Railway (BNSFR) right-of-way and east of SW 40<sup>th</sup> Street. It crosses beneath SW 40<sup>th</sup> Street and continues west paralleling the north side of the BNSFR right-of-way to approximately SW 60<sup>th</sup> Street. The trunk sewer will convey flow from three subbasins located between the BNSFR right-of-way and Holdrege Street. Subbasin sewers extend north and northwest from the trunk sewer at approximately SW 42<sup>nd</sup> Street, SW 44<sup>th</sup> Street and SW 60<sup>th</sup> Street. The first subbasin serves the drainage basins between NW 40<sup>th</sup> Street and NW 48<sup>th</sup> Street. The second subbasin sewer serves the drainage basins between NW 48<sup>th</sup> Street and NW 56<sup>th</sup> Street and the third subbasin sewer serves the drainage basins between NW 56<sup>th</sup> Street and NW 63<sup>rd</sup> Street.

Tier I-Priority A development is located north of the BNSFR right-of-way and south of Interstate 80. Tier II-Priority B development is located north of Interstate 80 and south of Holdrege Street. These areas are shown in the Planning Department figure in Appendix E.

#### 2. Datum

Elevations will be based on 1988 North American Vertical Datum (NAVD). Horizontal control will be based on the Lancaster County grid control system.

#### 3. Flood Protection

Flood elevations for Middle Creek will be determined using the “Lancaster County and Incorporated Areas Flood Insurance Study” and the “Flood Insurance Rate Maps.” The latest version of both references is September 21, 2001. Flood elevations may vary along the proposed sewer route for the given storm return intervals of 10-year, 50-year, 100-year and 500-year. Vents for sewer manholes shall be constructed one foot above the 100-year flood elevation at each of the respective locations.

### **B. Geotechnical Investigations**

A geotechnical investigation will be conducted by HWS for the trunk sewer and each of the subbasin sewers. HWS has secured and reviewed seven borings previously performed along the Trunk Sewer and Segment 5. In addition, three borings have been performed in the vicinity of the north end of Segment 3 near Shoemaker’s property. Along the Trunk Sewer, new borings are scheduled at eight locations. An additional two borings are scheduled for Segment 1 and three borings are scheduled for Segment 3. Testing of the samples will be used to determine the classification, moisture content, saturation level, strength of the soils, and the density.

The project is located in alluvial bottomlands adjacent to Middle Creek, loess mantled terraces along Middle Creek, or colluvial drainage ways. Previous straightening of Middle Creek for the BNSF Railway has occurred in the project area. Both a U.S. Geological Survey quadrangle map and aerial photos indicate that Middle Creek originally meandered repeatedly through the proposed Trunk Sewer alignment.

The Trunk Sewer will cross the former meanders of Middle Creek four times. The proposed route will be generally located in alluvial bottomlands; however, it will briefly cross into loess terrace topography at three different locations. Previous borings performed in both alluvial bottomlands and loess terraces at the beginning and end of the alignment indicate that subsurface materials will generally consist of cohesive natural soils interspersed with relatively thin silt and sand layers. The water table varied from approximately 7 to 28 feet below grade (elevations of 1156 to 1168.5 feet, respectively) near the beginning and the end of the alignment, respectively. It should be noted that this groundwater information might not reflect current water table conditions because this information was obtained from past projects—some as long ago as 33 years.

A 1948 soil survey along Segment 1 indicates that the proposed sewer will be exclusively situated in loess terrace topography. Previous borings in the loess terrace areas in the vicinity of the project site indicate that the subsurface material should consist of natural cohesive loess overlying cohesive alluvial soils. The underlying alluvial soils may have interspersed layers and lenses of silt and sand. Previous borings located in the vicinity of the south end of the alignment indicate that the water table could be 7 to 8 feet below grade.

Based on previously performed borings and soils survey data, Segment 3 will be located in alluvial bottomland, loess terrace, and colluvial drainage way topography. Subsurface soils should consist mainly of cohesive materials with possible silt and sand layers being present. Borings performed on the north end of the alignment indicate the water table was approximately 15 feet below grade.

**C. Topographic Survey, Easements, and Material Laydown Areas**

JEO Consulting Group Inc. has provided surveying services for the preparation of a topographic site survey for design and property descriptions of permanent and temporary construction easements. Permanent construction easement requirements for sewer construction are determined based on a 1:1 slope from the springline of the sewer to existing grade. The average depth of the proposed trunk sewer is 12-15 feet; therefore, the permanent construction easement required for the trunk sewer is 40 feet. The temporary construction easement for the trunk sewer is 60 feet. The average depth of the proposed subbasin sewers is 10-12 feet; therefore, the average permanent construction easement is 30 feet. The temporary construction easement for the subbasin sewers is 70 feet.

Material laydown areas for the project will need to be negotiated with individual property owners for the project. Potential areas for material laydown include portions of land owned by Schwisow Construction south of the two oxbows. An access road from West 'O' Street extends south to the BNSF Railway line and east to near Sta. 45+00. An additional laydown area may include property owned by Shoemaker's south of West 'O' Street and 48<sup>th</sup> Street.

Permanent easements shall be obtained for the extension of the Trunk Sewer on property owned by Schwisow Construction when obtaining the identified temporary and permanent easements. Permanent easements shall also be obtained for Segment 6.

**D. Documents**

1. Drafting Standards

The project drawings will be prepared on 22-inch by 34-inch sheets. A combination of HDR drawing standards and the City of Lincoln's proposed drafting standards will be utilized in the preparation of project drawings. The City's proposed standards will be utilized to the extent feasible for this project. Drawings will be produced using Microstation. Each sheet will have the following title:

West 'O' Street Trunk Sewer Extension  
Lincoln, Nebraska  
2005

2. Specifications

HDR technical specifications will be utilized in conjunction with the use of City of Lincoln front end documents to develop project specifications. City technical specifications and details will be utilized as appropriate.

3. Existing Data

The following data shall be used in the preparation of the Contract drawings and specifications:

- a. Lincoln Wastewater Facilities Plan Update - April 2003, prepared by Brown and Caldwell.
- b. 36" Sanitary Trunk Sewer Extension Project #701019 – August 2000, prepared by the City of Lincoln.
- c. 'P' Street Lift Station and Force Main Contract Drawings – July 1964, prepared by Harold Hoskins & Associates.
- d. Sewer Capacity Analysis For Future Growth Along West 'O' Street for Planning Areas NW-1, NW-2, & NW-2.5 – February 2001, prepared by Olsson Associates.
- e. City of Lincoln GIS data for sewer lengths, slopes, and collection sewer connections elevations to the existing trunk sewer for determination of allowable submergence.

**E. Applicable Standards and Guidelines**

The following standards and guidelines will be used for this project:

1. City of Lincoln Standard Plans and Specifications.
2. Recommended Standards for Wastewater Facilities, Great Lakes – Upper Mississippi River Board of State Public Health and Environmental Managers (10 States Standards).

**F. Project Approval Requirements**

The following agencies will review and approve the Contract Documents prior to Awarding the project for construction:

1. Nebraska Department of Environmental Quality for minimum sanitary requirements.
2. Lower Platte South Natural Resources District and U.S. Corps of Engineers for creek crossings of Middle Creek tributaries.
3. Nebraska Department of Roads for construction in the right-of-way and tunnel crossing of 'O' Street and Interstate I-80.
4. National Pollutant Discharge Elimination System (NPDES) Permit for control of run-off during construction.
5. Lancaster County Permits for crossing of SW 44<sup>th</sup> Street, Sylvan Avenue, and West 'M' Street (2 crossings).

### **III. SEWER DESIGN**

#### **A. Design Flows**

The Tier I service areas identified in the *Lincoln Wastewater Facilities Plan Update* (October 31, 2002, by Brown and Caldwell) were used as the basis for service areas for the preliminary evaluations. The document indicates an existing area of 1,042 acres and additional areas for Tier I growth of 1,900 acres. This equates to flow of 7.6 cfs and a future flow of 12.9 cfs for a combined Tier I total flow of 19.1 cfs (2,942 acres) [using the City of Lincoln design flow equation and assuming cumulative acres]. See Figure 1 for Basin Areas.

Based on conversations with LWWS personnel, the flow conditions identified in the *Lincoln Wastewater Facilities Plan Update* were not considered accurate and should be revised to incorporate existing flow data. LWWS indicated that at MH A5-129, a normal peak flow was recorded at 2.63 cfs. At MH A5-38, a normal peak flow was recorded at 0.48 cfs. This data was utilized as a basis of modeling and design of the new outfall sewer. See Figure 2 for design flows.

The existing 36 inch trunk sewer, 12 inch VCP sewer, 'P' Street Lift Station, 8 inch force main, and 12 inch sewer conveying flow into the Salt Valley Trunk Sewer were also modeled to determine available capacity to convey flow for the Trunk Sewer extension.

#### **B. Sewer Modeling**

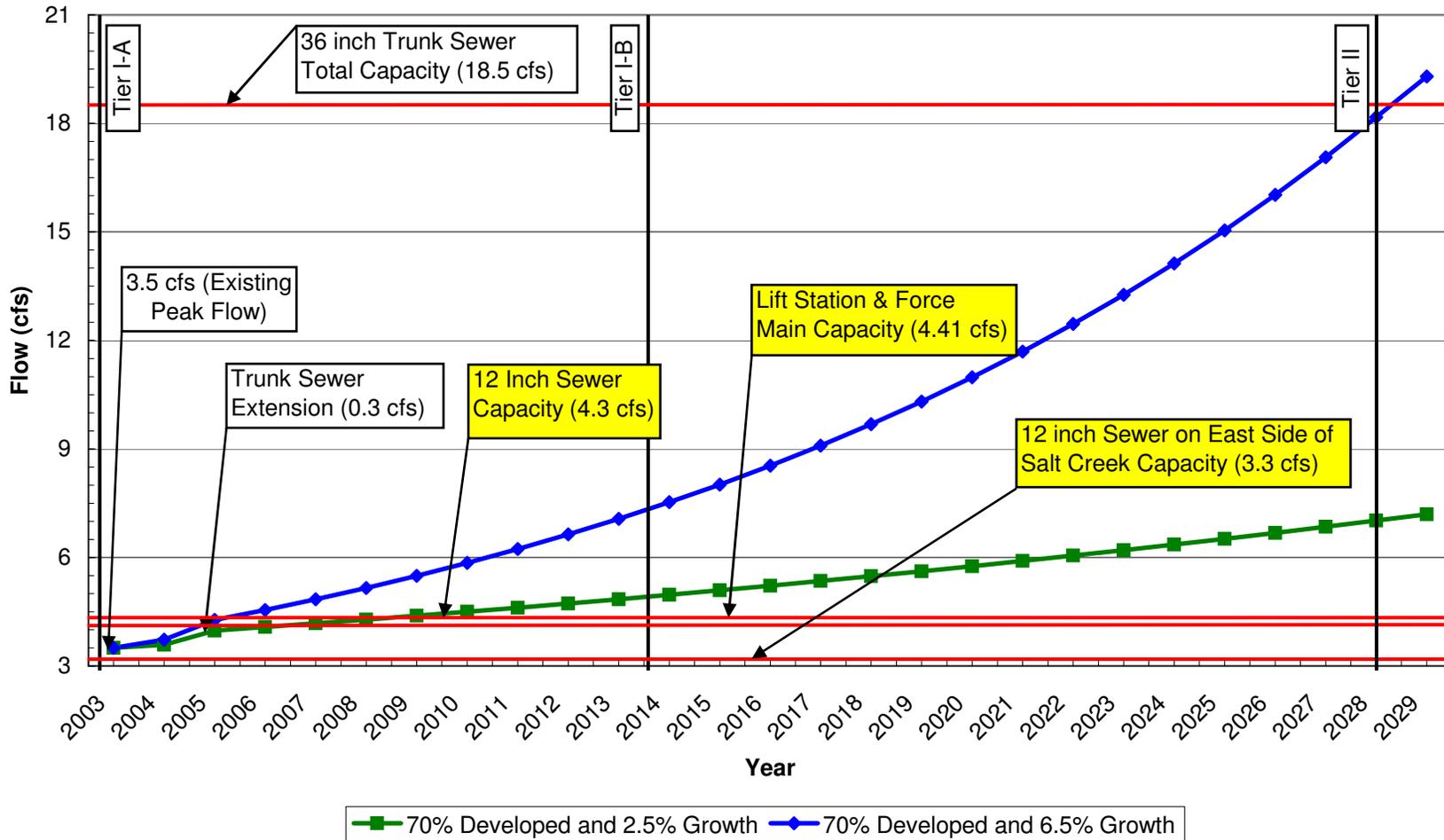
A sewer model was developed to evaluate the flows from the West 'O' Street basin over the entire flow range, from existing to future Tier I. The model consists of two main components that are linked together into one model. With this model it was possible to quickly evaluate the effects of pumps, and pipe variations on the flow conditions in each sewer segment in the system.

The first portion of the model evaluates the flow condition in the existing and new gravity sewers upstream from the 'P' Street Lift Station. The model determines if a pipe segment between manholes is operating in a submerged or gravity mode by taking into consideration the downstream water depth and the flow. The model then uses the Manning's equation for gravity flow or the Hazen-Williams equation for a submerged condition to determine the upstream depth of water. Working from the downstream condition to the upstream manhole of each pipe segment, the model calculates the depth of water until the last manhole is reached. The following summarizes the assumptions that are made in this portion of the model:

- When the downstream depth of water is greater than the pipe diameter, the pipe segment was considered submerged. Typically, the pipe is considered submerged when the downstream depth is equal to or greater than 80% of the pipe diameter, because the flow condition is unstable and fluctuates between submerged and unsubmerged conditions.
- When the flow in the pipe is greater than the calculated maximum flow, the pipe segment was considered submerged.
- Manning's loss coefficients for existing sewers were provided by the City's sewer database.
- A C-factor of 100 was used for all existing segments operating in a submerged condition. A C-factor of 120 was used for all new segments operating in a submerged condition.



## West 'O' Street Basin Projected Flow Curve\* (Tier I-A and Tier I-B Growth Conditions)



\*Assumption of Design Flow Based on City's Design Equation

Figure 2

- One exit and entrance fitting loss were also included in the calculations for headloss in a submerged condition.
- City of Lincoln design flow equation:  $Q=[0.01726 * (A^{0.8})] + [0.003 * A]$

The results of this portion of the model are presented graphically to allow the user to quickly evaluate the flow condition in each segment.

The second portion of the model evaluates the pump station portion of the system. In this portion, the design information for the station was input into the model to determine the pump system curve for different discharge conditions (one force main, two force mains, etc.) Once the model is set-up, the user can also input a variety of pump curves to size future pumps appropriately. The model also includes a variable speed pump condition where the user can select an operating speed for the pumps operating on variable frequency drives. Where the pump curve crosses the system curve, determines the flow capacity of the pump station at a given condition.

As stated previously, the model links these two portions together into one system model. If the flow condition changes, the model iterates until a resolution between the pump station, force main, and gravity sewers is reached. Once this occurs the model results can be evaluated.

1. Evaluation and Capacities of Existing Facilities and Sewers.

The existing facilities and sewers (12 inch and 36 inch Trunk Sewers, 'P' Street Lift Station, 8 inch force main, and 12 inch gravity sewer) were modeled to determine their capacity for conveying existing and future wastewater flows. The following describes each component of the existing conveyance system.

- a. Existing Trunk Sewer. The existing 36 inch trunk sewer was modeled independent of the 12 inch force main to determine the maximum capacity of the sewer with no submergence, 1 foot of submergence, and 2 feet of submergence. The two feet of submergence is recommended to be the maximum to be allowable capacity for operation of the trunk sewer. The existing 12 inch force main has been identified for replacement in the October 2002 Facilities Plan Update and is analyzed below. The submergence conditions identified and shown on the modeling figures represent submergence in the highest segment of the trunk sewer indicated with the red color.

To accurately determine the invert elevations in the existing trunk sewer, JEO surveyed the sewer. This survey data has been used in the model and will be incorporated into the City's GIS system.

Model 1 – No Submergence of Trunk Sewer (Appendix C – Figure 1-1)

Modeling of the existing 36-inch trunk sewer indicated an additional allowable acres contribution of 2,100 acres (14.1 cfs) without submergence of the sewer at any location. One 200-foot segment of the sewer is minimally submerged (red), with the remaining segments unsubmerged (green).

Model 2 – 1 ft. Submergence of Trunk Sewer (Appendix C – Figure 1-2)

Modeling of the sewer with a maximum of 1-foot of submergence indicated an additional allowable acres contribution of 2,400 acres (15.9 cfs). Flow in the

sewer is restricted by submergence in four segments (red), creating submergence in other segments (yellow).

Model 3 – 2 ft. Submergence of Trunk Sewer (Appendix C – Figure 1-3)

Modeling of the sewer with a maximum of 2-feet of submergence indicated an additional allowable acres contribution of 2,650 acres (17.4 cfs). Flow in the sewer is restricted by submergence in four segments (red), creating submergence in other segments (yellow). The flow condition resembles Model 2 with two segments continuing to be flow constricted, thus surcharging other portions of the alignment. Although these conditions operate in a similar condition, Model 3 has 1.5 cfs of additional capacity.

<b>Submergence Level</b>	<b>Area (acres)</b>	<b>Available Capacity (cfs)</b>
0 feet	2100	14.1
1 feet	2400	15.9
2 feet	2650	17.4

- b. The existing 12 inch gravity sewer that conveys flow from the 36 inch trunk sewer and 15 inch subbasin sewer was modeled to determine the maximum capacity without submerging subbasin sewers. The sewer can convey up to 4.28 cfs while utilizing the existing 36-inch Trunk Sewer as an extended wetwell. Beyond 4.28 cfs, the Trunk Sewer becomes surcharged to a level that inundates portions of the collection systems.
- c. The lift station capacity was evaluated by determining the pump capacity of the two existing 900 gpm pumps. The combined capacity is approximately 4.41 cfs. Installing pumps with greater capacity at the lift station is possible, but would require a new force main and gravity sewer to convey flow to the Salt Valley Trunk Sewer.
- d. The 8 inch force main capacity was identified to be 4.41 cfs based on the existing pumps. This equates to a flow velocity of 12.63 ft/s. The installation of larger pumps would not prove feasible without a parallel or larger replacement force main beneath Salt Creek. This is due to the dynamic head losses within the existing force main.
- e. The 12 inch gravity sewer on the east side of Salt Creek has an unsubmerged capacity of only 1.9 cfs. The sewer has a maximum capacity of 3.30 cfs before surcharging exceeds the rim elevation in MH-42. A parallel replacement sewer could be installed to divert flow into the Salt Valley Relief Trunk Sewer. The replacement sewer would operate as a force main or gravi-force main, since no service connections would exist between the lift station and the Salt Valley Relief Trunk Sewer.

2. Existing Flows

LWWS indicated that at MH A5-129, a normal peak was recorded at 2.63 cfs. At MH A5-38, a normal peak was recorded at 0.48 cfs. MH A5-38 conveys flow from an area that is considered to have reached 100% development; therefore, this flow was set as a constant of 0.5 cfs for the modeling. The remaining existing basin areas are at approximately 70% development. The flow at MH A5-129 is in the 12 inch sewer that is experiencing surcharging; therefore, the 2.63 cfs peak flow data was assumed to be low. A flow of 3.0 cfs was assumed for this location based on the developed areas of the basin and utilizing the City's Flow Equation to reflect the 70% developed assumption. Tables 2 and 3 reflect these assumptions for flows by beginning the total system flow at 3.5 cfs. In 2005, the Trunk Sewer Extension project will have a contribution of 0.3 cfs to account for flows from properties which will potentially be connected to the new sewers.

2. Tier I-B Flows

The Planning Department indicates that the entire West 'O' Street basin will be developed by the end of Tier I-B; therefore, the total area would include the existing basin area of 623 acres (not including the area for the BNSFR), and the development of 2,300 acres west of West 40<sup>th</sup> Street. This total build-out area contributes a design flow of 18.2 cfs. To reach the level of growth within the basin, the basin would have to grow at an effective 6.5% growth rate as indicated in Table 3.

Date	Condition	Total System (cfs)
2003	Tier I-A	3.5
2004	Tier I-A	3.6
2005	Tier I-A	4.0*
2006	Tier I-A	4.1
2007	Tier I-A	4.2
2008	Tier I-A	4.3
2009	Tier I-A	4.4
2010	Tier I-A	4.5
2011	Tier I-A	4.6
2012	Tier I-A	4.7
2013	Tier I-A	4.8
2014	Tier I-A	5.0
2015	Tier I-A	5.1
2016	Tier I-A	5.2
2017	Tier I-B	5.3
2018	Tier I-B	5.5
2019	Tier I-B	5.6
2020	Tier I-B	5.8
2021	Tier I-B	5.9
2022	Tier I-B	6.1
2023	Tier I-B	6.2
2024	Tier I-B	6.4
2025	Tier I-B	6.5
2026	Tier I-B	6.7
2027	Tier I-B	6.8
2028	Tier I-B	7.0

Date	Condition	Total System (cfs)
2003	Tier I-A	3.5
2004	Tier I-A	3.7
2005	Tier I-A	4.3
2006	Tier I-A	4.5
2007	Tier I-A	4.8
2008	Tier I-A	5.2
2009	Tier I-A	5.5
2010	Tier I-A	5.8
2011	Tier I-A	6.2
2012	Tier I-A	6.6
2013	Tier I-A	7.1
2014	Tier I-A	7.5
2015	Tier I-A	8.0
2016	Tier I-A	8.5
2017	Tier I-B	9.1
2018	Tier I-B	9.7
2019	Tier I-B	10.3
2020	Tier I-B	11.0
2021	Tier I-B	11.7
2022	Tier I-B	12.5
2023	Tier I-B	13.3
2024	Tier I-B	14.1
2025	Tier I-B	15.0
2026	Tier I-B	16.0
2027	Tier I-B	17.1
2028	Tier I-B	18.2

\*Additional 0.3 cfs from properties connecting to new sewers in 2005.

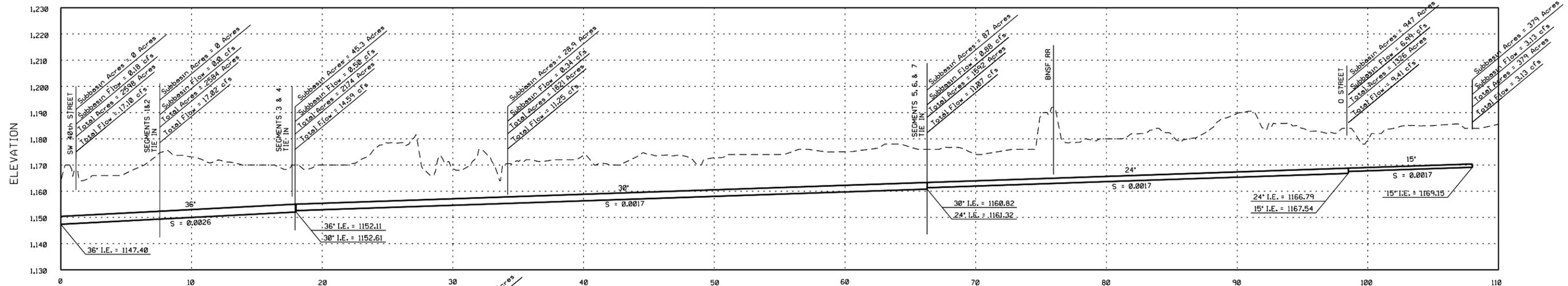
3. Design of Trunk Sewer Extension.

Based on the operating conditions for the existing 36 inch Trunk Sewer, a two foot submerged condition [17.1 cfs (2,598 acres)] was utilized as a basis of design for the Trunk Sewer Extension. This was based on only two segments affecting the upper portion of the existing sewer and the lower portion of the sewer having available capacity. The 2,598 acres of capacity exceeds the 1,900 acres identified for development of Tier I-A and Tier I-B areas.

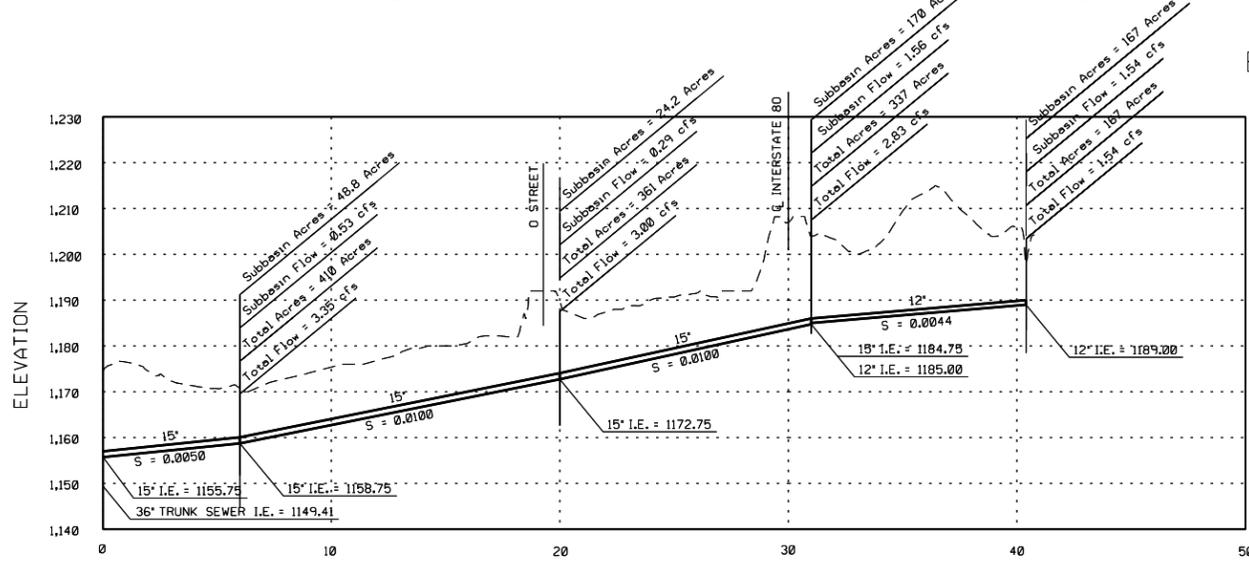
The associated flow conditions and sewer sizes are show in Figure 3 – Profiles for the Trunk Sewer Extension and subbasin sewer segments. Figure 4 – Additional Sewers shows the sewer sizing for additional subbasin collection sewers throughout the remainder of the West ‘O’ Street Basin.

Table 4 provides a summary designating when portions of the existing conveyance system will reach capacity. As indicated, the 12 inch gravity sewer

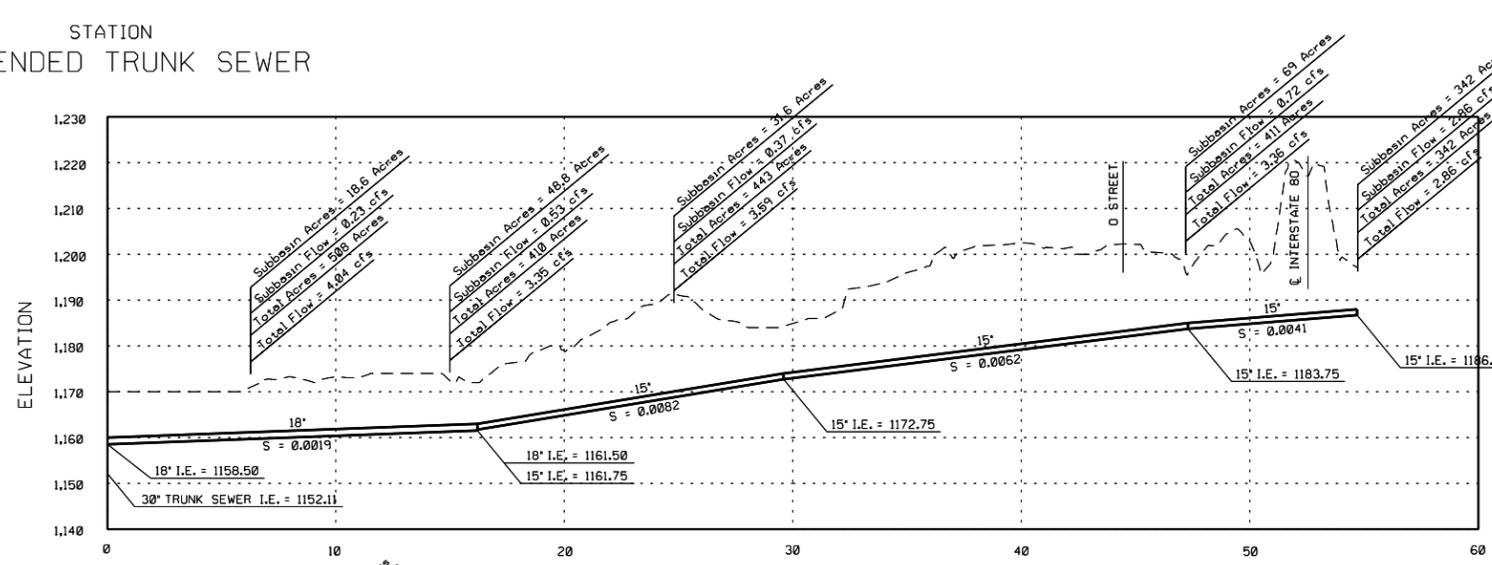
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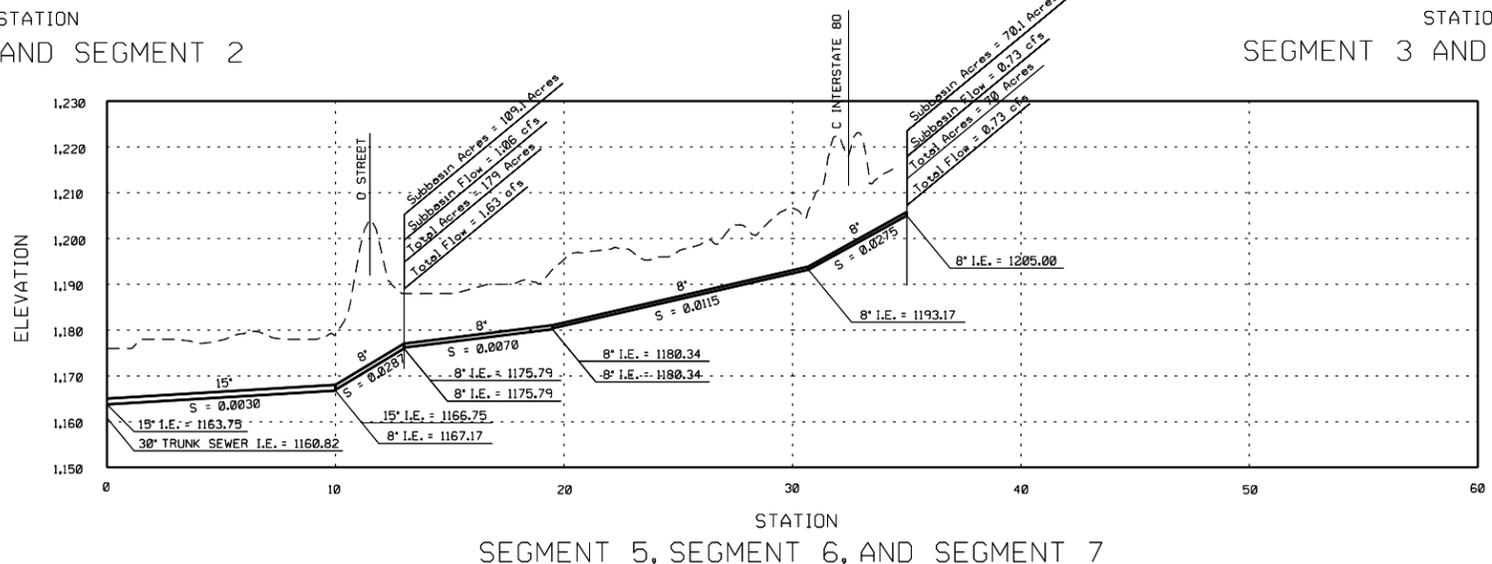
STATION  
EXTENDED TRUNK SEWER



STATION  
SEGMENT 1 AND SEGMENT 2



STATION  
SEGMENT 3 AND SEGMENT 4



STATION  
SEGMENT 5, SEGMENT 6, AND SEGMENT 7

SCALE  
HORIZ = 1:400  
VERT = 1:20



ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	
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**PRELIMINARY  
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OR  
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**West 'O' Street  
Trunk Sewer Extension  
Lincoln, Nebraska  
2005**

**PROFILES**

0 1" 2"

FILENAME	ALIGNMENT A	SHEET
SCALE		<b>FIG 3</b>

has reached capacity and is exceeding capacity during peak flow conditions. The rest of the system will reach capacity between 2005 and 2008 based on the different growth projections of 2.5% and 6.5%. Based on the close proximity of the dates when capacities will be reached, LWWS should consider implementation of a program to replace each of the components.

Component	Capacity	Year Capacity Exceeded (2.5% Growth)	Year Capacity Exceeded (6.5% Growth)
12 Inch Trunk Sewer	4.28 cfs	2008	2006
‘P’ Street Lift Station	4.41 cfs	2009	2005
8 Inch Force Main	4.41 cfs	2009	2005
12 Inch Gravity Sewer	3.30 cfs	2003	2003

As consideration is given to future improvement of the West ‘O’ Street trunk sewer system, a recognition of their interdependence is critical. Construction of a replacement sewer for the 12” trunk sewer increases trunk sewer capacity. At the same time, it will instantaneously overload the ‘P’ Street pumping station and force main.

Improvements in the ‘P’ Street Pumping Station to increase pumping capacity will require a new force main and outfall sewer to handle the capacity. Increased pumping capacity is also limited by the physical constraints of the existing pumping facility.

The West ‘O’ Street trunk sewer system may be better served by replacing the existing 12” trunk sewer with a 15” sewer to deliver wastewater south from the existing 15” collection system sewer to a new pumping station located conveniently to pick up wastewater flow from the existing 36-inch trunk. The pumping station, force main, and outfall sewer can then be constructed as an integrated entity without the constraints of operating the existing system during construction. They can also be sized for current flows and future wastewater flows.

An evaluation can be made on the outfall sewer to implement a concept for installation of a gravity outfall sewer which can be utilized in a pressure force main mode when flows increase. Pumps and piping can be sized to plan for an orderly transition to larger pumps as flow dictates. All of the improvements can be made to meet existing and future capacity needs with at a reduced initial cost and minimum future cost.

**C. Pipe Design**

1. Pipe Materials

The pipe materials for this project include centrifugally cast fiberglass reinforced polymer mortar pipe (CCFRPMP-Hobas), filament wound fiberglass reinforced polymer mortar pipe (FWFRPMP-Flowtite), solid and profile wall polyvinyl chloride pipe (PVC), and reinforced concrete pipe (RCP). The PVC sewer pipe ends will need to be grouted at each connection to a manhole.

These pipe materials will be specified as listed below for the following sizes and installation methods.

<u>Pipe Diameter (inches)</u>	<u>Pipe Materials</u>
36" & smaller-trenched	CCFRPMP, FWFRPMP, PVC, RCP
36" & smaller-tunneled (two-pass)	CCFRPMP, FWFRPMP, PVC, RCP

RCP will be furnished with rubber and concrete joints and an internal plastic liner (T-Lok).

Amitech USA (FWFRPMP-Flowtite) has offered the City of Lincoln, at no cost, 600 to 800 feet of 36 inch pipe for the purposes of evaluation. The actual quantity provided would be determined by the footage required to connect two manholes. Amitech USA has requested documentation from LWWS that details the evaluation/performance criteria and a defined period for the evaluation. Based on successful completion of the evaluation period, Amitech USA would request a formal letter of approval for Flowtite by the City of Lincoln.

2. Embedment, Backfill, and Spoil

a. Pipe Embedment

Filter fabric will be placed around the pipe embedment to prevent migration of the embedment into the surrounding soils for CCFRPMP, FWFRPMP, and PVC.

b. Trench Backfill

Backfilling requirements will be similar to previous LWWS projects. Fill under grass areas will be compacted to a minimum of 90%-92% density and fills under roads and streets will be compacted to a minimum of 95% density of standard proctor.

c. Spoil Materials

Excess spoil will be disposed of by the Contractor.

d. Groundwater Barriers

Groundwater barriers will be placed approximately every 500-1,000 feet along the alignment and shown on the drawings..

**D. Manholes**

Manholes shall be placed at the intersections of all sanitary sewer lines, changes in horizontal or vertical alignment, at pipe diameter or material changes, and at the end of any terminating line. Manhole spacing for the straight portions of the sewer shall be approximately 800 feet or as appropriate for site specific conditions. City of Lincoln standard manholes, constructed of concrete or fiberglass, will be used in all locations. Alternative materials may be considered. These will require resistance to hydrogen sulfide with data provided from testing that has been completed. An internal plastic liner will be provided for concrete manholes. The exterior of all manholes will be damp-proofed to maintain the plastic liner. Manholes will be covered with a concrete flat slab on grade and pressure tight manhole cover. No manhole steps will be included in the manholes.

Testing of the sewer will be conducted from manhole to manhole before installing the next section of the sewer. Testing will include TV, Mandrel test, and an air pressure test.

**E. Connections to Existing and Future Sewer Facilities**

The 36 inch trunk sewer extension will connect to the existing 36 inch trunk sewer north of the Burlington Northern and Santa Fe Railway (BNSFR) right-of-way and east of SW 40<sup>th</sup> Street at the existing manhole. A 15-inch sewer also conveys flow along SW 40<sup>th</sup> Street into the north side of this existing manhole. A future extension of the trunk sewer west of 60<sup>th</sup> Street will occur at the manhole intersection between the trunk sewer and subbasin sewer Segment 5. Three subbasin sewers will connect to the trunk sewer extension under this project.

Each of the subbasin sewers will terminate in manholes located just south of the Interstate 80 right-of-way. These sewers will be extended beneath the Interstate when services are requested for Tier I-B development. Crete Carrier and Shoemaker's Trunk Stop each operate wastewater lagoons adjacent to Interstate 80. The property owners will be responsible for connecting to the proposed subbasin sewer.

**F. Special Construction**

1. Horizontal Auger Boring

Horizontal auger boring will be allowed using steel casing pipe with CCFRPMP, FWRPMP, or PVC as the carrier pipe within the primary liner. Horizontal auger boring will be required for the following locations:

- a. West 'O' Street
- b. Interstate 80

2. Burlington Northern and Santa Fe Railway (BNSFR) Overpass

A casing pipe will be installed by excavation for the SW 40<sup>th</sup> Street crossing, in the location of the proposed bridge over the BNSFR. The bridge project is currently under preliminary design by Kirkham & Michael Associates. The casing pipe will be placed on piers to prevent settling associated with loading and construction of the overpass.

**G. Restoration**

1. Seeding

Areas disturbed by construction activities shall be reseeded in accordance with the City of Lincoln standards or restored as negotiated by City Real Estate when obtaining permanent and temporary construction easements.

2. Shoemaker's Truck Stop Parking Lot

Portions of the asphalt parking lot disturbed by construction activities shall be removed and replaced in accordance with the City of Lincoln standards or restored as negotiated by City Real Estate when obtaining permanent and temporary construction easements.

**H. Utility/Railroad/NDOR Coordination**

1. Utilities in Project Area

Digger's Hotline of Nebraska was contacted to determine existing utilities in the project area. Each of the utilities has been contacted and drawings illustrating the



utilities have been requested. The following is a listing of utilities in the project area:

- a. Alltel Communications
- b. Aquila
- c. Lincoln Water System (LWS)
- d. Lincoln Wastewater System (LWWS)
- e. City of Lincoln – Watershed Management (Stormwater)
- f. Lincoln Electric System (LES)
- g. MCI
- h. Time Warner Cable
- i. Magellan Pipeline Company (Fuel Oil Pipeline)

2. Burlington Northern and Santa Fe Railway (BNSFR)

BNSFR right-of-way will not be encroached upon under this contract, but BNSFR is intending on adding two additional rail lines west of SW 40<sup>th</sup> Street. These lines will be located on the north and south of the existing lines. BNSFR indicated that the additional line to the north will require approximately 25 additional feet of right-of-way.

3. Nebraska Department of Roads (NDOR)

NDOR is planning future expansion of Interstate 80, including modifications to the NW 48<sup>th</sup> Street interchange. This expansion includes the addition of a third lane of traffic in either direction. NDOR is also evaluating the potential expansion of West ‘O’ Street west of NW 48<sup>th</sup> to four lanes, but this expansion will not occur until at least 2009 and does not include the purchase of additional right-of-way.

#### **IV. PROJECT COSTS**

##### **A. Basis of Project Costs**

Capital costs developed for the sewer alignments were based on opinions of cost for previous HDR projects and invoices from previous LWWS projects. All lengths for pipelines and tunnels were scaled from the 2003 aerial photographs obtained from the City's GIS department. All project costs are provided in October 2004 dollars. Additional amounts for contingencies; easement acquisition; and engineering, legal, and administrative costs were added to obtain a total opinion of probable project cost for each alignment.

##### **B. Construction and Engineering Costs**

Costs were calculated on a linear foot basis for the sewer on each alignment accounting for depth of bury for the pipe. Tunneling beneath West ‘O’ Street and Interstate I-80, was evaluated for each location to provide a cost per linear foot of tunnel. Additional costs were included for dewatering, manholes, street repairs, utility relocations, and seeding. Fifteen 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.

**C. Easement Acquisition Costs**

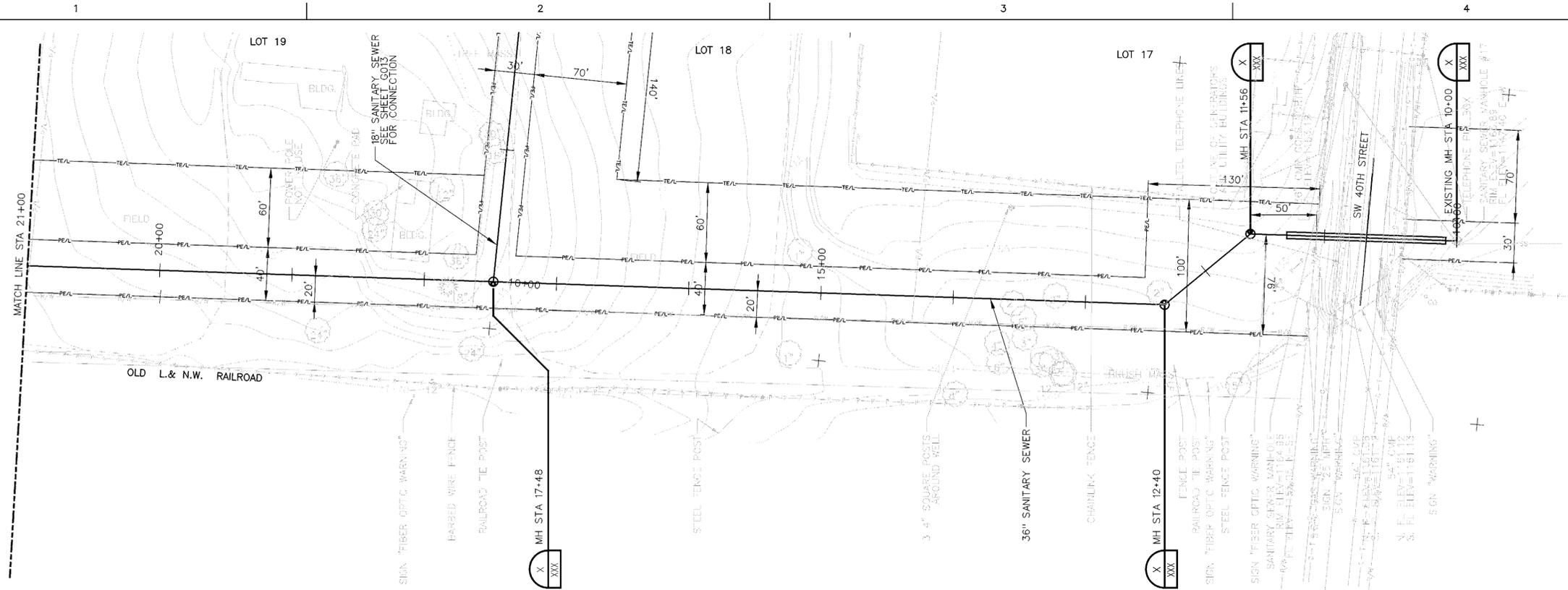
Easement acquisition costs were estimated based on a square foot basis for permanent easements and temporary construction easements. A cost of \$0.50 to \$1.00 per square foot was used for permanent easements, based on the location of the property in reference to the 100-year flood elevation, and \$0.10 per square foot was used for temporary construction easements.

**D. Present Value Opinion of Probable Project Cost**

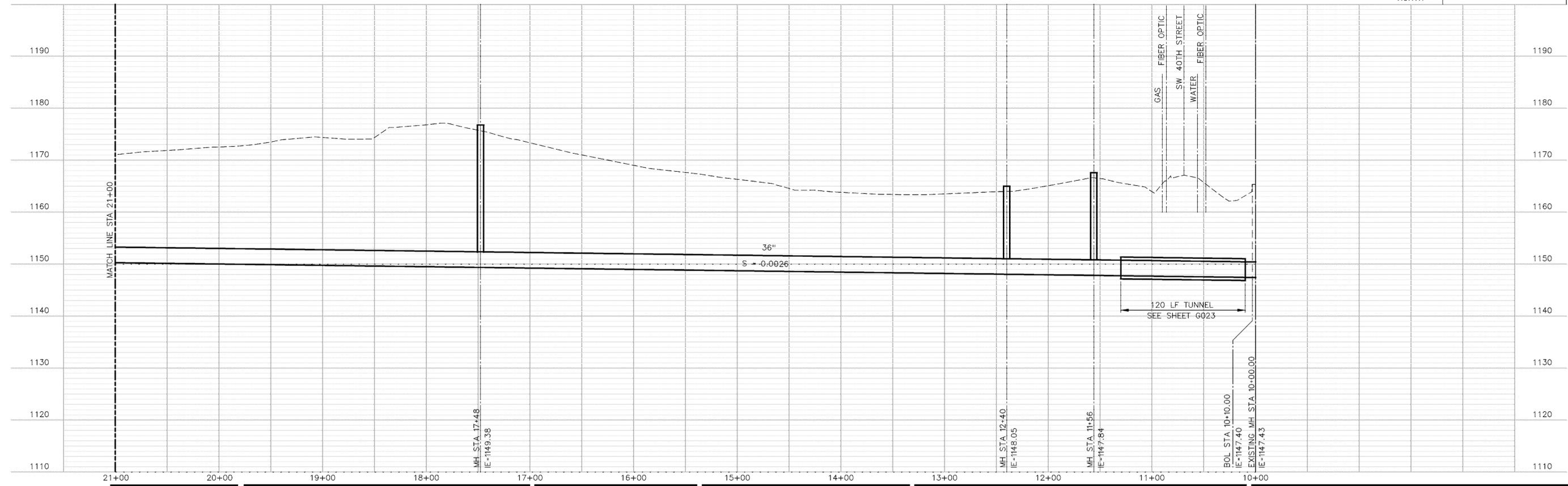
The opinion of probable project cost is listed in Table 5. A complete breakdown of the capital costs is located in Appendix B. The project cost for each alternative includes capital costs, general requirements, and contingencies. Engineering, legal, and administrative costs and easement acquisition costs are excluded from these project costs.

<b>Table 5 – Opinion of Probable Project Cost</b>	
<b>Growth Tier and Segment</b>	<b>Capital Cost</b>
Tier 1-A: Trunk Sewer to Segment 5, Segments 3 & 5	\$3,239,000
Tier 1-A: Segment 1	\$574,000
Tier 1-B: Segments 2 & 4	\$627,000
<b>Total Cost</b>	<b>\$4,440,000</b>

**APPENDIX “A”**  
**Preliminary Plan and Profile Drawings**



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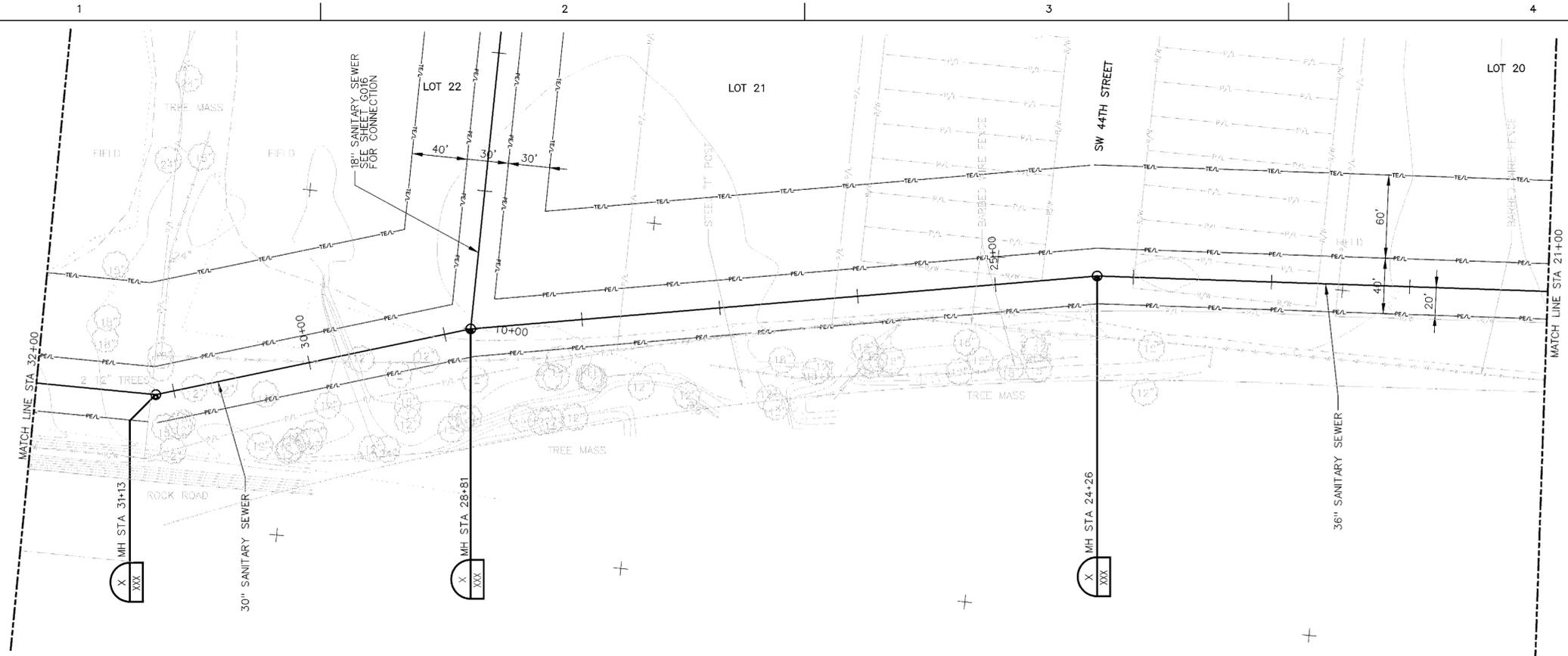


**West 'O' Street  
 Trunk Sewer Extension  
 Lincoln, Nebraska  
 2005**

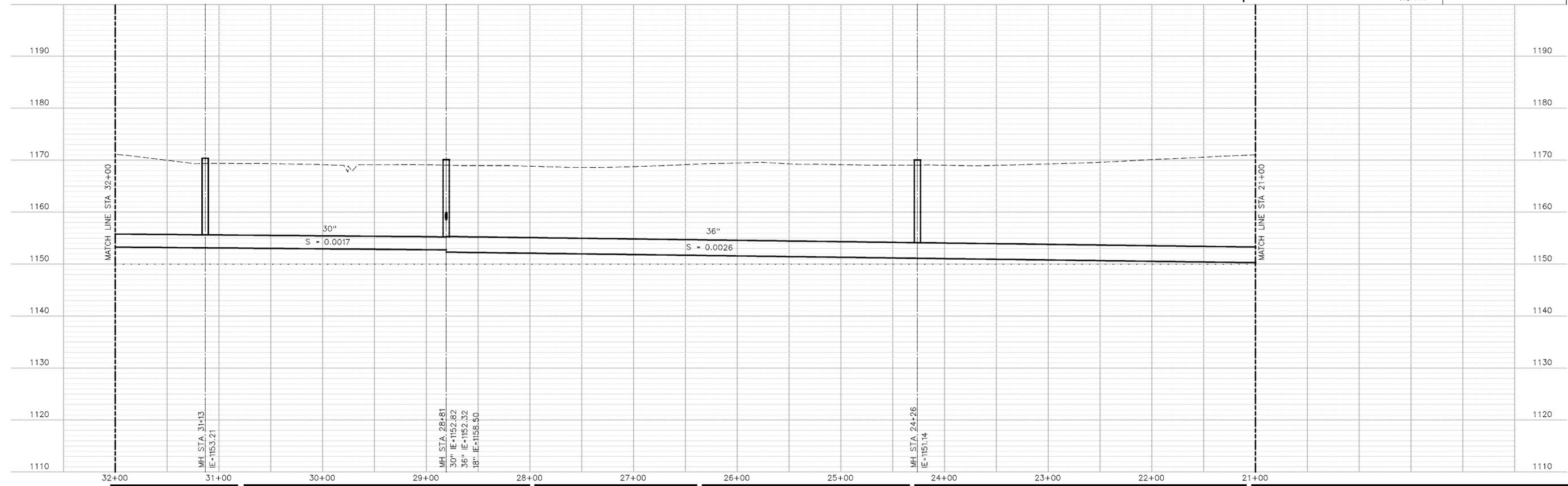
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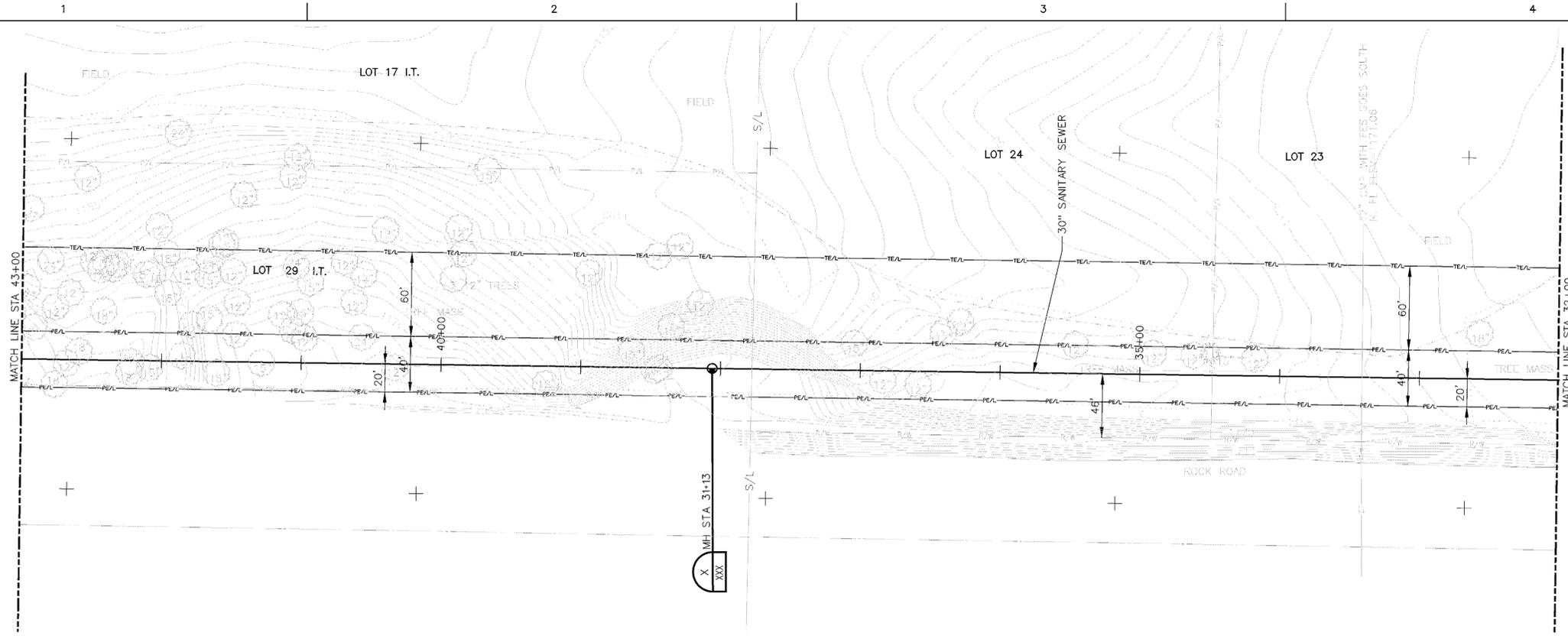
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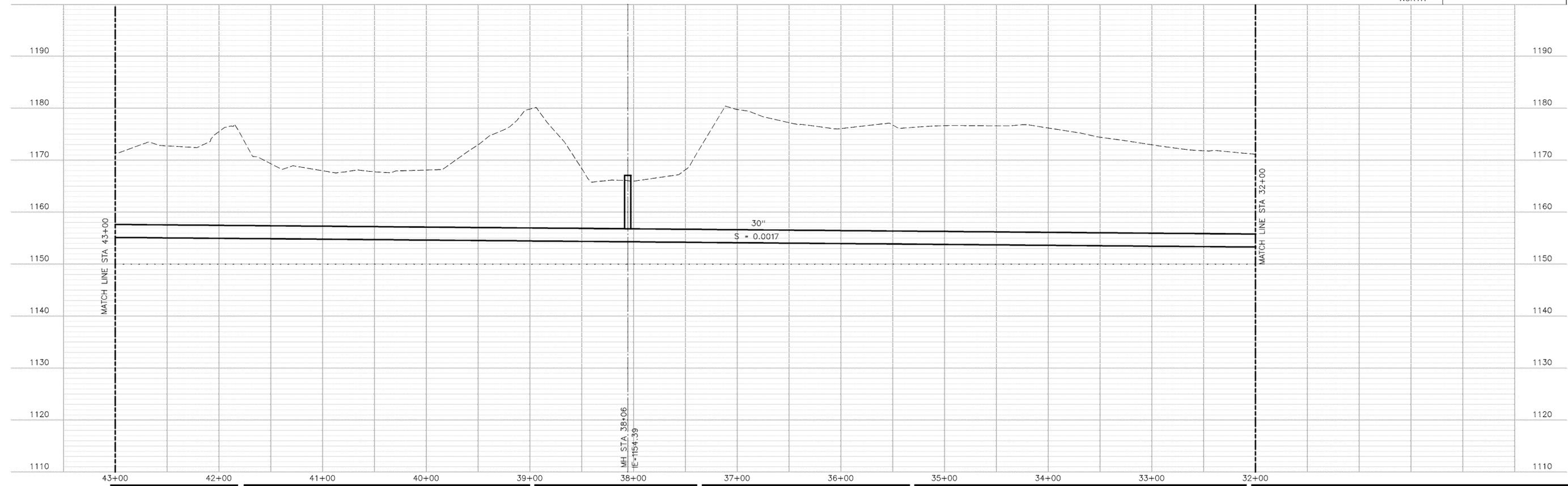


**West 'O' Street  
 Trunk Sewer Extension  
 Lincoln, Nebraska  
 2005**

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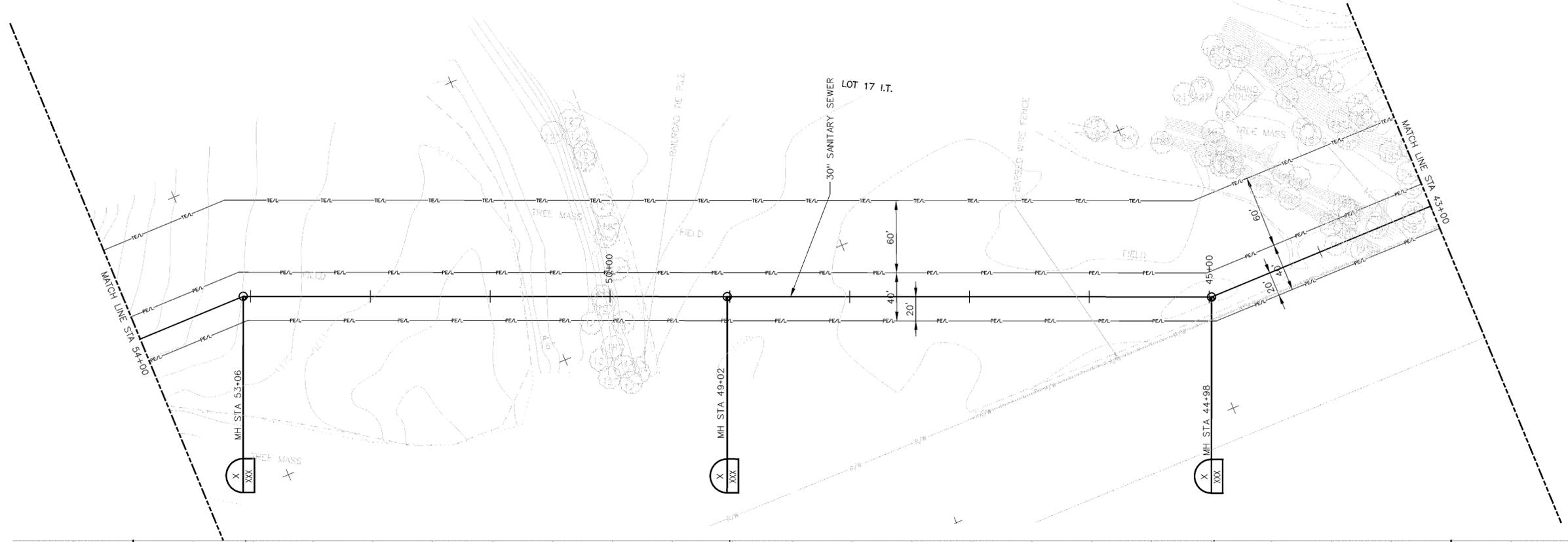
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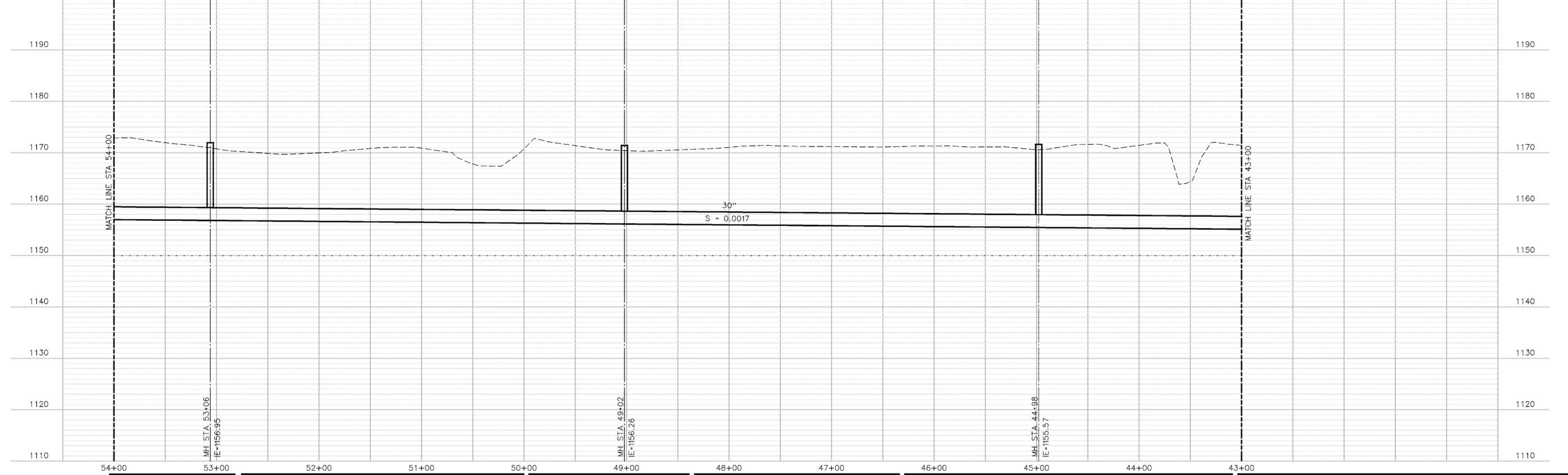
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 Lincoln, Nebraska  
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**TRUNK SEWER  
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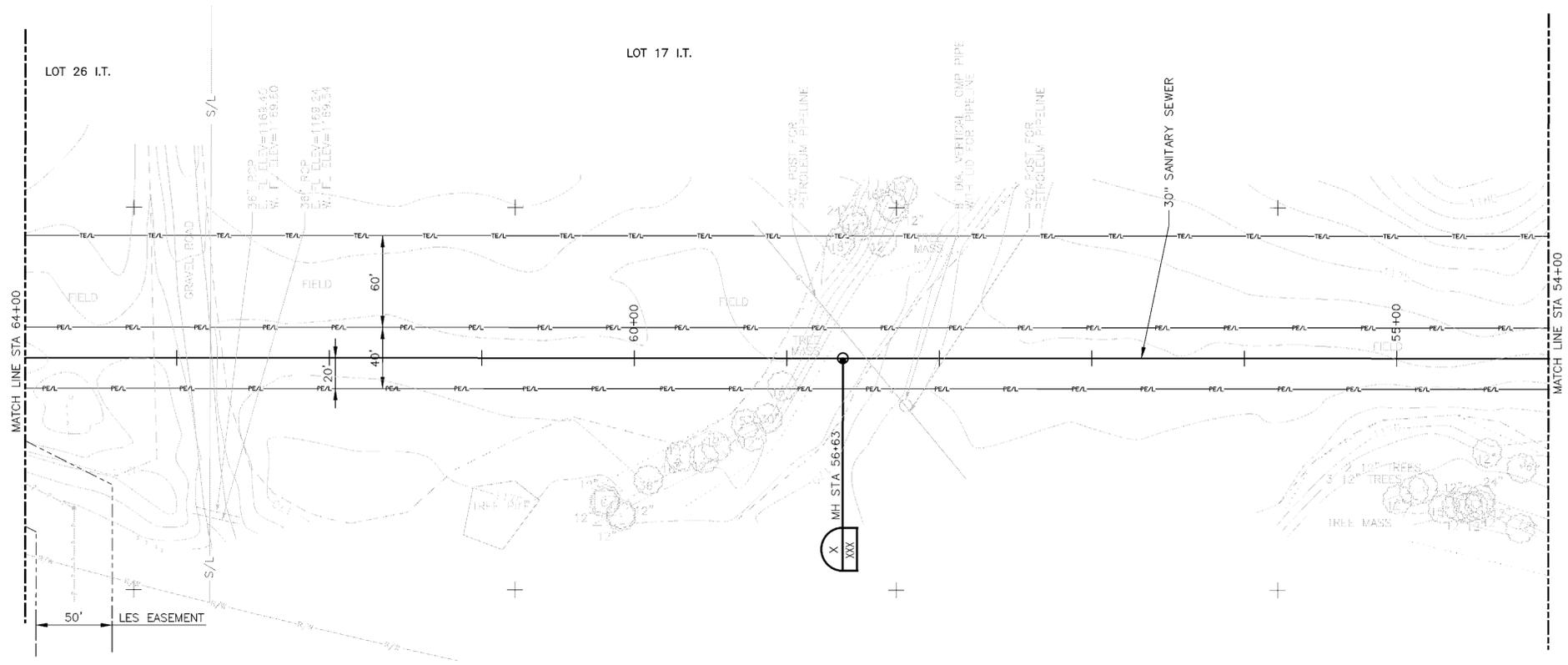
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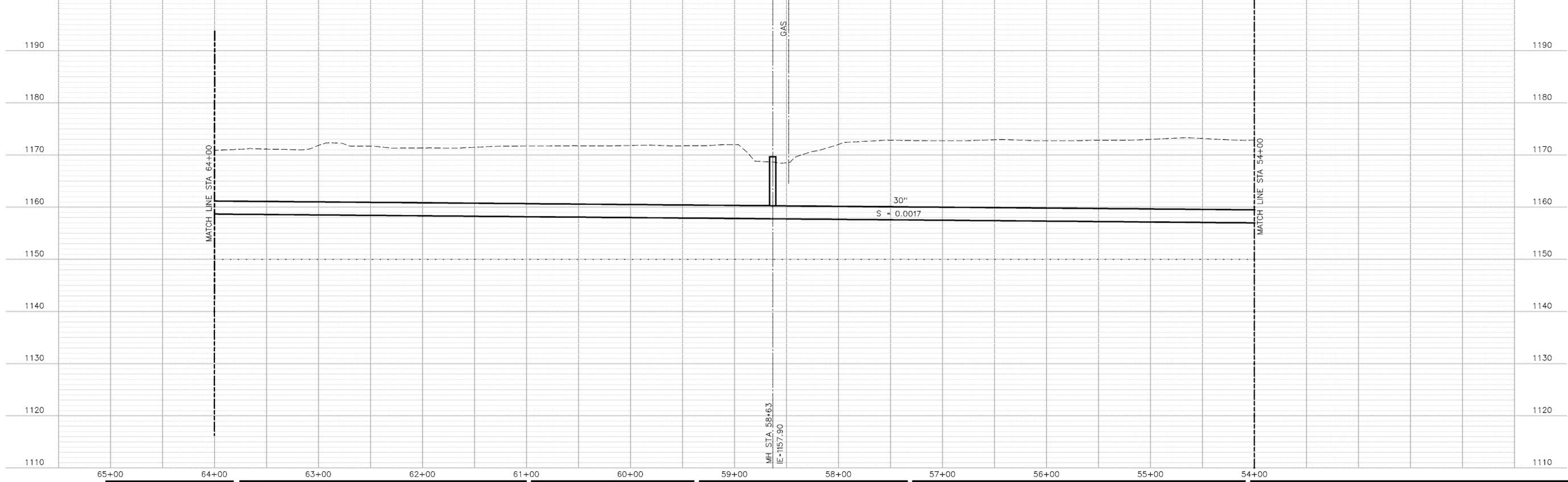


**West 'O' Street  
 Trunk Sewer Extension  
 Lincoln, Nebraska  
 2005**

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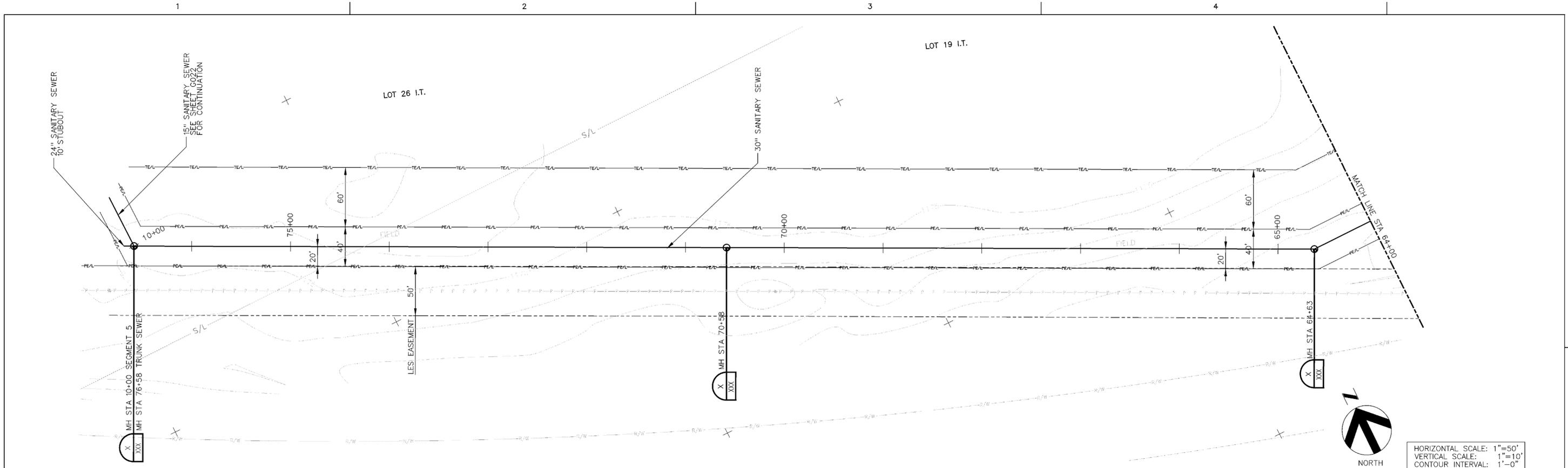
**West 'O' Street  
 Trunk Sewer Extension  
 Lincoln, Nebraska  
 2005**

**TRUNK SEWER  
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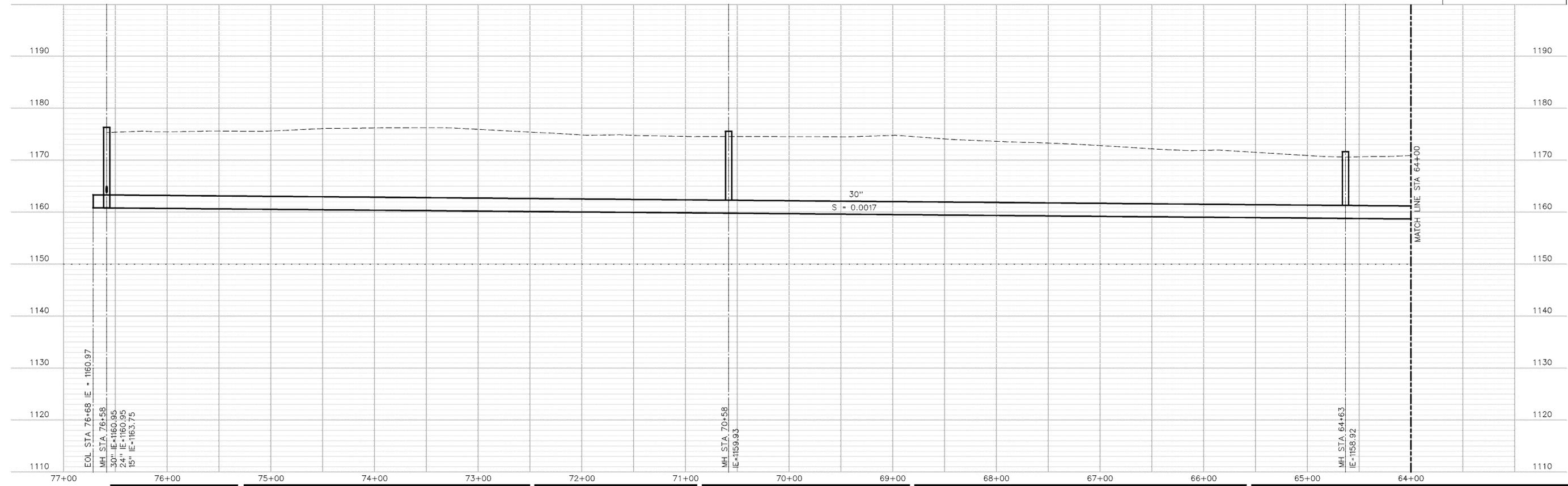
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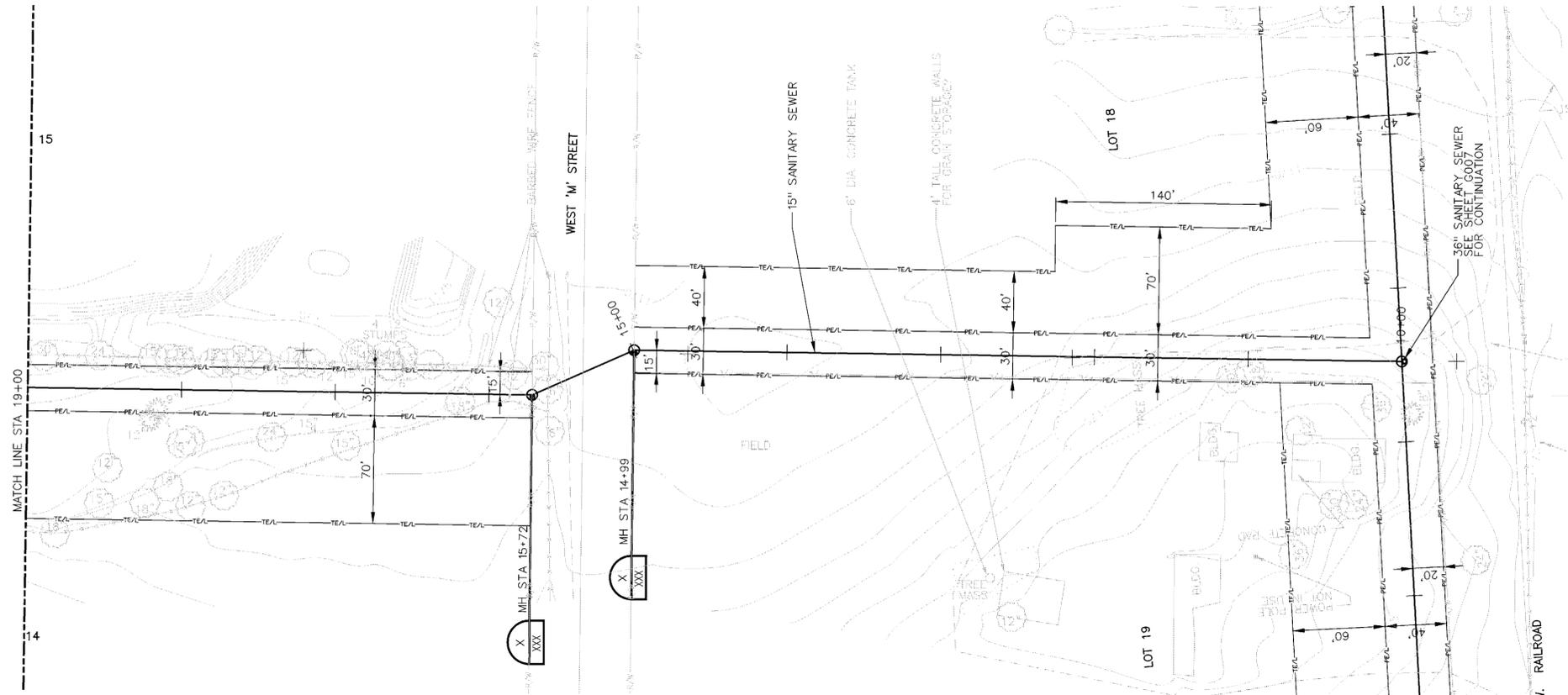
**West 'O' Street  
 Trunk Sewer Extension  
 Lincoln, Nebraska  
 2005**

**TRUNK SEWER  
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 STA 64+00 TO STA 76+58**

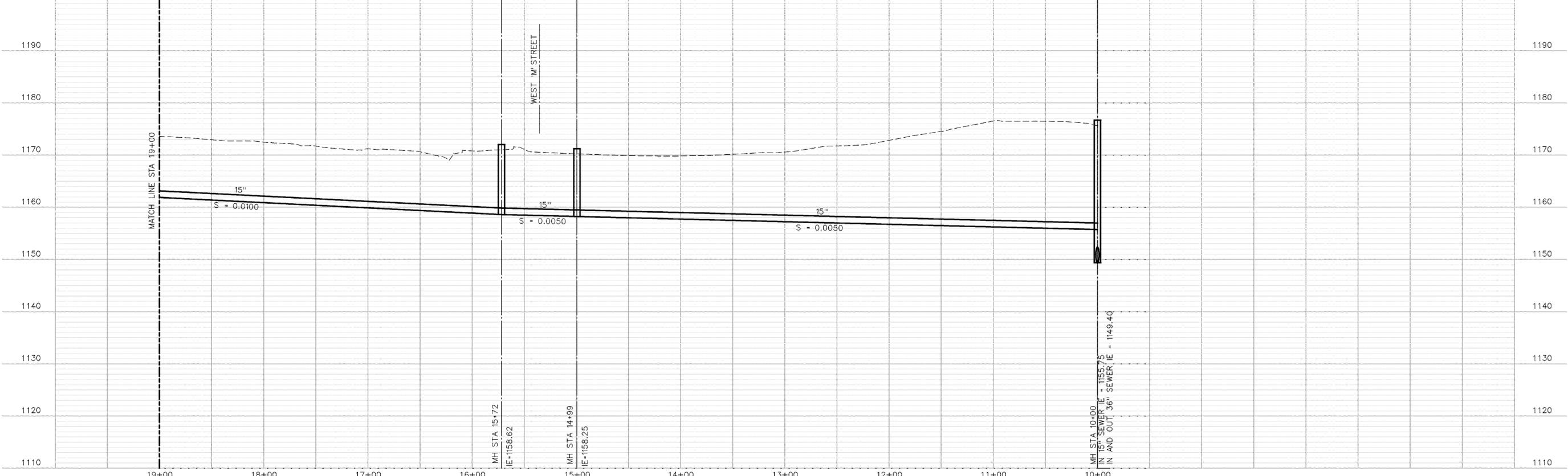
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PROJECT NUMBER	12733

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NOT FOR  
CONSTRUCTION  
OR  
RECORDING



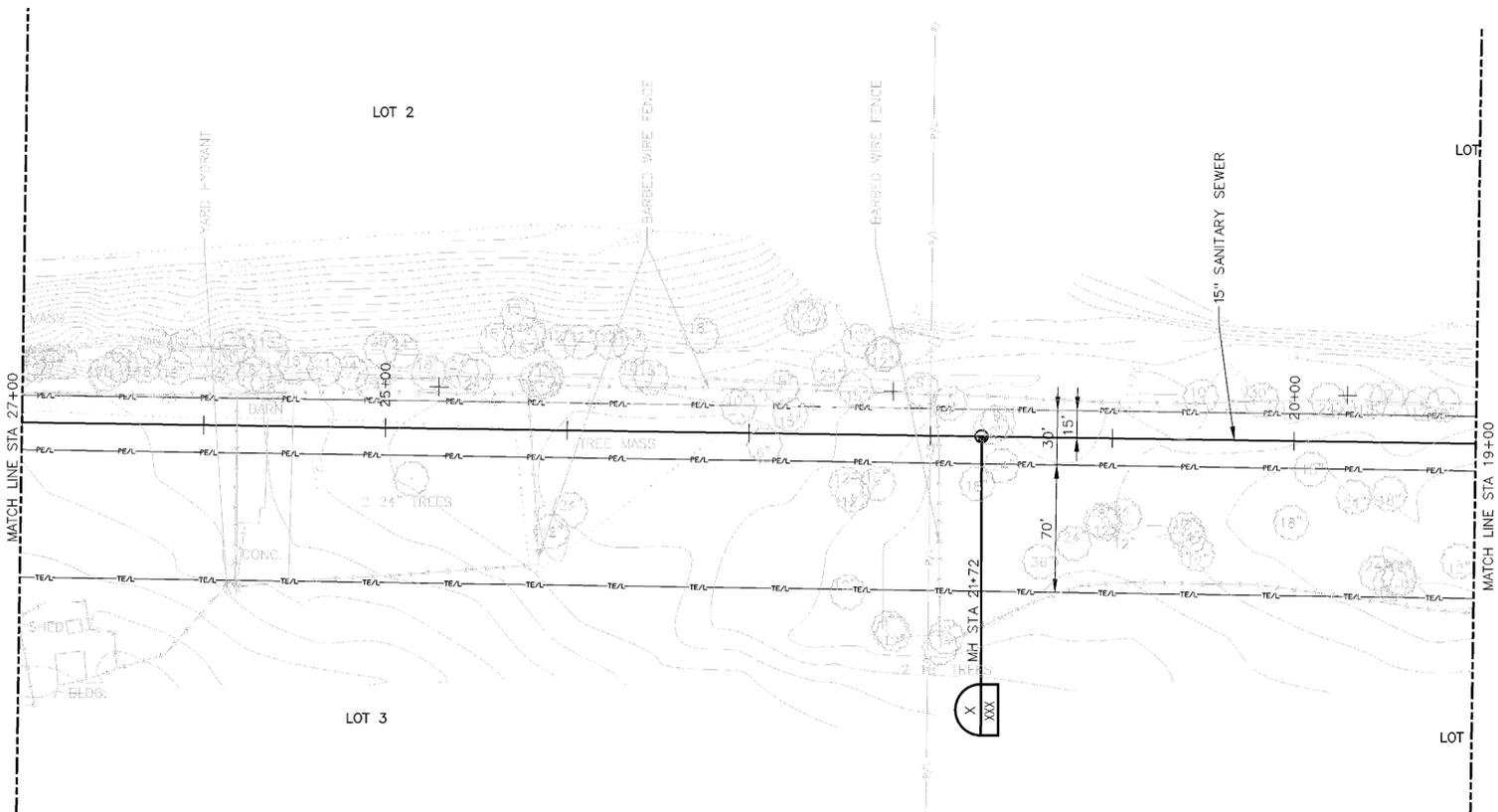
**West 'O' Street  
Trunk Sewer Extension  
Lincoln, Nebraska  
2005**

**SEGMENT 1  
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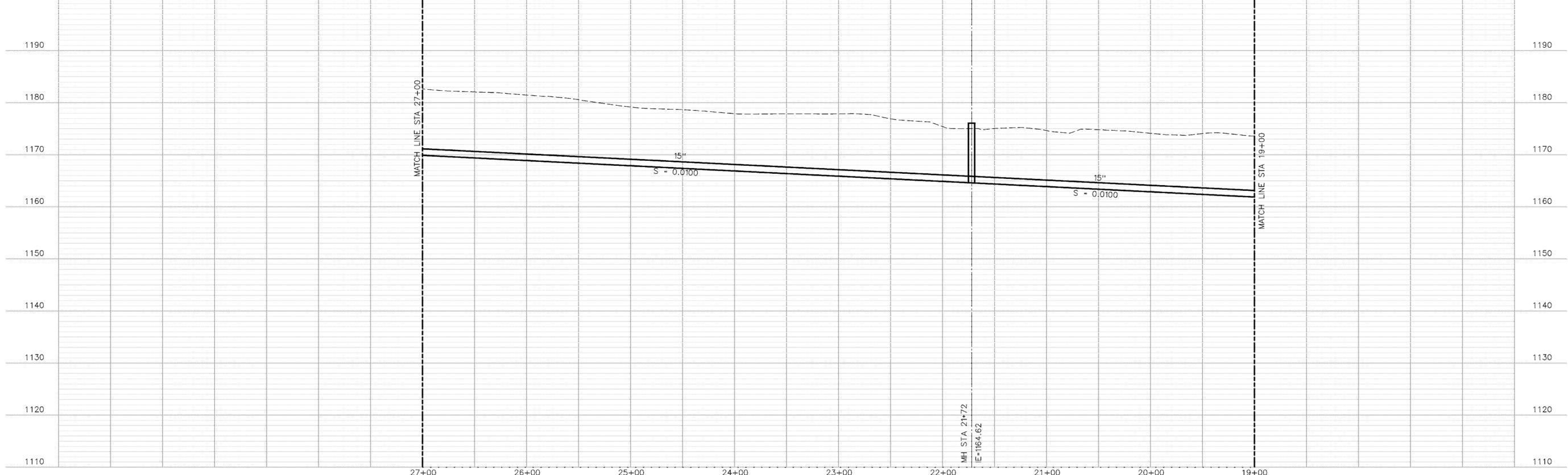
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CIVIL	SCOTT AURIT
STRUCTURAL	
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MECHANICAL	
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PROJECT NUMBER	12733

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 NOT FOR  
 CONSTRUCTION  
 OR  
 RECORDING



West 'O' Street  
 Trunk Sewer Extension  
 Lincoln, Nebraska  
 2005

SEGMENT 1  
 PLAN AND PROFILE  
 STA 19+00 TO STA 27+00

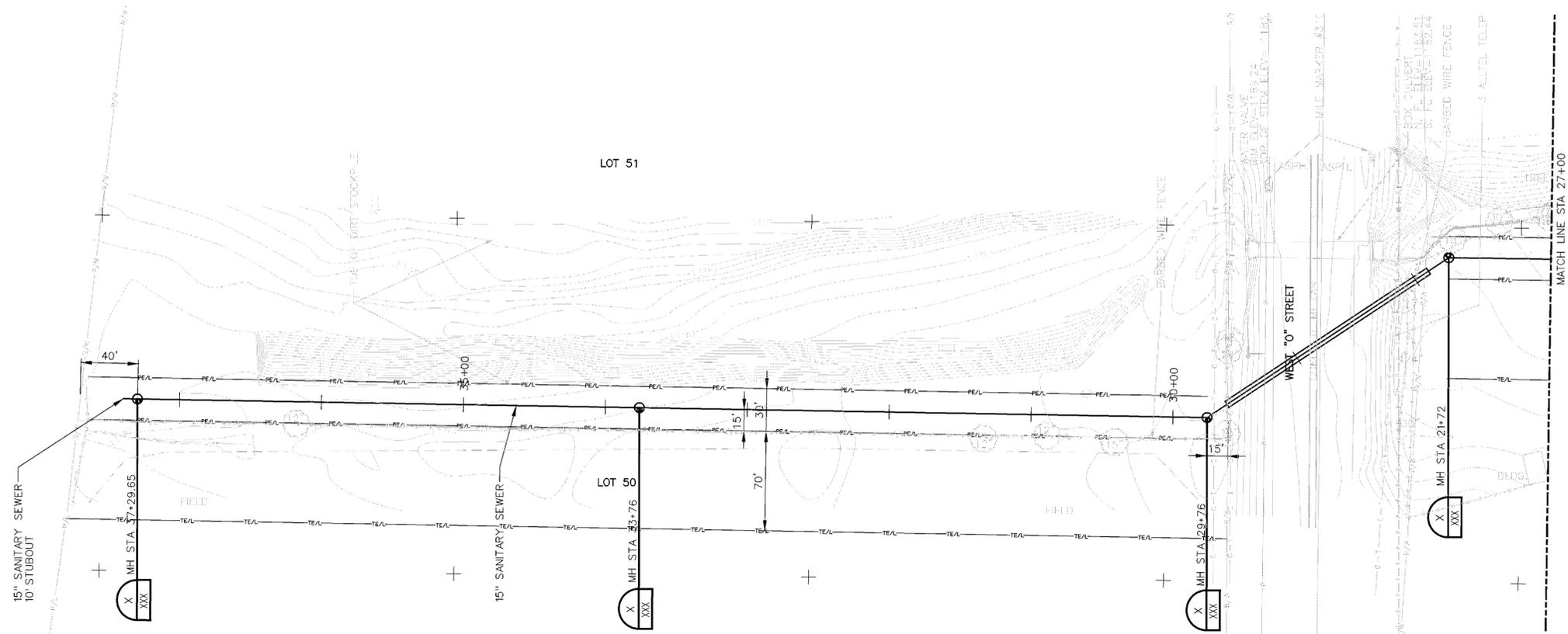
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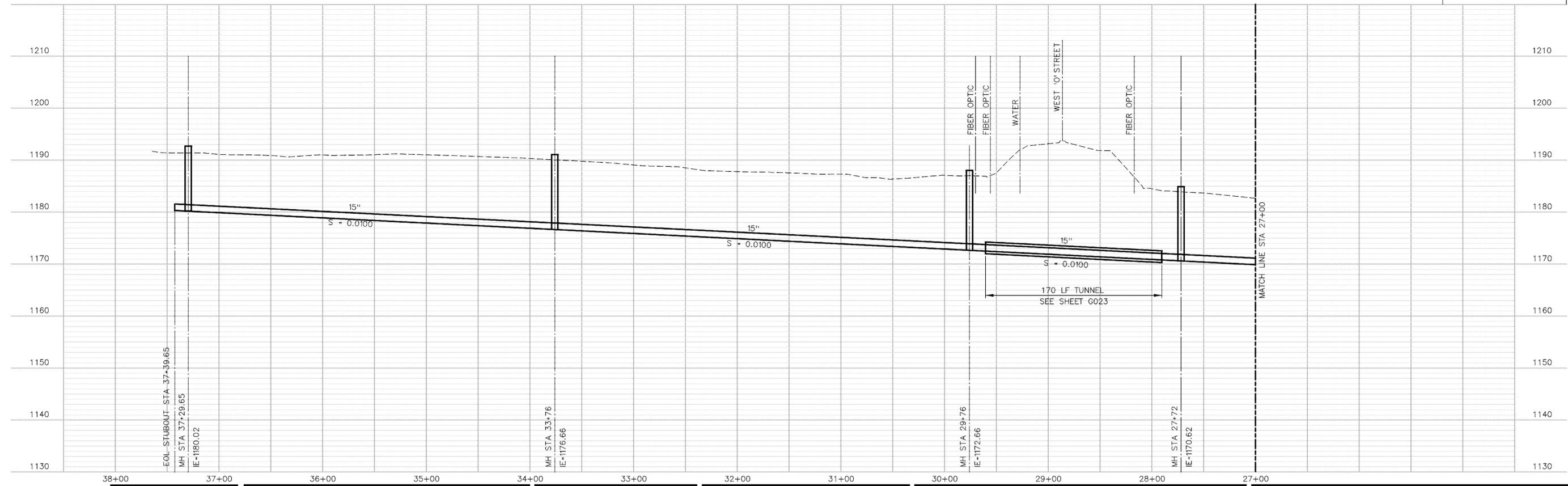
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INTERSTATE 80



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CIVIL	SCOTT AURIT
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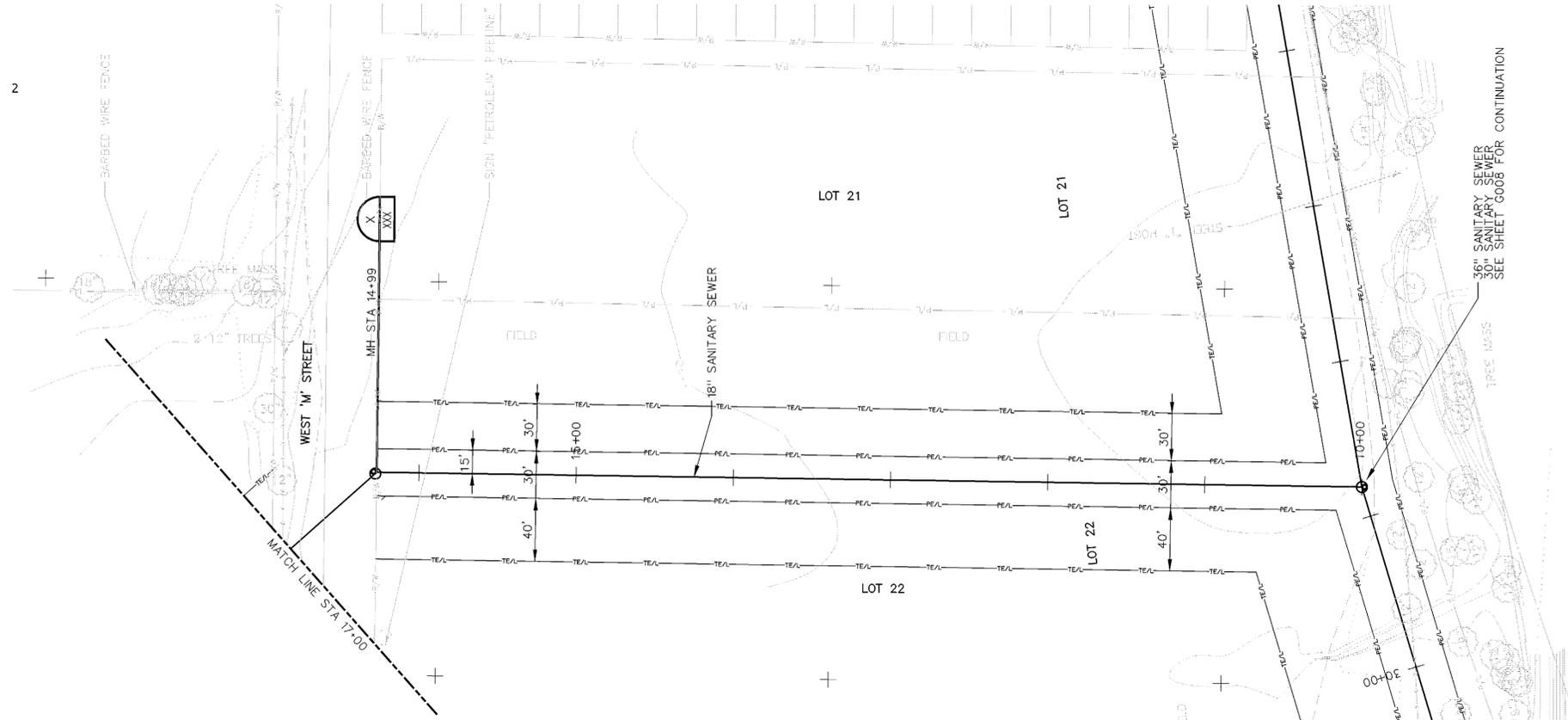
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OR  
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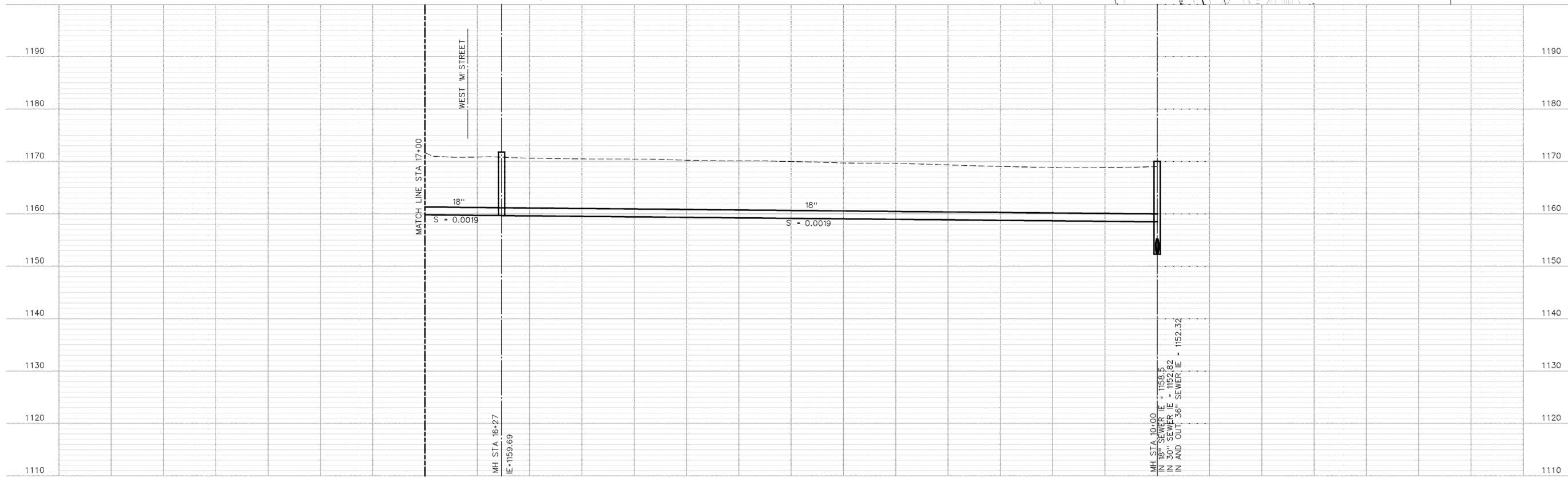
**West 'O' Street  
Trunk Sewer Extension  
Lincoln, Nebraska  
2005**

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CIVIL	SCOTT AURIT
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PROJECT NUMBER	12733

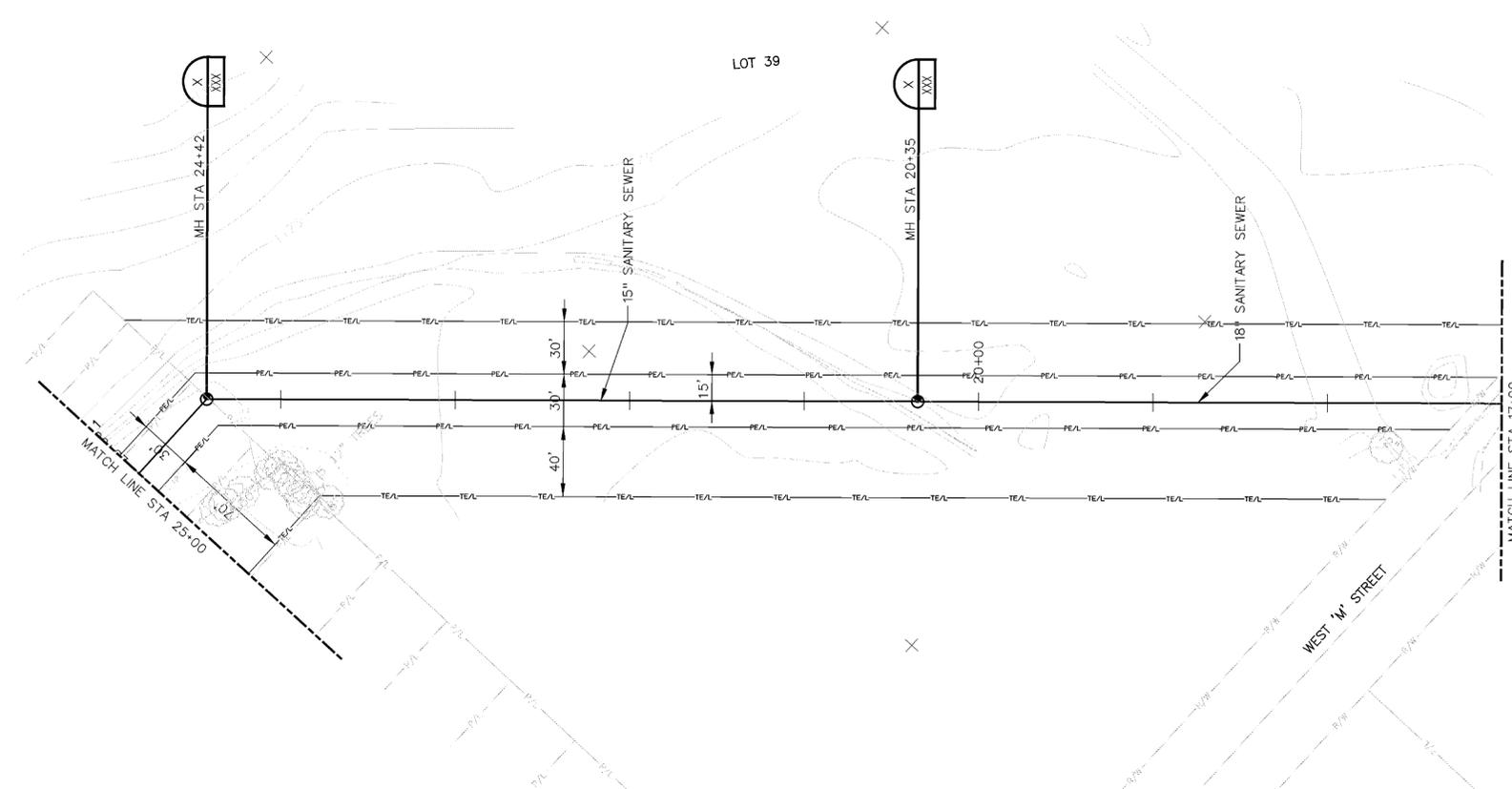
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OR  
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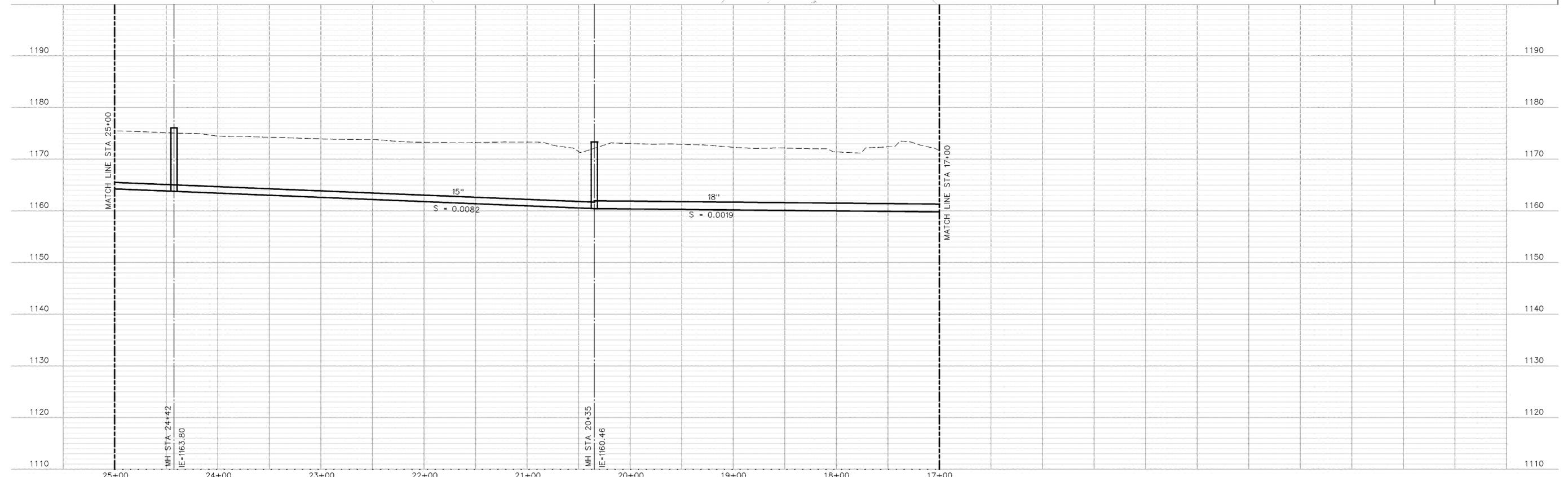
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Trunk Sewer Extension  
Lincoln, Nebraska  
2005**

**SEGMENT 3  
PLAN AND PROFILE  
STA 10+00 TO STA 17+00**

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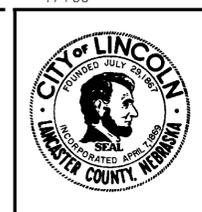
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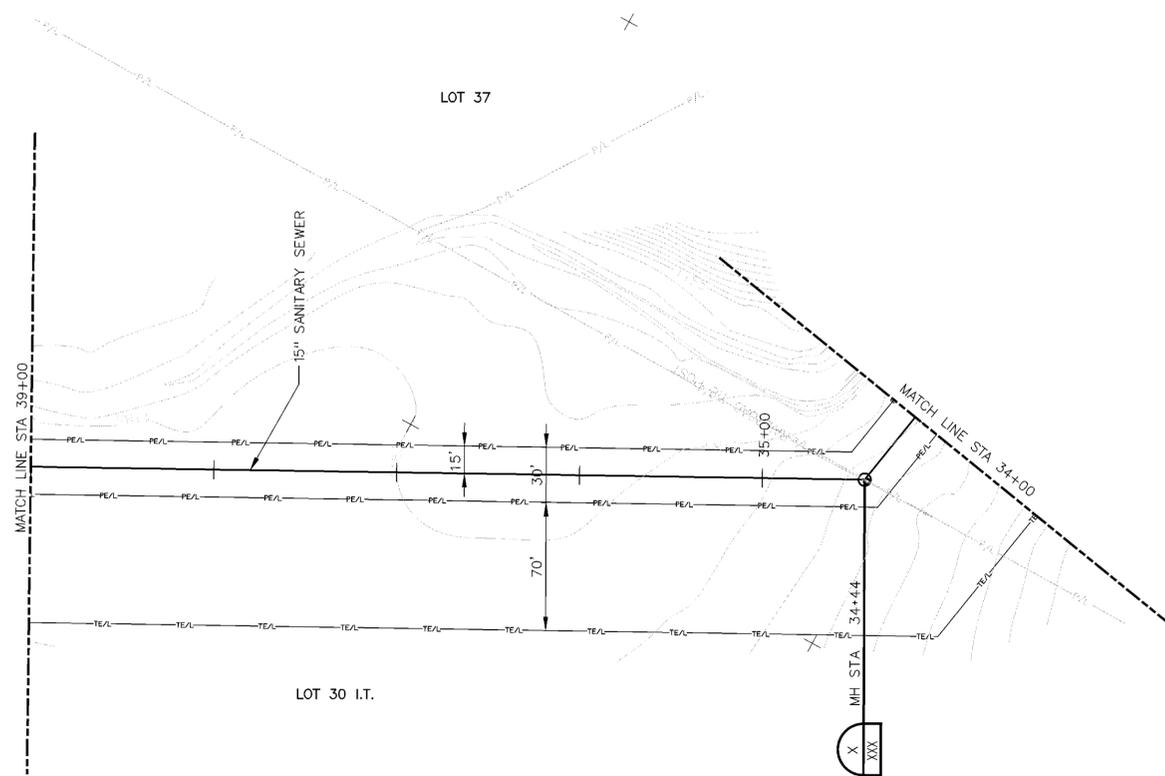
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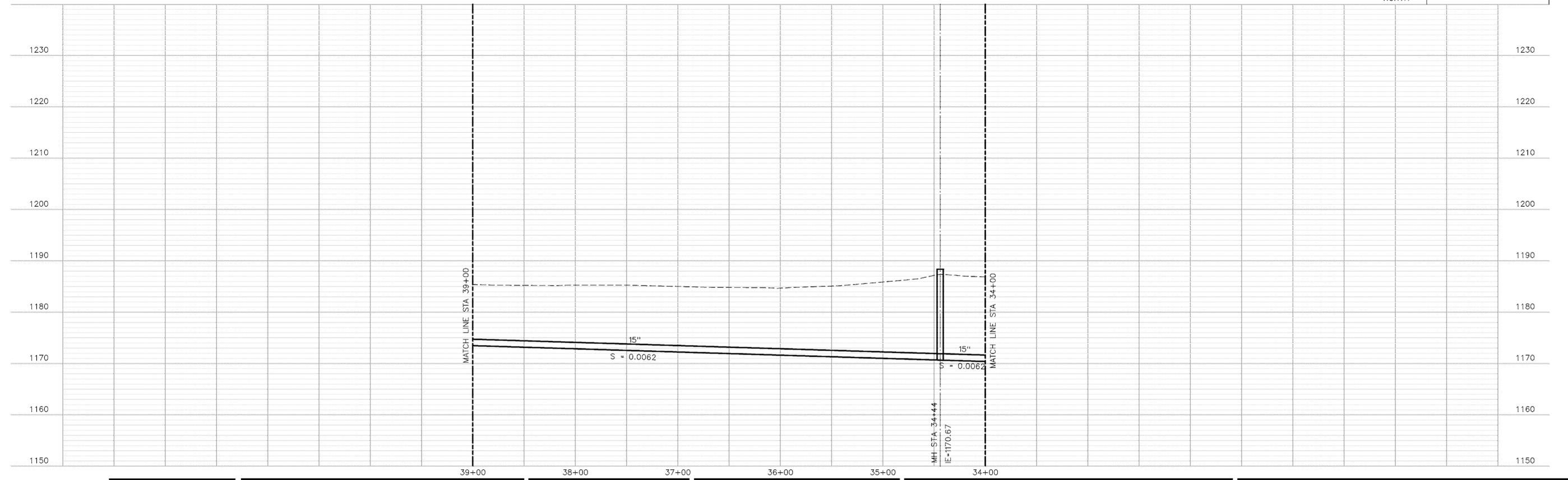
**West 'O' Street  
Trunk Sewer Extension  
Lincoln, Nebraska  
2005**

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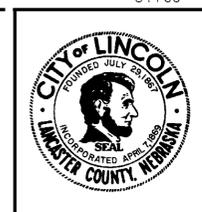
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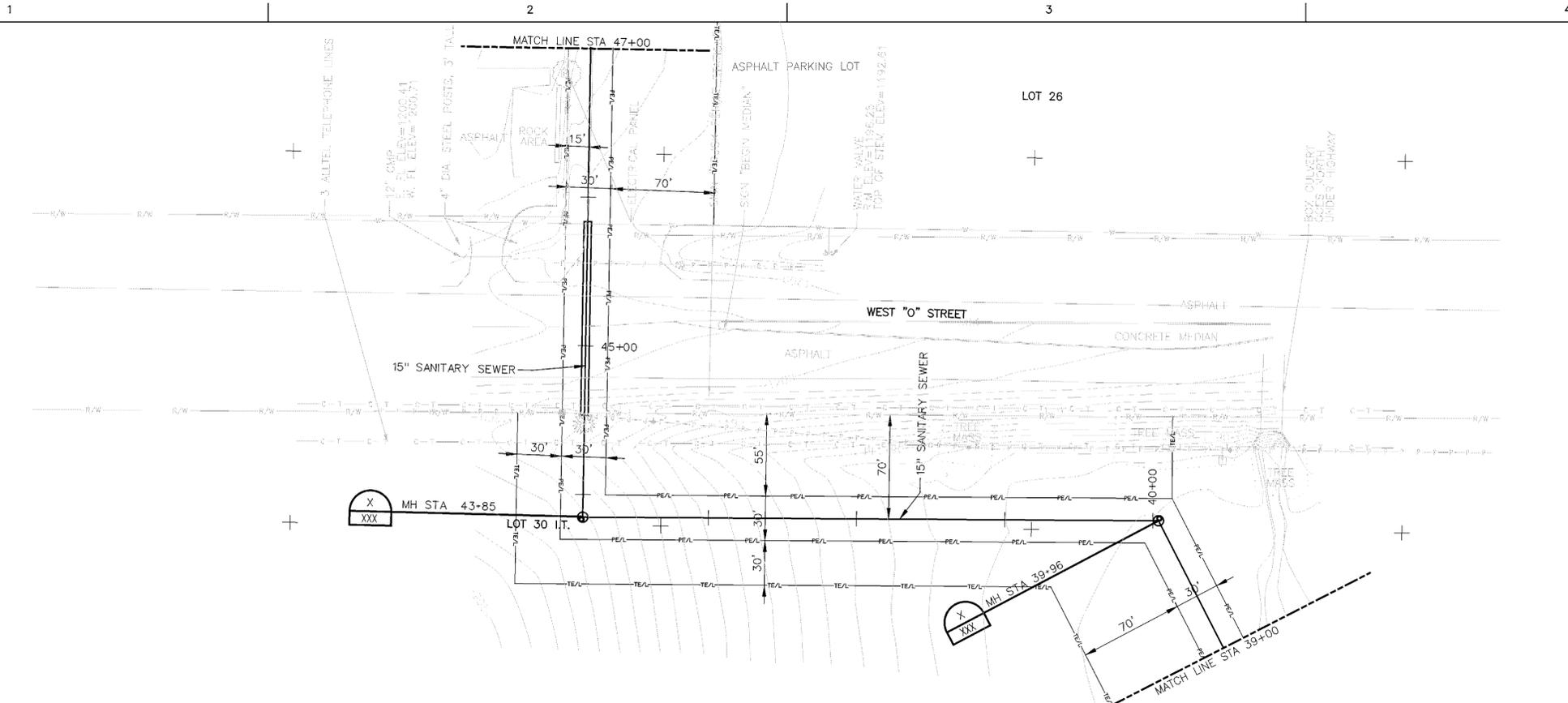
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 CONSTRUCTION  
 OR  
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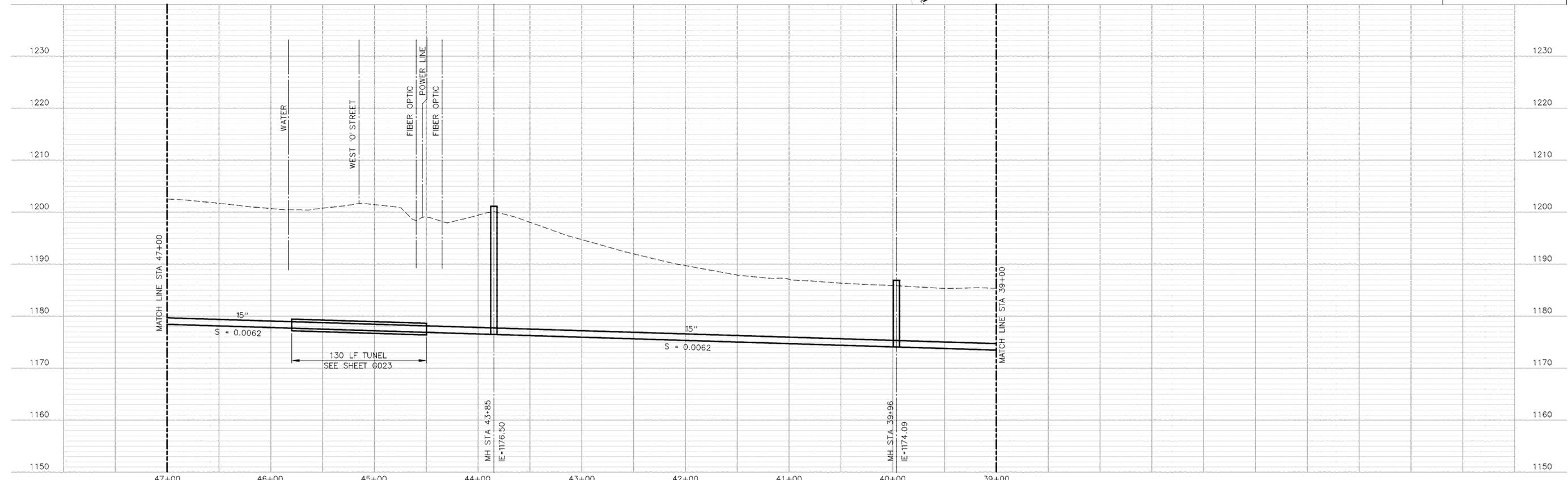
**West 'O' Street  
 Trunk Sewer Extension  
 Lincoln, Nebraska  
 2005**

**SEGMENT 3  
 PLAN AND PROFILE  
 STA 34+00 TO STA 39+00**

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PROJECT MANAGER	KENT PRIOR
CIVIL	SCOTT AURIT
STRUCTURAL	
ARCHITECTURAL	
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INSTRUMENTATION	
PROJECT NUMBER	12733

PRELIMINARY  
 NOT FOR  
 CONSTRUCTION  
 OR  
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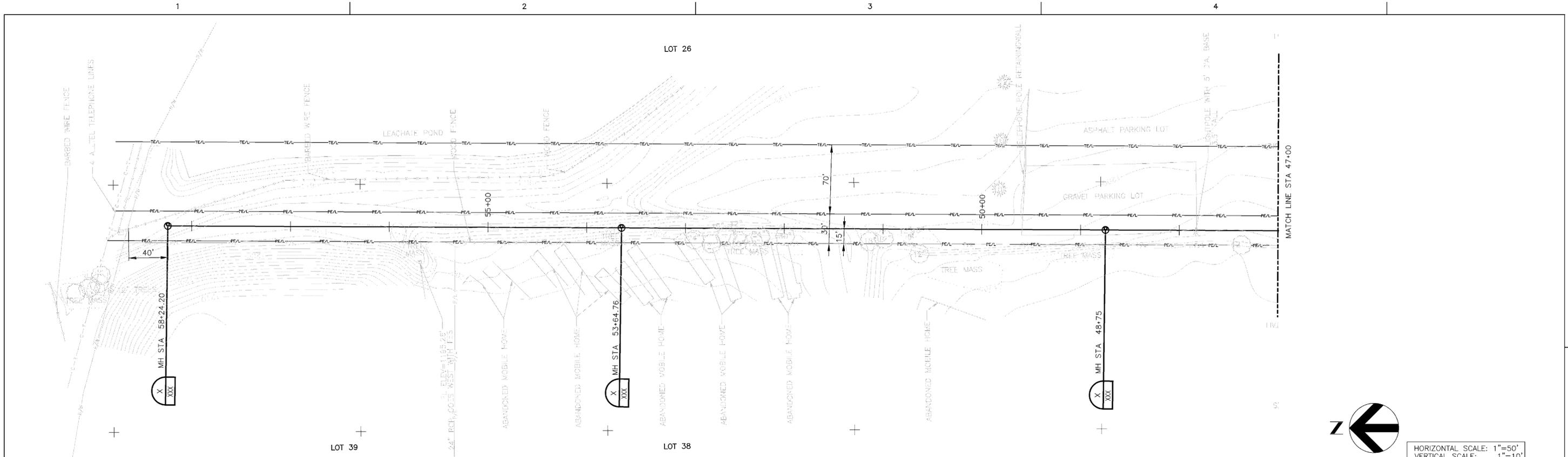


**West 'O' Street  
 Trunk Sewer Extension  
 Lincoln, Nebraska  
 2005**

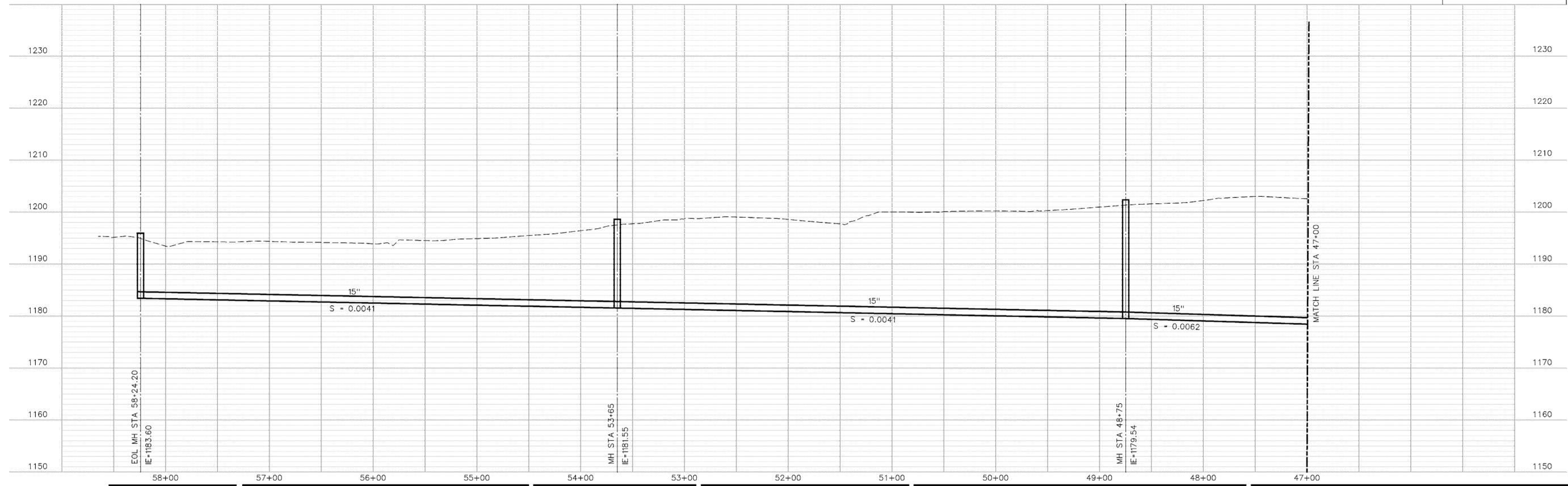
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ISSUE	DATE	DESCRIPTION
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PROJECT MANAGER	KENT PRIOR
CIVIL	SCOTT AURIT
STRUCTURAL	
ARCHITECTURAL	
PROCESS	
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INSTRUMENTATION	
PROJECT NUMBER	12733

PRELIMINARY  
NOT FOR  
CONSTRUCTION  
OR  
RECORDING



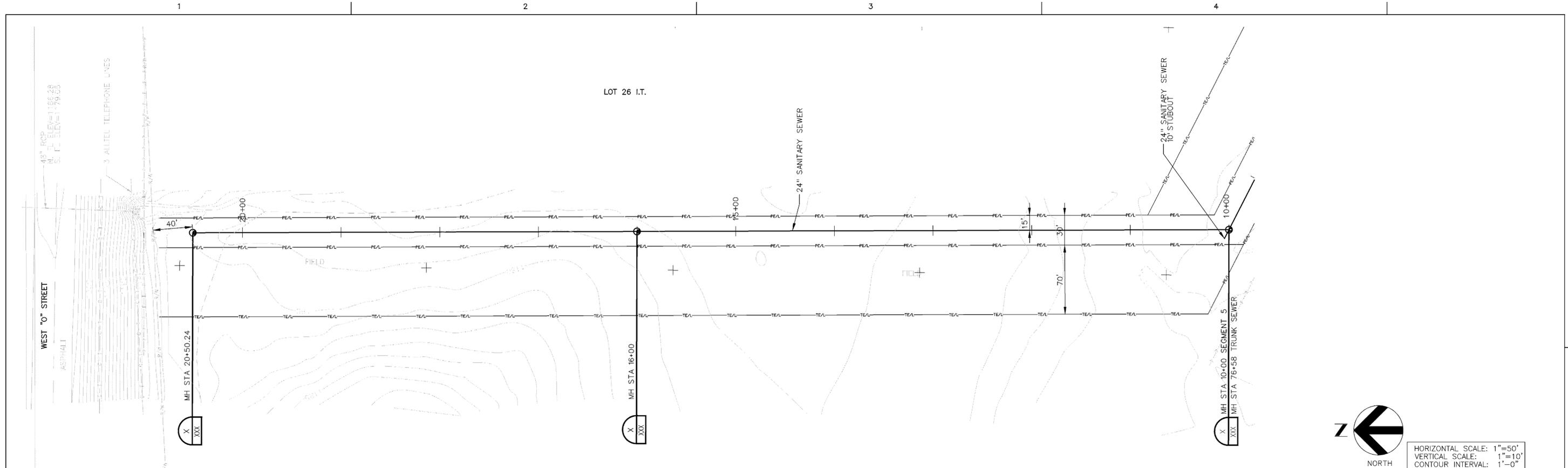
West 'O' Street  
Trunk Sewer Extension  
Lincoln, Nebraska  
2005

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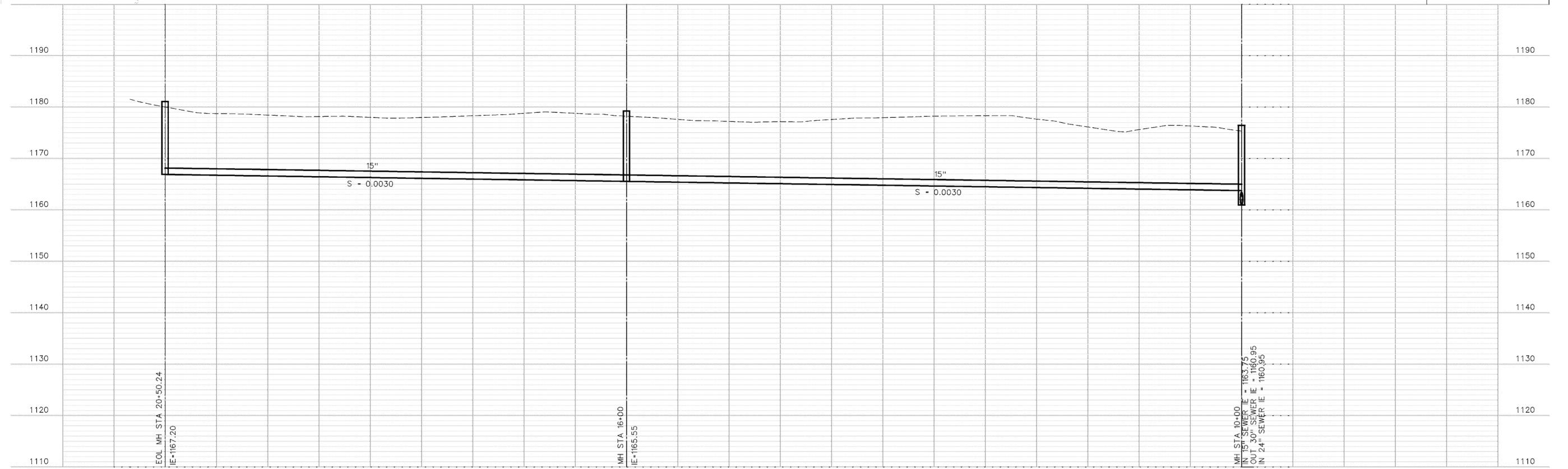
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PROJECT MANAGER	KENT PRIOR
CIVIL	SCOTT AURIT
STRUCTURAL	
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MECHANICAL	
ELECTRICAL	
INSTRUMENTATION	
PROJECT NUMBER	12733

PRELIMINARY  
NOT FOR  
CONSTRUCTION  
OR  
RECORDING



West 'O' Street  
Trunk Sewer Extension  
Lincoln, Nebraska  
2005

**SEGMENT 5  
PLAN AND PROFILE  
STA 10+00 TO STA 20+50.24**

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**APPENDIX “B”**  
**Opinion of Probable Project Cost**

**West "O" Street Trunk Sewer Extension  
 Final Design Memorandum Cost Estimate**

**SUMMARY OF PROJECT COSTS**

**TRUNK SEWER TO SEGMENT 5**

Construction Cost Total	\$1,595,000
Right-of-Way Costs	\$173,000

**SEGMENT 1**

Construction Cost Total	\$414,000
Right-of-Way Costs	\$77,000

**SEGMENT 2**

Construction Cost Total	\$278,000
Right-of-Way Costs	\$20,000

**SEGMENT 3**

Construction Cost Total	\$730,000
Right-of-Way Costs	\$140,000

**SEGMENT 4**

Construction Cost Total	\$225,000
Right-of-Way Costs	\$3,000

**SEGMENT 5**

Construction Cost Total	\$93,000
Right-of-Way Costs	\$24,000

Engineering, Legal, and Administrative Costs (Excludes ROW Costs)	20%	\$667,000
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<b>TOTAL PROJECT COST</b>	<b>\$4,439,000</b>
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**PROJECT COST (TRUNK SEWER TO SEGMENT 5, SEGMENTS 3 & 5)**

Construction Cost Total	\$2,418,000
Engineering, Legal, and Administrative Costs (Excludes ROW Costs)	\$484,000
Right-of-Way Costs	\$337,000

<b>TOTAL PROJECT COST (TRUNK SEWER TO SEGMENT 5, SEGMENTS 3 &amp; 5)</b>	<b>\$3,239,000</b>
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**PROJECT COST (SEGMENT 1)**

Construction Cost Total	\$414,000
Engineering, Legal, and Administrative Costs (Excludes ROW Costs)	\$83,000
Right-of-Way Costs	\$77,000

<b>TOTAL PROJECT COST (SEGMENT 1)</b>	<b>\$574,000</b>
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**PROJECT COST (SEGMENTS 2 & 4)**

Construction Cost Total	\$503,000
Engineering, Legal, and Administrative Costs (Excludes ROW Costs)	\$101,000
Right-of-Way Costs	\$23,000

<b>TOTAL PROJECT COST (SEGMENTS 2 &amp; 4)</b>	<b>\$627,000</b>
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**West "O" Street Trunk Sewer Extension  
 Final Design Memorandum Cost Estimate**

**TRUNK SEWER AND CONNECTIONS TO SUBBASIN SEWERS**

<b>DESCRIPTION</b>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Cost</u>	<u>Total Cost</u>
General Requirements (10%)				\$126,000
36" Sewer Pipe	1,880	LF	\$162	\$305,000
30" Sewer Pipe	4,780	LF	\$135	\$645,000
24" Sewer Pipe	10	LF	\$108	\$1,000
Standard Manhole 4' Dia., 8' Deep or Less	14	EA	\$2,000	\$28,000
Standard and Drop Manhole Additional Depth	112	LF	\$250	\$28,000
5 Foot Average Dewatering Depth for Sewer	6,660	LF	\$25	\$167,000
Seeding	37,000	SY	\$0.40	\$15,000
Clearing	7,000	SY	\$2.00	\$14,000
Regrading	3,000	CY	\$10.00	\$30,000
Gravel Road Replacement	100	SY	\$15.00	\$2,000
48 Inch Casing Pipe for Crossing SW 40th Street	120	LF	\$216.00	\$26,000
<b>Construction Cost Subtotal</b>				<b>\$1,387,000</b>
<b>Contingencies</b>			<b>15%</b>	<b>\$208,000</b>
<b>Construction Cost Total</b>				<b>\$1,595,000</b>
<b>Right-of-Way Costs</b>				
Permanent Easement	266,800	SF	\$0.50	\$133,000
Temporary Construction Easement	400,200	SF	\$0.10	\$40,000
<b>Right-of-Way Cost Subtotal</b>				<b>\$173,000</b>
<b>CONSTRUCTION AND RIGHT-OF-WAY COSTS-TRUNK SEWER</b>				<b>\$1,768,000</b>

**SEGMENT 1-EAST SUBBASIN SEWER TO I-80 R/W**

<b>DESCRIPTION</b>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Cost</u>	<u>Total Cost</u>
General Requirements (10%)				\$33,000
15" Sewer Pipe	2,770	LF	\$60	\$166,000
24 Inch Tunnel West "O" Street near NW 42nd Street	170	LF	\$360	\$61,000
Standard Manhole 4' Dia., 8' Deep or Less	7	EA	\$2,000	\$14,000
Standard and Drop Manhole Additional Depth	42	LF	\$250	\$11,000
5 Foot Average Dewatering Depth for Sewer	2,770	LF	\$25	\$69,000
Seeding	14,000	SY	\$0.40	\$6,000
<b>Construction Cost Subtotal</b>				<b>\$360,000</b>
<b>Contingencies</b>			<b>15%</b>	<b>\$54,000</b>
<b>Construction Cost Total</b>				<b>\$414,000</b>
<b>Right-of-Way Costs</b>				
Permanent Easement	78,000	SF	\$0.75	\$59,000
Temporary Construction Easement	182,000	SF	\$0.10	\$18,000
<b>Right-of-Way Cost Subtotal</b>				<b>\$77,000</b>
<b>CONSTRUCTION AND RIGHT-OF-WAY COSTS-SEGMENT 1</b>				<b>\$491,000</b>

**West "O" Street Trunk Sewer Extension  
 Final Design Memorandum Cost Estimate**

**SEGMENT 2-EAST SUBBASIN SEWER UNDERCROSSING AND PROCEEDING NORTH OF INTERSTATE 80**

<b>DESCRIPTION</b>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Cost</u>	<u>Total Cost</u>
General Requirements (10%)				\$22,000
15" Sewer Pipe	400	LF	\$60	\$24,000
12" Sewer Pipe	900	LF	\$48	\$43,000
24 Inch Tunnel Interstate 80 near NW 42th Street	400	LF	\$360	\$144,000
Standard Manhole 4' Dia., 8' Deep or Less	2	EA	\$2,000	\$4,000
Standard and Drop Manhole Additional Depth	12	LF	\$250	\$3,000
Seeding	5,000	SY	\$0.40	\$2,000
<b>Construction Cost Subtotal</b>				<b>\$242,000</b>
<b>Contingencies</b>			<b>15%</b>	<b>\$36,000</b>
<b>Construction Cost Total</b>				<b>\$278,000</b>
<b>Right-of-Way Costs</b>				
Permanent Easement	27,000	SF	\$0.50	\$14,000
Temporary Construction Easement	63,000	SF	\$0.10	\$6,000
<b>Right-of-Way Cost Subtotal</b>				<b>\$20,000</b>

**CONSTRUCTION AND RIGHT-OF-WAY COSTS-SEGMENT 2** **\$298,000**

**SEGMENT 3-MIDDLE SUBBASIN SEWER FROM TRUNK SEWER ACROSS "O" STREET**

<b>DESCRIPTION</b>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Cost</u>	<u>Total Cost</u>
General Requirements (10%)				\$57,000
15" Sewer Pipe	3,830	LF	\$60	\$230,000
18" Sewer Pipe	1,040	LF	\$72	\$75,000
24 Inch Tunnel West "O" Street near NW 52nd Street	130	LF	\$360	\$47,000
Standard Manhole 4' Dia., 8' Deep or Less	10	EA	\$2,000	\$20,000
Standard and Drop Manhole Additional Depth	60	LF	\$250	\$15,000
3 Foot Average Dewatering Depth for Sewer	4,870	LF	\$15	\$73,000
Replace Asphalt Pavement	2,200	SY	\$45	\$99,000
Seeding	24,000	SY	\$0.40	\$10,000
<b>Construction Cost Subtotal</b>				<b>\$626,000</b>
<b>Contingencies</b>			<b>15%</b>	<b>\$94,000</b>
<b>Construction Cost Total</b>				<b>\$730,000</b>
<b>Right-of-Way Costs</b>				
Permanent Easement	142,200	SF	\$0.75	\$107,000
Temporary Construction Easement	331,800	SF	\$0.10	\$33,000
<b>Right-of-Way Cost Subtotal</b>				<b>\$140,000</b>

**CONSTRUCTION AND RIGHT-OF-WAY COSTS-SEGMENT 3** **\$870,000**

**West "O" Street Trunk Sewer Extension  
 Final Design Memorandum Cost Estimate**

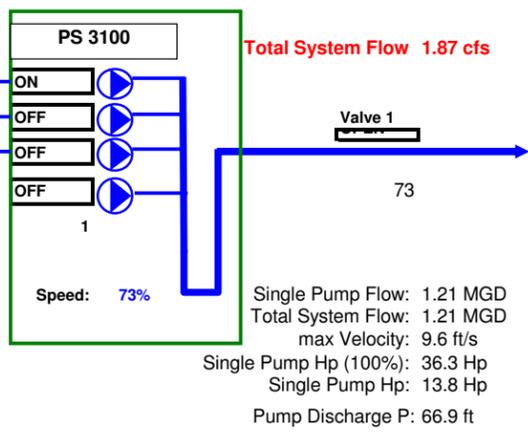
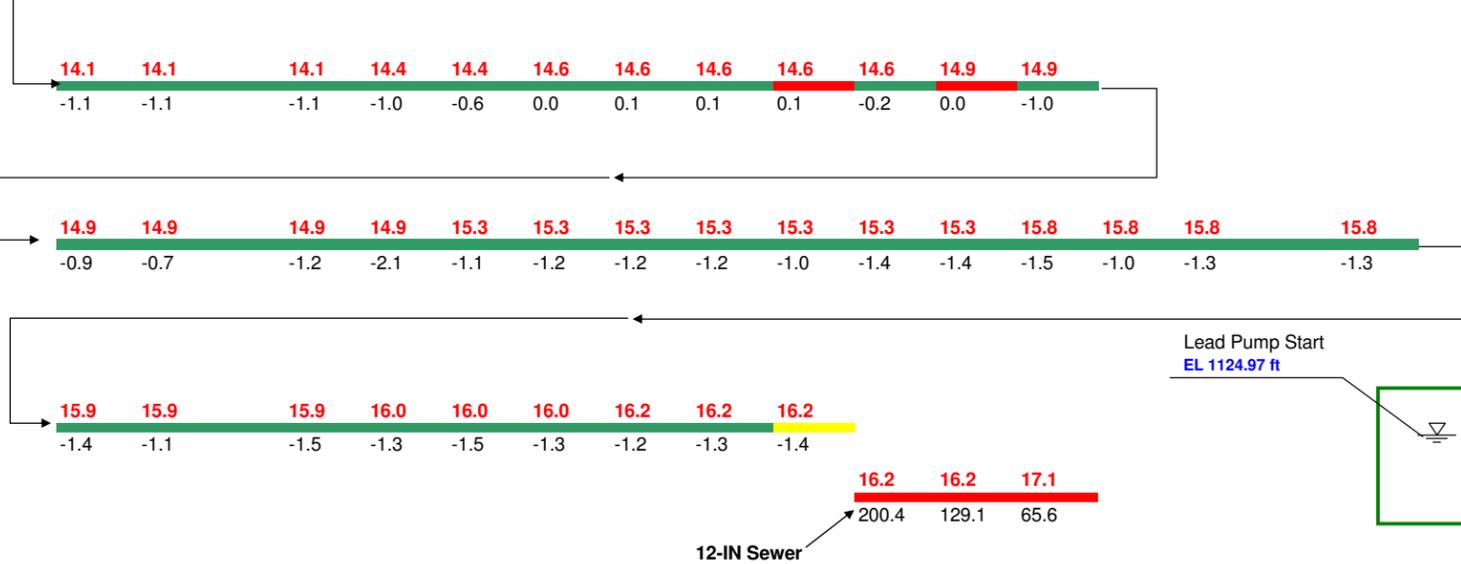
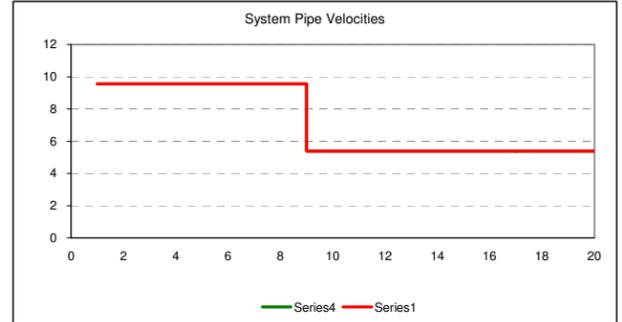
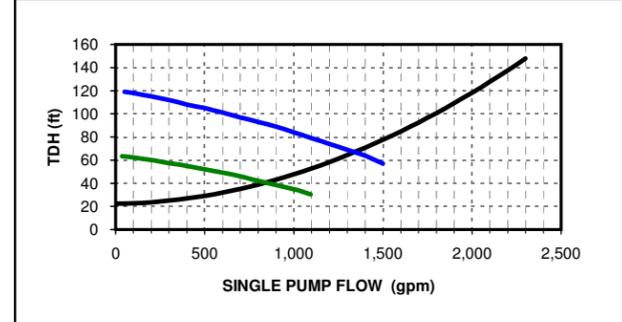
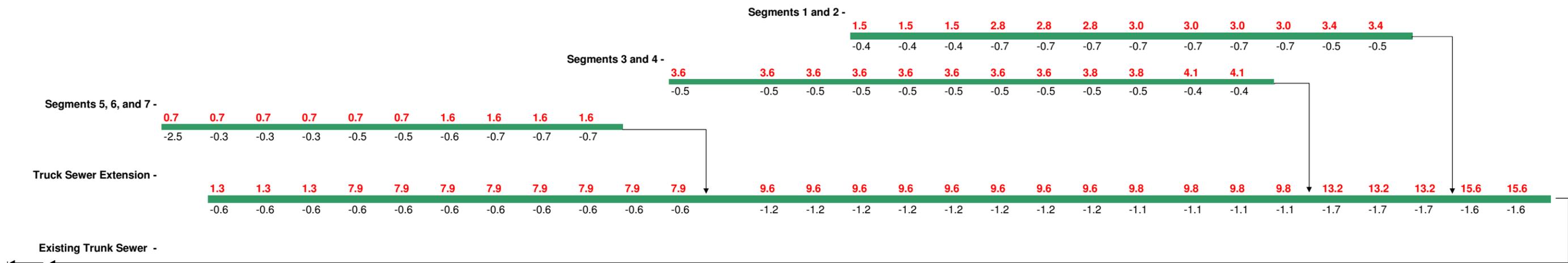
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<b>DESCRIPTION</b>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Cost</u>	<u>Total Cost</u>
General Requirements (10%)				\$18,000
15" Sewer Pipe	500	LF	\$60	\$30,000
24 Inch Tunnel Interstate 80 near NW 44th Street	400	LF	\$360	\$144,000
Standard Manhole 4' Dia., 8' Deep or Less	1	EA	\$2,000	\$2,000
Standard and Drop Manhole Additional Depth	6	LF	\$250	\$2,000
Seeding	1,000	SY	\$0.40	\$0
<b>Construction Cost Subtotal</b>				<b>\$196,000</b>
<b>Contingencies</b>			<b>15%</b>	<b>\$29,000</b>
<b>Construction Cost Total</b>				<b>\$225,000</b>
<b>Right-of-Way Costs</b>				
Permanent Easement	3,000	SF	\$0.50	\$2,000
Temporary Construction Easement	7,000	SF	\$0.10	\$1,000
<b>Right-of-Way Cost Subtotal</b>				<b>\$3,000</b>
<b>CONSTRUCTION AND RIGHT-OF-WAY COSTS-SEGMENT 4</b>				<b>\$228,000</b>

**SEGMENT 5-WEST SUBBASIN SEWER FROM TRUNK SEWER TO SOUTH OF "O" STREET**

<b>DESCRIPTION</b>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Cost</u>	<u>Total Cost</u>
General Requirements (10%)				\$7,000
15" Sewer Pipe	1,080	LF	\$60	\$65,000
Standard Manhole 4' Dia., 8' Deep or Less	2	EA	\$2,000	\$4,000
Standard and Drop Manhole Additional Depth	13	LF	\$250	\$3,000
Seeding	6,000	SY	\$0.40	\$2,000
<b>Construction Cost Subtotal</b>				<b>\$81,000</b>
<b>Contingencies</b>			<b>15%</b>	<b>\$12,000</b>
<b>Construction Cost Total</b>				<b>\$93,000</b>
<b>Right-of-Way Costs</b>				
Permanent Easement	32,400	SF	\$0.50	\$16,000
Temporary Construction Easement	75,600	SF	\$0.10	\$8,000
<b>Right-of-Way Cost Subtotal</b>				<b>\$24,000</b>
<b>CONSTRUCTION AND RIGHT-OF-WAY COSTS-SEGMENT 5</b>				<b>\$117,000</b>

**APPENDIX “C”  
Modeling Graphics**



**KEY**

23.1	Flow, cfs
-1.1	Submergence, FT (Positive number indicates depth of water over top of pipe)

**LEGEND**

	Submerged Due to Flow Condition
	Submerged Due to Outlet Condition
	Gravity Flow



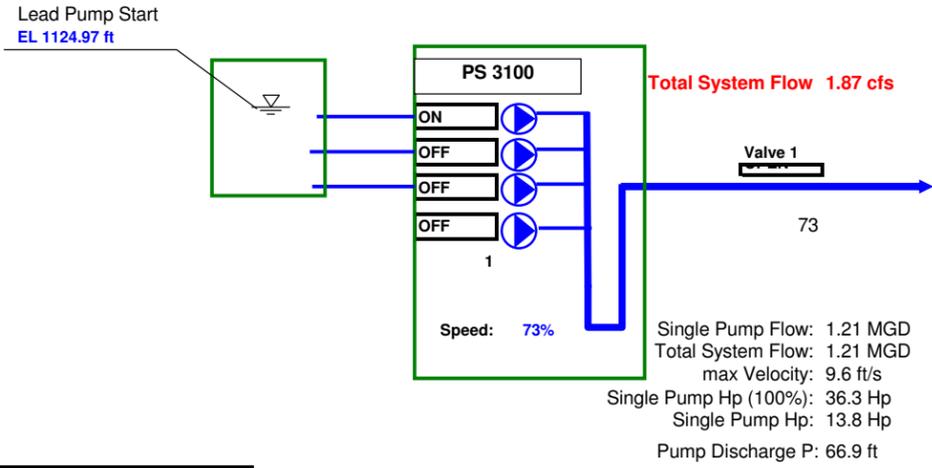
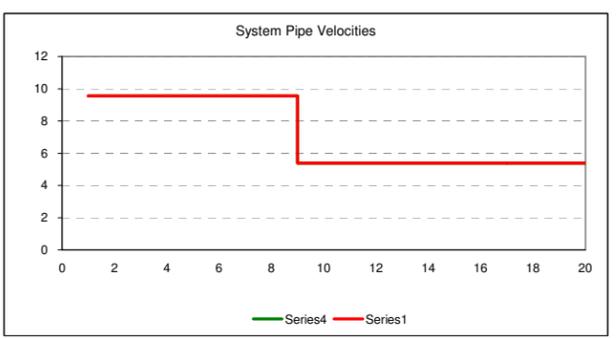
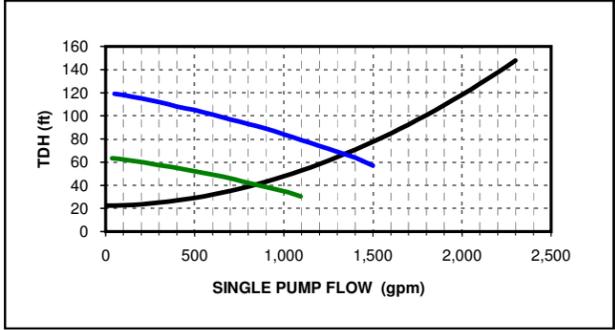
**HYDRAULIC MODELING RESULTS - No Submergence**  
**WEST "O" ST. SEWER IMPROVEMENTS**  
**LINCOLN WASTEWATER SYSTEM**

Date  
10/21/2004

Fig.  
1 - 1

Total System Flow 1.87 cfs

Single Pump Flow: 1.21 MGD  
 Total System Flow: 1.21 MGD  
 max Velocity: 9.6 ft/s  
 Single Pump Hp (100%): 36.3 Hp  
 Single Pump Hp: 13.8 Hp  
 Pump Discharge P: 66.9 ft



**KEY**

23.1	← Flow, cfs
-1.1	← Submergence, FT (Positive number indicates depth of water over top of pipe)

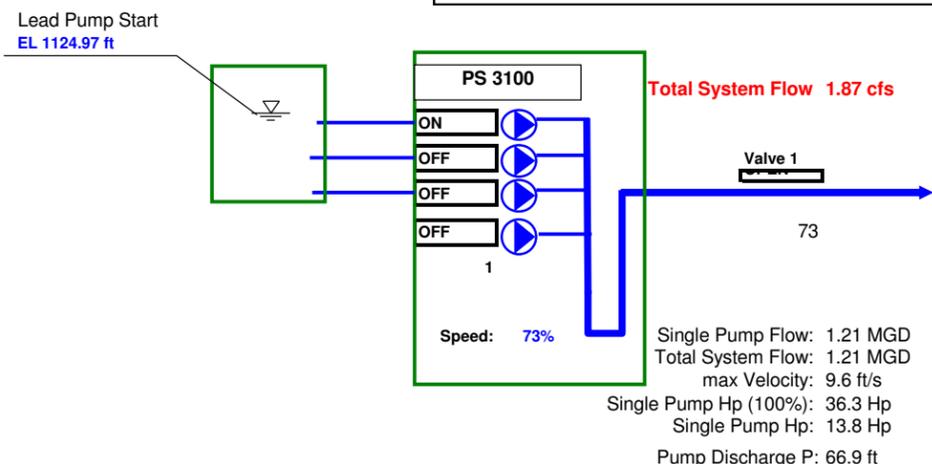
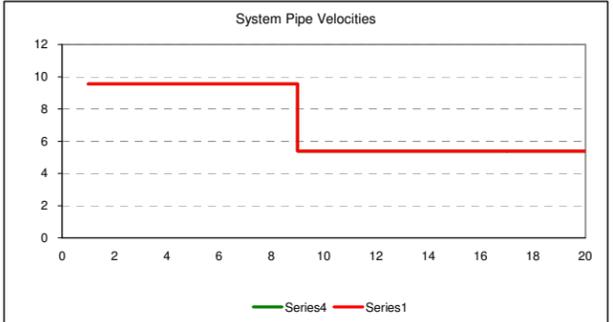
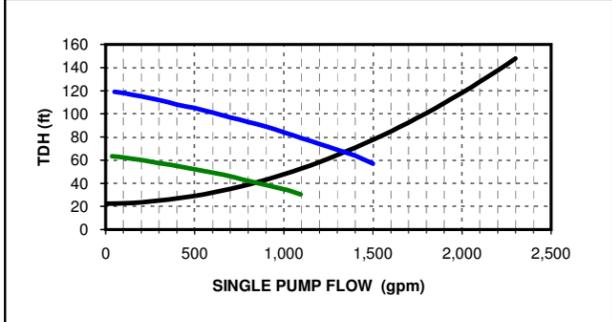
**LEGEND**

<span style="background-color: red; width: 20px; height: 10px; display: inline-block;"></span>	Submerged Due to Flow Condition
<span style="background-color: yellow; width: 20px; height: 10px; display: inline-block;"></span>	Submerged Due to Outlet Condition
<span style="background-color: green; width: 20px; height: 10px; display: inline-block;"></span>	Gravity Flow



**HYDRAULIC MODELING RESULTS - 1-FT Submergence**  
**WEST "O" ST. SEWER IMPROVEMENTS**  
**LINCOLN WASTEWATER SYSTEM**

Date: 10/21/2004  
 Fig.: 1 - 2



**KEY**

23.1	← Flow, cfs
-1.1	← Submergence, FT (Positive number indicates depth of water over top of pipe)

**LEGEND**

<span style="background-color: red; width: 20px; height: 10px; display: inline-block;"></span>	Submerged Due to Flow Condition
<span style="background-color: yellow; width: 20px; height: 10px; display: inline-block;"></span>	Submerged Due to Outlet Condition
<span style="background-color: green; width: 20px; height: 10px; display: inline-block;"></span>	Gravity Flow



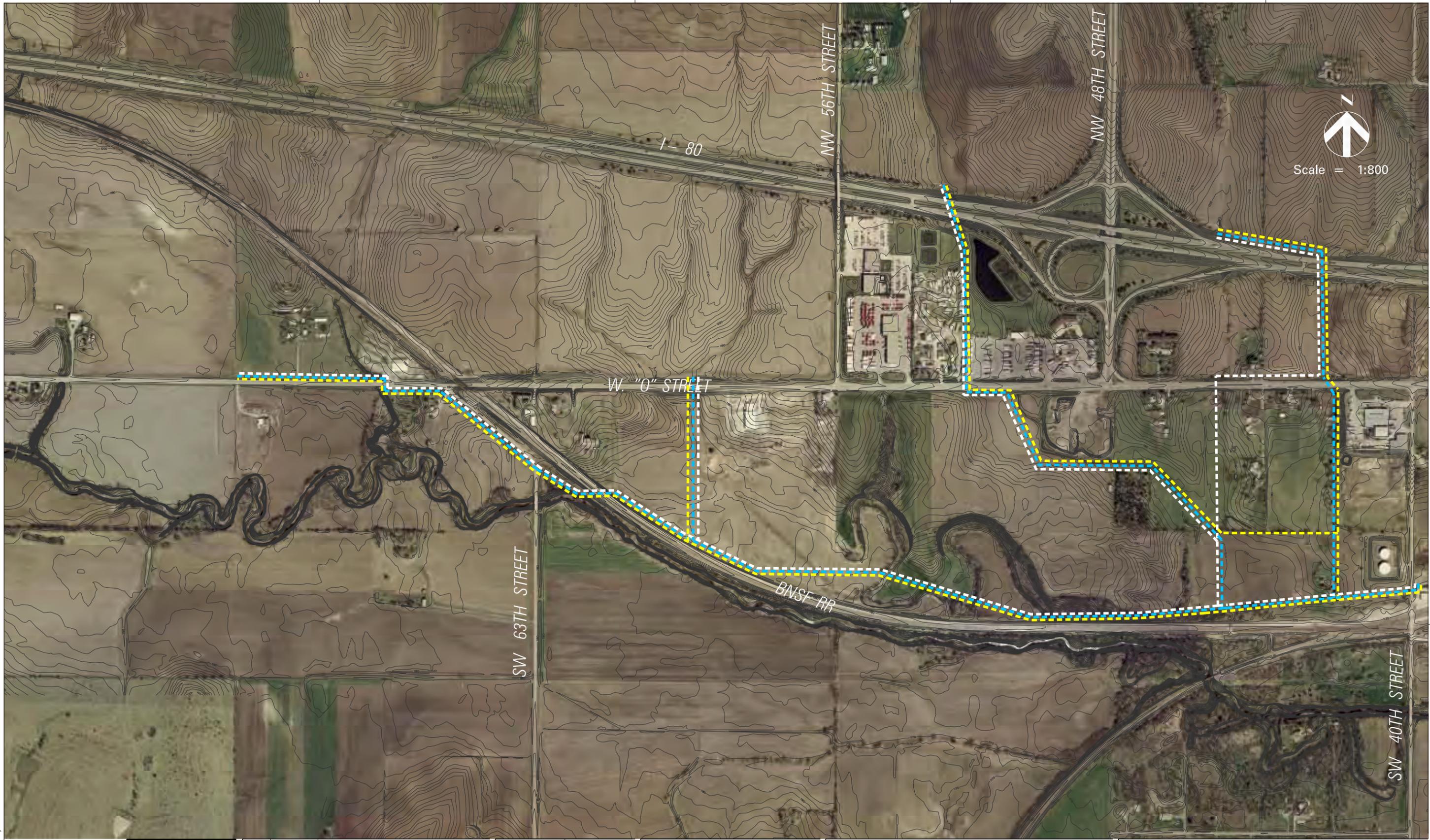
**HYDRAULIC MODELING RESULTS - 2-FT Submergence**  
**WEST "O" ST. SEWER IMPROVEMENTS**  
**LINCOLN WASTEWATER SYSTEM**

Date  
10/21/2004

Fig.  
1 - 3

**APPENDIX “D”**  
**Alignment Study Figures and Cost Estimate**

C:\WINDM\LINCOLN\O\_STTRUNK\_SEWER\FIGURE3A1.DGN  
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ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	
CIVIL	
STRUCTURAL	
ARCHITECTURAL	
PROCESS	
MECHANICAL	
ELECTRICAL	
INSTRUMENTATION	
PROJECT NUMBER	



**West "O" Street  
Trunk Sewer  
Extension Project  
Lincoln Wastewater System**



ALIGNMENT NO. 1	
ALIGNMENT NO. 2	
ALIGNMENT NO. 3	
FILENAME	FIGURE3A1.DGN
SCALE	

SHEET	
-------	--

**West "O" Street Trunk Sewer Extension  
 Alignment No. 1**

**SUMMARY OF PROJECT COSTS FOR ALIGNMENT NO 1**

<b>SEGMENT 1</b>		
Construction Cost Total		\$268,000
Right-of-Way Costs		\$36,000
<b>SEGMENT 2</b>		
Construction Cost Total		\$662,000
Right-of-Way Costs		\$135,000
<b>SEGMENT 3</b>		
Construction Cost Total		\$211,000
Right-of-Way Costs		\$42,000
<b>SEGMENT 4</b>		
Construction Cost Total		\$338,000
Right-of-Way Costs		\$26,000
<b>SEGMENT 5</b>		
Construction Cost Total		\$411,000
Right-of-Way Costs		\$56,000
Engineering, Legal, and Administrative Costs (Excludes ROW Costs)	20%	\$378,000
<b>TOTAL PROJECT COST - ALIGNMENT 1</b>		<b>\$2,563,000</b>

**SEGMENT 1-TRUNK SEWER AND CONNECTION TO SUBBASIN SEWERS**

<b>DESCRIPTION</b>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Cost</u>	<u>Total Cost</u>
General Requirements (10%)				\$21,200
36" Sewer Pipe	800	LF	\$162	\$130,000
18" Sewer Pipe	600	LF	\$81	\$49,000
Standard Manhole 4' Dia., 8' Deep or Less	3	EA	\$2,000	\$6,000
Standard and Drop Manhole Additional Depth	17	LF	\$250	\$4,000
6 Foot Average Dewatering Depth for Trunk Sewer	800	LF	\$25	\$20,000
Seeding	8,000	SY	\$0.40	\$3,000
<b>Construction Cost Subtotal</b>				<b>\$233,200</b>
<b>Contingencies</b>			<b>15%</b>	<b>\$34,980</b>
<b>Construction Cost Total</b>				<b>\$268,000</b>
<b>Right-of-Way Costs</b>				
Permanent Easement	56,000	SF	\$0.50	\$28,000
Temporary Construction Easement	84,000	SF	\$0.10	\$8,000
<b>CONSTRUCTION AND RIGHT-OF-WAY COSTS-SEGMENT 1</b>				<b>\$304,000</b>

**West "O" Street Trunk Sewer Extension  
 Alignment No. 1**

**SEGMENT 2-WEST SUBBASIN SEWER TO NORTH OF "O" STREET**

<b>DESCRIPTION</b>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Cost</u>	<u>Total Cost</u>
General Requirements (10%)				\$52,300
15" Sewer Pipe	4,700	LF	\$68	\$317,000
33 Inch Tunnel West "O" Street near NW 52nd Street	120	LF	\$495	\$59,000
Standard Manhole 4' Dia., 8' Deep or Less	10	EA	\$2,000	\$20,000
Standard and Drop Manhole Additional Depth	60	LF	\$250	\$15,000
Replace Asphalt Pavement	2,300	SY	\$45	\$104,000
Seeding	21,000	SY	\$0.40	\$8,000
<b>Construction Cost Subtotal</b>				<b>\$575,300</b>
<b>Contingencies</b>			<b>15%</b>	<b>\$86,295</b>
<b>Construction Cost Total</b>				<b>\$662,000</b>
<b>Right-of-Way Costs</b>				
Permanent Easement	137,400	SF	\$0.75	\$103,000
Temporary Construction Easement	320,600	SF	\$0.10	\$32,000
<b>CONSTRUCTION AND RIGHT-OF-WAY COSTS-SEGMENT 2</b>				<b>\$797,000</b>

**SEGMENT 3-EAST SUBBASIN SEWER TO NORTH OF "O" STREET**

<b>DESCRIPTION</b>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Cost</u>	<u>Total Cost</u>
General Requirements (10%)				\$16,700
15" Sewer Pipe	1,400	LF	\$68	\$95,000
33 Inch Tunnel West "O" Street near NW 44th Street	120	LF	\$495	\$59,000
Standard Manhole 4' Dia., 8' Deep or Less	3	EA	\$2,000	\$6,000
Standard and Drop Manhole Additional Depth	17	LF	\$250	\$4,000
Seeding	8,000	SY	\$0.40	\$3,000
<b>Construction Cost Subtotal</b>				<b>\$183,700</b>
<b>Contingencies</b>			<b>15%</b>	<b>\$27,555</b>
<b>Construction Cost Total</b>				<b>\$211,000</b>
<b>Right-of-Way Costs</b>				
Permanent Easement	42,000	SF	\$0.75	\$32,000
Temporary Construction Easement	98,000	SF	\$0.10	\$10,000
<b>CONSTRUCTION AND RIGHT-OF-WAY COSTS-SEGMENT 3</b>				<b>\$253,000</b>

**West "O" Street Trunk Sewer Extension  
 Alignment No. 1**

**SEGMENT 4-WEST SUBBASIN SEWER FROM "O" STREET TO NORTH OF I-80**

<b>DESCRIPTION</b>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Cost</u>	<u>Total Cost</u>
General Requirements (10%)				\$26,720
15" Sewer Pipe	900	LF	\$68	\$61,000
33 Inch Tunnel Interstate 80 near NW 52nd Street	400	LF	\$495	\$198,000
Standard Manhole 4' Dia., 8' Deep or Less	2	EA	\$2,000	\$4,000
Standard and Drop Manhole Additional Depth	11	LF	\$250	\$3,000
Seeding	3,000	SY	\$0.40	\$1,200
<b>Construction Cost Subtotal</b>				<b>\$293,920</b>
<b>Contingencies</b>			<b>15%</b>	<b>\$44,088</b>
<b>Construction Cost Total</b>				<b>\$338,000</b>
<b>Right-of-Way Costs</b>				
Permanent Easement	27,000	SF	\$0.75	\$20,000
Temporary Construction Easement	63,000	SF	\$0.10	\$6,000
<b>CONSTRUCTION AND RIGHT-OF-WAY COSTS-SEGMENT 4</b>				<b>\$364,000</b>

**SEGMENT 5-EAST SUBBASIN SEWER FROM "O" STREET TO NORTH OF I-80**

<b>DESCRIPTION</b>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Cost</u>	<u>Total Cost</u>
General Requirements (10%)				\$32,500
15" Sewer Pipe	1,000	LF	\$68	\$68,000
12" Sewer Pipe	900	LF	\$54	\$49,000
33 Inch Tunnel Interstate 80 near NW 44th Street	400	LF	\$495	\$198,000
Standard Manhole 4' Dia., 8' Deep or Less	2	EA	\$2,000	\$4,000
Standard and Drop Manhole Additional Depth	11	LF	\$250	\$3,000
Seeding	8,000	SY	\$0.40	\$3,000
<b>Construction Cost Subtotal</b>				<b>\$357,500</b>
<b>Contingencies</b>			<b>15%</b>	<b>\$53,625</b>
<b>Construction Cost Total</b>				<b>\$411,000</b>
<b>Right-of-Way Costs</b>				
Permanent Easement	57,000	SF	\$0.75	\$43,000
Temporary Construction Easement	133,000	SF	\$0.10	\$13,000
<b>CONSTRUCTION AND RIGHT-OF-WAY COSTS-SEGMENT 5</b>				<b>\$467,000</b>

**West "O" Street Trunk Sewer Extension  
 Alignment No. 2**

**SUMMARY OF PROJECT COSTS FOR ALIGNMENT NO 2**

<b>SEGMENT 1</b>		
Construction Cost Total		\$516,000
Right-of-Way Costs		\$62,000
<b>SEGMENT 2</b>		
Construction Cost Total		\$601,000
Right-of-Way Costs		\$114,000
<b>SEGMENT 3</b>		
Construction Cost Total		\$307,000
Right-of-Way Costs		\$67,000
<b>SEGMENT 4</b>		
Construction Cost Total		\$338,000
Right-of-Way Costs		\$15,000
<b>SEGMENT 5</b>		
Construction Cost Total		\$411,000
Right-of-Way Costs		\$45,000
 Engineering, Legal, and Administrative Costs (Excludes ROW Costs)	 20%	 \$434,600
<b>TOTAL PROJECT COST - ALIGNMENT 2</b>		<b>\$2,910,600</b>

**SEGMENT 1-TRUNK SEWER AND CONNECTION TO SUBBASIN SEWERS**

<b>DESCRIPTION</b>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Cost</u>	<u>Total Cost</u>
General Requirements (10%)				\$40,800
36" Sewer Pipe	1,800	LF	\$162	\$292,000
18" Sewer Pipe	600	LF	\$81	\$49,000
Standard Manhole 4' Dia., 8' Deep or Less	5	EA	\$2,000	\$10,000
Standard and Drop Manhole Additional Depth	29	LF	\$250	\$7,000
6 Foot Average Dewatering Depth for Trunk Sewer	1,800	LF	\$25	\$45,000
Seeding	13,000	SY	\$0.40	\$5,000
<b>Construction Cost Subtotal</b>				<b>\$448,800</b>
 <b>Contingencies</b>			 15%	 <b>\$67,320</b>
 <b>Construction Cost Total</b>				 <b>\$516,000</b>
 <b>Right-of-Way Costs</b>				
Permanent Easement	96,000	SF	\$0.50	\$48,000
Temporary Construction Easement	144,000	SF	\$0.10	\$14,000
 <b>CONSTRUCTION AND RIGHT-OF-WAY COSTS-SEGMENT 1</b>				 <b>\$578,000</b>

**West "O" Street Trunk Sewer Extension  
 Alignment No. 2**

**SEGMENT 2-WEST SUBBASIN SEWER TO NORTH OF "O" STREET**

<b>DESCRIPTION</b>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Cost</u>	<u>Total Cost</u>
General Requirements (10%)				\$47,500
15" Sewer Pipe	4,000	LF	\$68	\$270,000
33 Inch Tunnel West "O" Street near NW 52nd Street	120	LF	\$495	\$59,000
Standard Manhole 4' Dia., 8' Deep or Less	10	EA	\$2,000	\$20,000
Standard and Drop Manhole Additional Depth	60	LF	\$250	\$15,000
Replace Asphalt Pavement	2,300	SY	\$45	\$104,000
Seeding	17,000	SY	\$0.40	\$7,000
<b>Construction Cost Subtotal</b>				<b>\$522,500</b>
<b>Contingencies</b>			<b>15%</b>	<b>\$78,375</b>
<b>Construction Cost Total</b>				<b>\$601,000</b>
<b>Right-of-Way Costs</b>				
Permanent Easement	116,400	SF	\$0.75	\$87,000
Temporary Construction Easement	271,600	SF	\$0.10	\$27,000
<b>CONSTRUCTION AND RIGHT-OF-WAY COSTS-SEGMENT 2</b>				<b>\$715,000</b>

**SEGMENT 3-EAST SUBBASIN SEWER TO NORTH OF "O" STREET**

<b>DESCRIPTION</b>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Cost</u>	<u>Total Cost</u>
General Requirements (10%)				\$24,300
15" Sewer Pipe	2,400	LF	\$68	\$162,000
33 Inch Tunnel West "O" Street near NW 44th Street	120	LF	\$495	\$59,000
Standard Manhole 4' Dia., 8' Deep or Less	5	EA	\$2,000	\$10,000
Standard and Drop Manhole Additional Depth	29	LF	\$250	\$7,000
Seeding	13,000	SY	\$0.40	\$5,000
<b>Construction Cost Subtotal</b>				<b>\$267,300</b>
<b>Contingencies</b>			<b>15%</b>	<b>\$40,095</b>
<b>Construction Cost Total</b>				<b>\$307,000</b>
<b>Right-of-Way Costs</b>				
Permanent Easement	68,400	SF	\$0.75	\$51,000
Temporary Construction Easement	159,600	SF	\$0.10	\$16,000
<b>CONSTRUCTION AND RIGHT-OF-WAY COSTS-SEGMENT 3</b>				<b>\$374,000</b>

**West "O" Street Trunk Sewer Extension  
 Alignment No. 2**

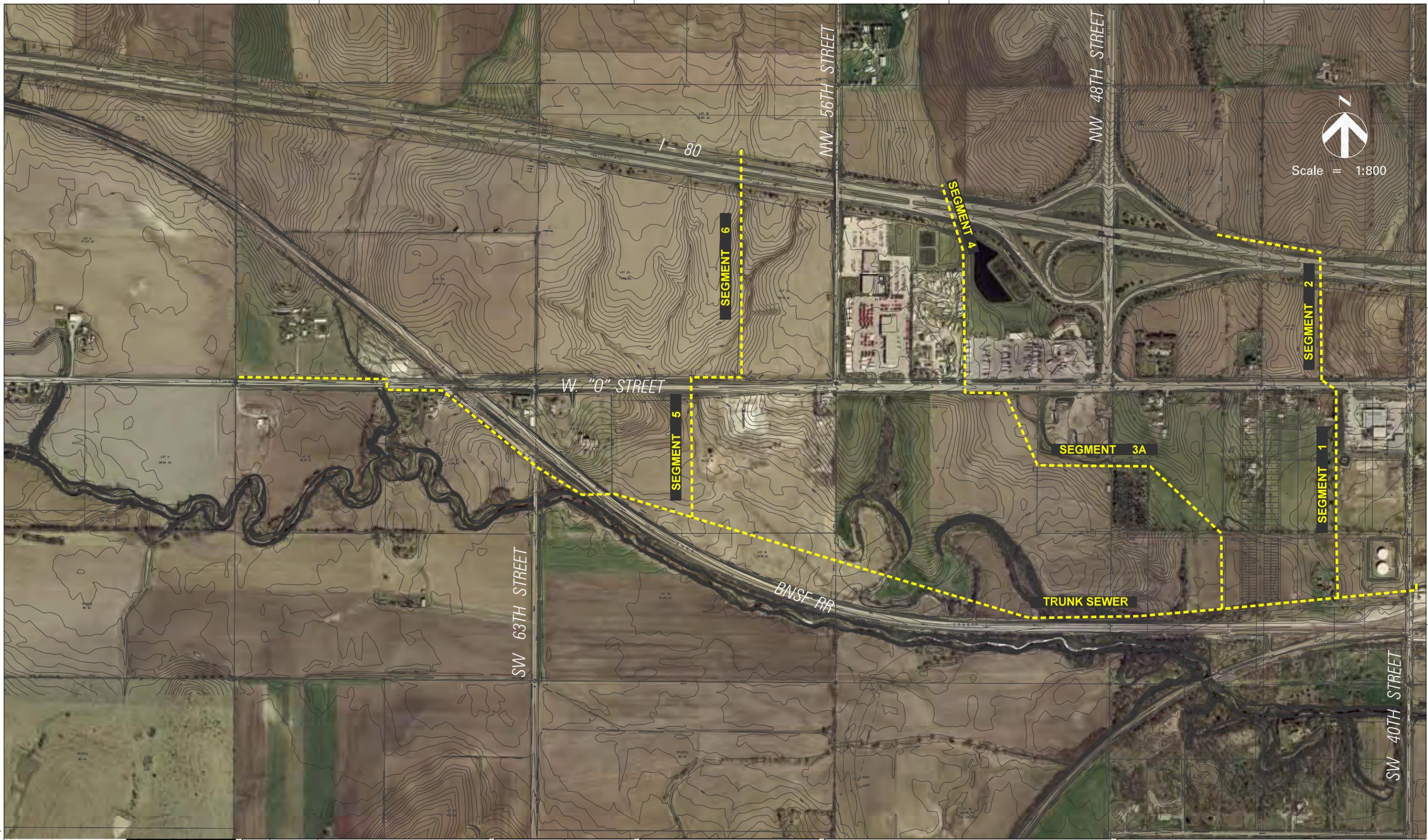
**SEGMENT 4-WEST SUBBASIN SEWER FROM "O" STREET TO NORTH OF I-80**

<b>DESCRIPTION</b>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Cost</u>	<u>Total Cost</u>
General Requirements (10%)				\$26,720
15" Sewer Pipe	900	LF	\$68	\$61,000
33 Inch Tunnel Interstate 80 near NW 52nd Street	400	LF	\$495	\$198,000
Standard Manhole 4' Dia., 8' Deep or Less	2	EA	\$2,000	\$4,000
Standard and Drop Manhole Additional Depth	11	LF	\$250	\$3,000
Seeding	3,000	SY	\$0.40	\$1,200
<b>Construction Cost Subtotal</b>				<b>\$293,920</b>
<b>Contingencies</b>			<b>15%</b>	<b>\$44,088</b>
<b>Construction Cost Total</b>				<b>\$338,000</b>
<b>Right-of-Way Costs</b>				
Permanent Easement	15,000	SF	\$0.75	\$11,000
Temporary Construction Easement	35,000	SF	\$0.10	\$4,000
<b>CONSTRUCTION AND RIGHT-OF-WAY COSTS-SEGMENT 4</b>				<b>\$353,000</b>

**SEGMENT 5-EAST SUBBASIN SEWER FROM "O" STREET TO NORTH OF I-80**

<b>DESCRIPTION</b>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Cost</u>	<u>Total Cost</u>
General Requirements (10%)				\$32,500
15" Sewer Pipe	1,000	LF	\$68	\$68,000
12" Sewer Pipe	900	LF	\$54	\$49,000
33 Inch Tunnel Interstate 80 near NW 44th Street	400	LF	\$495	\$198,000
Standard Manhole 4' Dia., 8' Deep or Less	2	EA	\$2,000	\$4,000
Standard and Drop Manhole Additional Depth	11	LF	\$250	\$3,000
Seeding	8,000	SY	\$0.40	\$3,000
<b>Construction Cost Subtotal</b>				<b>\$357,500</b>
<b>Contingencies</b>			<b>15%</b>	<b>\$53,625</b>
<b>Construction Cost Total</b>				<b>\$411,000</b>
<b>Right-of-Way Costs</b>				
Permanent Easement	45,000	SF	\$0.75	\$34,000
Temporary Construction Easement	105,000	SF	\$0.10	\$11,000
<b>CONSTRUCTION AND RIGHT-OF-WAY COSTS-SEGMENT 5</b>				<b>\$456,000</b>

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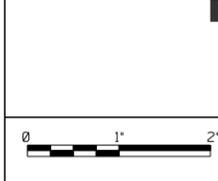


ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	
CIVIL	
STRUCTURAL	
ARCHITECTURAL	
PROCESS	
MECHANICAL	
ELECTRICAL	
INSTRUMENTATION	
PROJECT NUMBER	



**West "O" Street  
Trunk Sewer  
Extension Project  
Lincoln Wastewater System**



<b>ALIGNMENT A</b>		FILENAME	SHEET
		SCALE	

**West "O" Street Trunk Sewer Extension  
 Alignment No. 3**

**SUMMARY OF PROJECT COSTS FOR ALIGNMENT NO 3**

<b>SEGMENT 1</b>		
Construction Cost Total		\$199,000
Right-of-Way Costs		\$21,000
<b>SEGMENT 2</b>		
Construction Cost Total		\$816,000
Right-of-Way Costs		\$123,000
<b>SEGMENT 3</b>		
Construction Cost Total		\$277,000
Right-of-Way Costs		\$59,000
<b>SEGMENT 4</b>		
Construction Cost Total		\$338,000
Right-of-Way Costs		\$15,000
<b>SEGMENT 5</b>		
Construction Cost Total		\$411,000
Right-of-Way Costs		\$45,000
 Engineering, Legal, and Administrative Costs (Excludes ROW Costs)	 20%	 \$408,200
<b>TOTAL PROJECT COST - ALIGNMENT 3</b>		<b>\$2,712,200</b>

**SEGMENT 1-TRUNK SEWER AND CONNECTION TO SUBBASIN SEWERS**

<b>DESCRIPTION</b>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Cost</u>	<u>Total Cost</u>
General Requirements (10%)				\$15,700
36" Sewer Pipe	800	LF	\$162	\$130,000
Standard Manhole 4' Dia., 8' Deep or Less	2	EA	\$2,000	\$3,000
Standard and Drop Manhole Additional Depth	10	LF	\$250	\$2,000
6 Foot Average Dewatering Depth for Trunk Sewer	800	LF	\$25	\$20,000
Seeding	4,000	SY	\$0.40	\$2,000
<b>Construction Cost Subtotal</b>				<b>\$172,700</b>
 <b>Contingencies</b>			 15%	 <b>\$25,905</b>
 <b>Construction Cost Total</b>				 <b>\$199,000</b>
 <b>Right-of-Way Costs</b>				
Permanent Easement	32,000	SF	\$0.50	\$16,000
Temporary Construction Easement	48,000	SF	\$0.10	\$5,000
 <b>CONSTRUCTION AND RIGHT-OF-WAY COSTS-SEGMENT 1</b>				 <b>\$220,000</b>

**West "O" Street Trunk Sewer Extension  
 Alignment No. 3**

**SEGMENT 2-WEST SUBBASIN SEWER TO NORTH OF "O" STREET**

<b>DESCRIPTION</b>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Cost</u>	<u>Total Cost</u>
General Requirements (10%)				\$49,800
36" Sewer Pipe	1,000	LF	\$162	\$162,000
15" Sewer Pipe	4,300	LF	\$68	\$290,000
33 Inch Tunnel West "O" Street near NW 52nd Street	120	LF	\$495	\$59,000
Standard Manhole 4' Dia., 8' Deep or Less	10	EA	\$2,000	\$20,000
Standard and Drop Manhole Additional Depth	60	LF	\$250	\$15,000
Replace Asphalt Pavement	2,300	SY	\$45	\$104,000
Seeding	24,000	SY	\$0.40	\$10,000
<b>Construction Cost Subtotal</b>				<b>\$709,800</b>
<b>Contingencies</b>			<b>15%</b>	<b>\$106,470</b>
<b>Construction Cost Total</b>				<b>\$816,000</b>
<b>Right-of-Way Costs</b>				
Permanent Easement	125,400	SF	\$0.75	\$94,000
Temporary Construction Easement	292,600	SF	\$0.10	\$29,000
<b>CONSTRUCTION AND RIGHT-OF-WAY COSTS-SEGMENT 2</b>				<b>\$939,000</b>

**SEGMENT 3-EAST SUBBASIN SEWER TO NORTH OF "O" STREET**

<b>DESCRIPTION</b>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Cost</u>	<u>Total Cost</u>
General Requirements (10%)				\$21,900
15" Sewer Pipe	2,100	LF	\$68	\$142,000
33 Inch Tunnel West "O" Street near NW 44th Street	120	LF	\$495	\$59,000
Standard Manhole 4' Dia., 8' Deep or Less	4	EA	\$2,000	\$8,000
Standard and Drop Manhole Additional Depth	25	LF	\$250	\$6,000
Seeding	11,000	SY	\$0.40	\$4,000
<b>Construction Cost Subtotal</b>				<b>\$240,900</b>
<b>Contingencies</b>			<b>15%</b>	<b>\$36,135</b>
<b>Construction Cost Total</b>				<b>\$277,000</b>
<b>Right-of-Way Costs</b>				
Permanent Easement	59,400	SF	\$0.75	\$45,000
Temporary Construction Easement	138,600	SF	\$0.10	\$14,000
<b>CONSTRUCTION AND RIGHT-OF-WAY COSTS-SEGMENT 3</b>				<b>\$336,000</b>

**West "O" Street Trunk Sewer Extension  
 Alignment No. 3**

**SEGMENT 4-WEST SUBBASIN SEWER FROM "O" STREET TO NORTH OF I-80**

DESCRIPTION	<u>Quantity</u>	<u>Unit</u>	<u>Unit Cost</u>	<u>Total Cost</u>
General Requirements (10%)				\$26,720
15" Sewer Pipe	900	LF	\$68	\$61,000
33 Inch Tunnel Interstate 80 near NW 52nd Street	400	LF	\$495	\$198,000
Standard Manhole 4' Dia., 8' Deep or Less	2	EA	\$2,000	\$4,000
Standard and Drop Manhole Additional Depth	11	LF	\$250	\$3,000
Seeding	3,000	SY	\$0.40	\$1,200
<b>Construction Cost Subtotal</b>				<b>\$293,920</b>
<b>Contingencies</b>			<b>15%</b>	<b>\$44,088</b>
<b>Construction Cost Total</b>				<b>\$338,000</b>
<b>Right-of-Way Costs</b>				
Permanent Easement	15,000	SF	\$0.75	\$11,000
Temporary Construction Easement	35,000	SF	\$0.10	\$4,000
<b>CONSTRUCTION AND RIGHT-OF-WAY COSTS-SEGMENT 4</b>				<b>\$353,000</b>

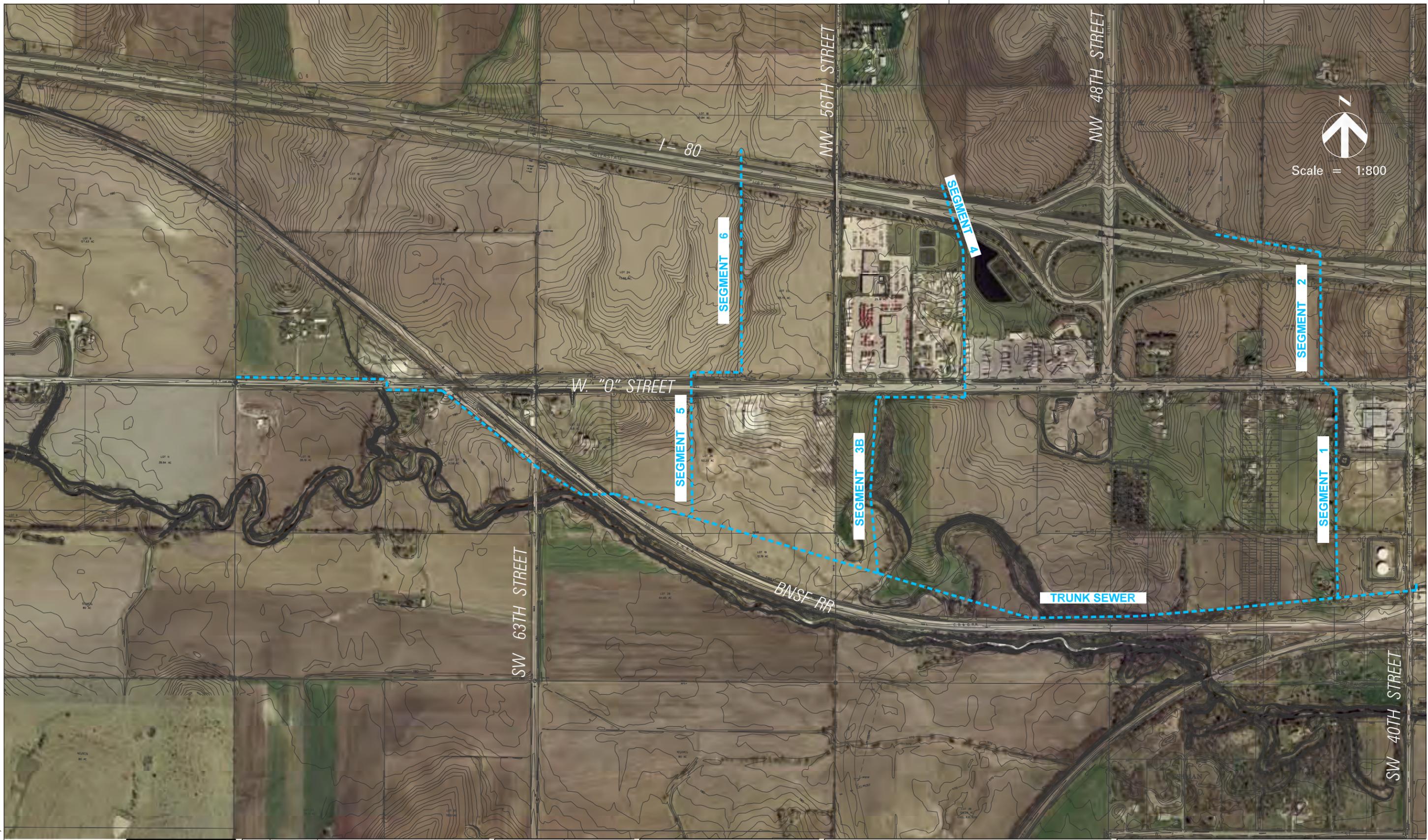
**SEGMENT 5-EAST SUBBASIN SEWER FROM "O" STREET TO NORTH OF I-80**

DESCRIPTION	<u>Quantity</u>	<u>Unit</u>	<u>Unit Cost</u>	<u>Total Cost</u>
General Requirements (10%)				\$32,500
15" Sewer Pipe	1,000	LF	\$68	\$68,000
12" Sewer Pipe	900	LF	\$54	\$49,000
33 Inch Tunnel Interstate 80 near NW 44th Street	400	LF	\$495	\$198,000
Standard Manhole 4' Dia., 8' Deep or Less	2	EA	\$2,000	\$4,000
Standard and Drop Manhole Additional Depth	11	LF	\$250	\$3,000
Seeding	8,000	SY	\$0.40	\$3,000
<b>Construction Cost Subtotal</b>				<b>\$357,500</b>
<b>Contingencies</b>			<b>15%</b>	<b>\$53,625</b>
<b>Construction Cost Total</b>				<b>\$411,000</b>
<b>Right-of-Way Costs</b>				
Permanent Easement	45,000	SF	\$0.75	\$34,000
Temporary Construction Easement	105,000	SF	\$0.10	\$11,000
<b>CONSTRUCTION AND RIGHT-OF-WAY COSTS-SEGMENT 5</b>				<b>\$456,000</b>

**SEGMENT 3A - SUBBASIN SEWER TO NORTH OF "O" STREET**

<b>DESCRIPTION</b>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Cost</u>	<u>Total Cost</u>
General Requirements (10%)				\$31,800
15" Sewer Pipe	3,110	LF	\$60	\$187,000
18" Sewer Pipe	1,620	LF	\$72	\$117,000
33 Inch Tunnel West "O" Street near NW 52nd Street	120	LF	\$495	\$59,000
Standard Manhole 4' Dia., 8' Deep or Less	9	EA	\$2,000	\$19,000
Standard and Drop Manhole Additional Depth	38	LF	\$250	\$9,000
Replace Asphalt Pavement	2,300	SY	\$45	\$104,000
Seeding	26,000	SY	\$0.40	\$10,000
<b>Construction Cost Subtotal</b>				<b>\$536,800</b>
<b>Contingencies</b>			<b>10%</b>	<b>\$53,680</b>
<b>Construction Cost Total</b>				<b>\$590,000</b>
<b>Right-of-Way Costs</b>				
Permanent Easement	141,900	SF	\$0.50	\$71,000
Temporary Construction Easement	331,100	SF	\$0.10	\$33,000
<b>CONSTRUCTION AND RIGHT-OF-WAY COSTS-SEGMENT 3A</b>				<b>\$694,000</b>
<b>Developer Charge for Collection Sewer</b>				
8" Sewer	2,500	LF	\$32	\$80,000
<b>REVISED CONST AND RIGHT-OF-WAY COSTS-SEGMENT 3A</b>				<b>\$614,000</b>

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ISSUE	DATE	DESCRIPTION

PROJECT MANAGER	
CIVIL	
STRUCTURAL	
ARCHITECTURAL	
PROCESS	
MECHANICAL	
ELECTRICAL	
INSTRUMENTATION	
PROJECT NUMBER	



**West "O" Street  
Trunk Sewer  
Extension Project  
Lincoln Wastewater System**

**ALIGNMENT B**

FILENAME		SHEET	
SCALE			

**SEGMENT 3B - SUBBASIN SEWER TO NORTH OF "O" STREET**

<b>DESCRIPTION</b>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Cost</u>	<u>Total Cost</u>
General Requirements (10%)				\$45,300
18" Sewer Pipe	3,540	LF	\$72	\$255,000
36 Inch Tunnel West "O" Street near NW 52nd Street	120	LF	\$540	\$65,000
Standard Manhole 4' Dia., 8' Deep or Less	7	EA	\$2,000	\$14,000
Standard and Drop Manhole Additional Depth	28	LF	\$250	\$7,000
Replace Asphalt Pavement	2,300	SY	\$45	\$104,000
Seeding	20,000	SY	\$0.40	\$8,000
<b>Construction Cost Subtotal</b>				<b>\$498,300</b>
<b>Contingencies</b>			<b>10%</b>	<b>\$49,830</b>
<b>Construction Cost Total</b>				<b>\$548,000</b>
<b>Right-of-Way Costs</b>				
Permanent Easement	106,200	SF	\$0.50	\$53,000
Temporary Construction Easement	247,800	SF	\$0.10	\$25,000
<b>CONSTRUCTION AND RIGHT-OF-WAY COSTS-SEGMENT 3B</b>				<b>\$626,000</b>
<b>Increase Trunk Sewer from 30 to 36 inches</b>				
Additional 6" Sewer Pipe	3,200	LF	\$24	\$77,000
<b>REVISED CONST AND RIGHT-OF-WAY COSTS-SEGMENT 3B</b>				<b>\$703,000</b>



**APPENDIX “E”**  
**Wastewater Availability Figure**