MESHEK & ASSOCIATES, PLC

Drainage Study
Vineyard Subdivision

January 29, 2016

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Section 1 - Background

In July of 2015, Meshek & Associates, PLC (Meshek) performed a preliminary analysis of the flooding problems in the Vineyard subdivision in Norman, OK. This included a review of the previous drainage reports and studies that were available. In addition to the July 5, 2015 letter, we attended a neighborhood meeting to discuss our preliminary results and discuss the history of flooding with the citizens living in the neighborhood.

During our meeting with the citizens, it became clear that the primary flooding concern was storm water flowing between the houses at 3012 and 3016 Harwich Court and others. This combines with other flow moving east towards the end of the cul-de-sac which results in flooding for multiple houses. There is also risk of flooding from the tributary of Woodcrest Creek immediately east of the subdivision. However, this is not the highest risk at this time.

After that meeting, the City requested additional detailed modeling be developed to determine if there were structural changes that would reduce the risk of flooding. The City collected survey data on the detention ponds in Highland Village and the Vineyard subdivisions as well as the storm sewer systems in the area. This report documents the methods, results and recommendations based on our detailed analysis.

Section 2 – Analysis & Results

The analysis for the hydrology and hydraulics consisted of performing the hydrology and hydraulic analysis using PC-SWMM v6.1.2025 and HEC-HMS v4.1. Four basins were delineated and elevation-storage-outflow data was prepared for three ponds as shown in **Figure 1**. PC-SWMM allows for a fully hydrodynamic model of a design storm hydrograph and includes the option for using a two dimensional analysis for the portion of the flow that flows overland. We built a DTM using the 2015 LiDAR data provided by the City of Norman.

Based on our analysis, the pond in the Vineyard has a capacity to drain a 2-year to 5-year storm event without overtopping due to the limited capacity of the 18-inch storm sewer pipe draining east along the south boundary of the subdivision. This results in a maximum of 15-20 cfs flowing through the 18-inch pipe in any storm event. During a 10-year event, approximately 120 cfs overtop the pond and flow through the neighborhood and approximately 310 cfs overflow.

Using a 2-dimensionsal PC-SWMM model and Mesonet rainfall data, we analyzed the May 2015 storm event. The results of this analysis were consistent with the firsthand accounts of flooding. The flow patterns for the overflow appear to be consistent with the 100-year flow patterns shown in **Figure 2**.

Residents also reported storm water flowing like a fountain out of an inlet on North Porter Ave. Based on the analysis, the storm sewer draining from Weymouth Court goes from a steeper section to a much flatter section. The flatter section has a much lower capacity and would cause a fountain to occur from any additional flow. Our initial concern was that the upstream pond could not build up enough head pressure to cause this problem. The detailed survey data revealed that these two systems are not connected and the system from Weymouth Court did cause a fountain in our model as shown on the profile of the pipe and water elevations in **Figure 3**.

To reduce the risk of flooding in this area, several alternatives were modeled. Our first approach included increasing the volume of the detention pond at the entrance to Highland Village as well as the detention pond in the southwest corner of the Vineyard. Unfortunately, we were not able to create enough additional storage volume to prevent overflow through the Vineyard with the 18-inch pipe as an outlet.

Two possible scenarios were identified that would reduce flooding due to overflow from the Vineyard pond. **Alternative 1** would provide capacity for a 10-year system by re-grading the Vineyard pond to the maximum potential extents within the existing easement. This would provide just over 5 acre-feet of storage volume compared to 1.2 acre-feet in existing conditions. Though the grading would reduce the flow rates considerably for a 10-year storm event, the 18-inch pipe would need to be replaced with a double 30-inch pipe or an open channel approximately 6 foot by 2 ft concrete lined

Vineyard Addition Drainage Review

0 350 700
Feet

Drainage Basins

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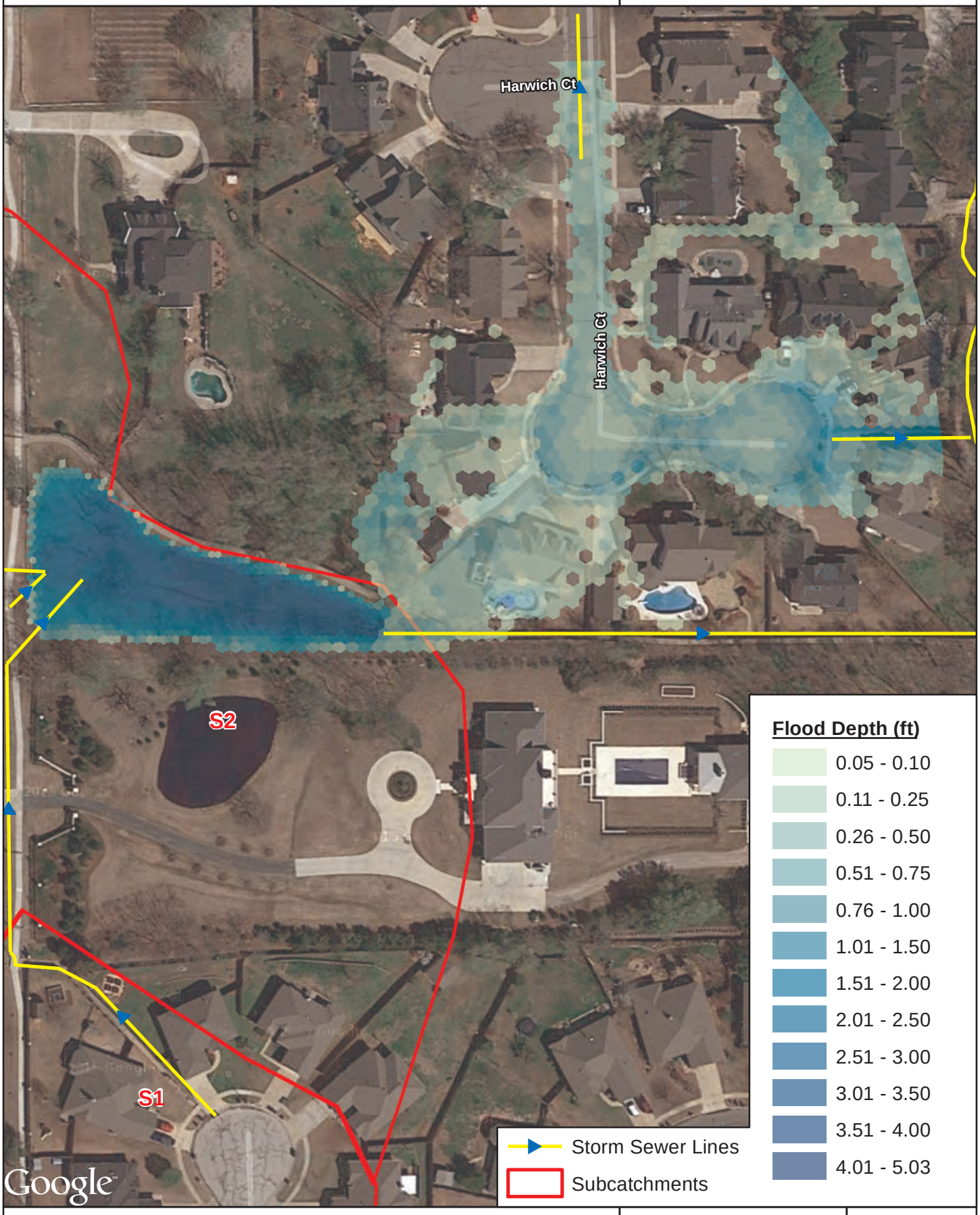
Figure 1

Vineyard Addition Drainage Review



100 year Existing Conditions

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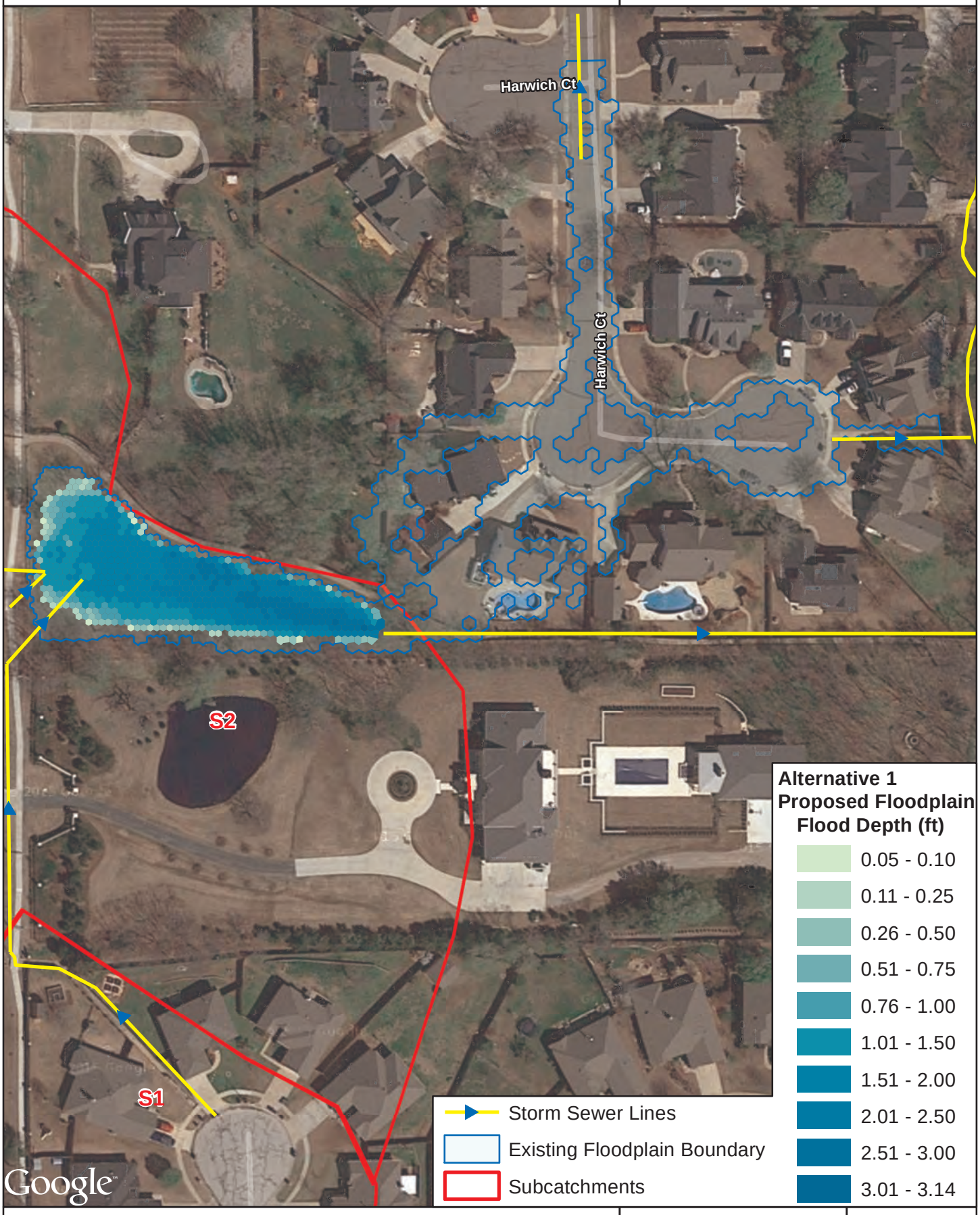
Figure 2

Vineyard Addition Drainage Review



Alternative 1

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Figure 3

channel. This may be difficult due to the sanitary sewer and other utilities in the existing easement. The cost of the excavation and the double 30-inch pipes is estimated at $246,500 as shown in Appendix A. The outflow from the Highland Village pond and the Vineyard pond are shown in the table below. There is not a significant benefit during a 100-year storm event. This would require considerable more volume for detention storage.

Table 2-1 Alternative 1 Pond Outflow Rates (cfs)

	10YR EX	10YR PR	25YR EX	25YR PR	100YR EX	100YR PR
Highland Village Pond	139.2	139.2	217.3	217.3	329.4	329.4
Vineyard Pond	157.3	64.5	226.6	75.4	344.1	324.3

The Highland Village pond has approximately 4.5 acre-feet of storage at an elevation of 1153. By excavating the pond and raising the embankment overflow elevation to 1154 for **Alternative 2**, we can get 11 acre-feet of storage. When combined with the improvements identified in Alternative 1, there are additional benefits downstream as shown in the table below.

Table 2-2 Alternative 2 Pond Outflow Rates (cfs)

	10YR EX	10YR PR	25YR EX	25YR PR	100YR EX	100YR PR
Highland Village Pond	139.2	30	217.3	113.7	329.4	286
Vineyard Pond	157.3	35.8	226.6	61.3	344.1	215

The reduction in flow rates would allow for the double 30-inch outlet to be replaced with a single 36-inch pipe or a 4 foot by 2 foot concrete channel for the 25-year storm event. The estimated costs for this alternative assuming a pipe would be installed is $510,000 as shown in Appendix A. As with Alternative 1, existing utilities are a concern and could jeopardize the feasibility of the project.

Section 3 – Recommendation

Based on the results of our analysis, either option would provide a reduction in the flooding risk for the neighborhood at similar costs. However, neither option would completely reduce the risk of flooding during an extreme flooding event. It could be difficult to replace the existing 18-inch pipe in this area due to the development on both sides of the alignment and the existing utilities in the easement. The existing walking trail in close proximity to the existing storm sewer is assumed to be replaced in both alternatives.

Appendix A

Cost Estimates

Appendix A- Cost Estimate

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Phone 392-5620, Fax 392-5621	**Checked by**		

City of Norman

Vineyard Addition Drainage Improvement Alternative #1

ITEM	DESCRIPTION	UNIT	TOTAL	UNIT PRICE	TOTAL COST
1	CLEARING AND GRUBBING	LS	1	$ 5,000.00	$ 5,000.00
2	RAISE EARTH EMBANKMENT	CY	2175	$ 12.00	$ 26,100.00
3	SOLID SLAB BERMUDA SODDING	SY	802	$ 5.00	$ 4,008.33
4	2-30" RCP	LF	481	$ 228.00	$ 109,668.00
5	JUNCTION BOX	EA	1	$ 4,000.00	$ 4,000.00
6	HEADWALL INLET	EA	1	$ 3,000.00	$ 3,000.00
7	HEADWALL OUTLET	EA	1	$ 3,000.00	$ 3,000.00
8	TRENCH EXCAVATION	CY	882	$ 8.00	$ 7,054.67
9	STANDARD BEDDING MATERIAL	CY	232	$ 20.00	$ 4,631.85
10	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	1	$ 5,000.00	$ 5,000.00

Subtotal	**$ 171,462.85**
15% Contingency	**$ 25,719.43**
Subtotal	**$ 197,182.28**
25% Utility Relocation Contingency	**$ 49,295.57**
Total	***$ 246,477.85***

Vineyard Addition Drainage Improvement Alternative #2

ITEM	DESCRIPTION	UNIT	TOTAL	UNIT PRICE	TOTAL COST
1	CLEARING AND GRUBBING	LS	1	$ 5,000.00	$ 5,000.00
2	RAISE EARTH EMBANKMENT	CY	20590	$ 12.00	$ 247,080.00
3	SOLID SLAB BERMUDA SODDING	SY	802	$ 5.00	$ 4,008.33
4	1-36" RCP	LF	481	$ 150.00	$ 72,150.00
5	JUNCTION BOX	EA	1	$ 4,000.00	$ 4,000.00
6	HEADWALL INLET	EA	1	$ 3,000.00	$ 3,000.00
7	HEADWALL OUTLET	EA	1	$ 3,000.00	$ 3,000.00
8	TRENCH EXCAVATION	CY	882	$ 8.00	$ 7,054.67
9	STANDARD BEDDING MATERIAL	CY	232	$ 20.00	$ 4,631.85
10	REMOVAL OF STRUCTURES AND OBSTRUCTIONS	LS	1	$ 5,000.00	$ 5,000.00

Subtotal	**$ 354,924.85**
15% Contingency	**$ 53,238.73**
Subtotal	**$ 408,163.58**
25% Utility Relocation Contingency	**$ 102,040.89**
Total	***$ 510,204.47***