

- **TO:** Montrose Tax Increment Reinvestment Zone No. 27
- FROM: Derek St. John, P.E., CFM, Gauge Engineering
- **DATE:** 2/17/2022

RE: Montrose Blvd Stormwater Trunkline Size Optimization

WBS: N-T27000-0005-7

Background and Purpose

The Montrose Drainage Study (February 2021) recommended the construction of 2-10'x10' RCBs along Montrose for the extent of the project area from Buffalo Bayou to W Alabama Street and a single 10'x10' RCB to the end of the project near I-69. Construction of the dual boxes will serve as a backbone drainage improvement for the region that will help reduce both frequent and extreme event ponding and allow the entire project area to meet City of Houston drainage criteria.

Between the time of the study and present day, inflation has caused the prices of concrete boxes to double, and the previous estimated project budget to construct the recommended dual box culverts is no longer valid. This Technical Memorandum summarizes a sensitivity analysis to determine the cost-benefit relationship between the box size and the benefit along Montrose Blvd. from Buffalo Bayou to I-69. The objective is to right size the boxes accounting for both cost and benefit. Due to the increase in construction costs that is being experienced, it is important to understand the incremental cost and flood reduction benefit of these two scenarios.

Additionally, utility conflict information and general constructability of the proposed large boxes was incorporated into the box sizing recommendation. Tradeoffs between box sizes and characteristics such as traffic/construction phasing limitations, loss of trees, available ROW or need for additional ROW, are summarized below.

Modeling Methodology and Approach

The modeling platform used for this analysis builds on the platform that was developed for the comprehensive Montrose Drainage Study (February 2021). Gauge performed the hydrologic and hydraulic analysis utilizing the Infoworks ICM 2D modeling platform to evaluate the performance of the different box sizes. The evaluation considered ultimate conditions with assumed potential future storm water improvements on W Alabama Street, Richmond Avenue, Westheimer, and Fairview. Pre-project and post-project inundation limits were overlaid on top of each other to assist in visually assessing project benefits. Additionally, pre-project and post-project inundation raster deltas were developed to evaluate the reduction in inundation as a result of the proposed improvement.

Utility Conflict Evaluation

The Montrose Blvd Improvement Design Concept Report (DCR) advanced the planning that was performed in the Montrose Drainage Study and included a more thorough evaluation of utilities within the Montrose corridor. This information was utilized to evaluate and understand the cost implications of resolving conflicts with utilities. Conflict resolution can come in the form of utility adjustments for pressurized lines such as water lines or sanitary force mains, conflict resolution boxes for gravity sanitary sewer lines that cannot be avoided, and adjustments to the proposed box profile for Montrose Blvd. Significant utility conflicts were identified at Fairview Street, Hawthorne Street, Kipling Street, and Richmond Avenue that forced a reduction in box depth and size from Fairview Street upstream (south) to Woodrow Street. It was determined that the cost to avoid the conflict did not justify the incremental benefit in flood mitigation. This is a logical conclusion as storm sewer trunk line sizes generally reduce in size as you move upstream, or away, from the outfall and the contributing

drainage area is reduced. Table 1 identifies the key utility conflicts that are avoided with the proposed box depth adjustment. The sanitary sewers, if impacted, would require a significant length of improvements down the Fairview Street and Hawthorne Street. The waterlines, if impacted, would require much undesirable design and coordination with large diameter waterlines, but regardless of this, the sanitary sewers were more constraining than these.

Table 1 – Utility Conflicts Avoided

Street	Utility Conflict Avoided
Fairview Street	18-inch sanitary sewer
Hawthorne Street	36-inch sanitary sewer
Kipling Street	72-inch waterline
Richmond Avenue	66-inch waterline

Improvement Options Evaluated

Multiple alternatives were considered and evaluated to narrow the improvement options down to two for detailed hydraulic modeling purposes. Consideration was given to utility conflicts as described above, corridor congestion with other parallel utility such as gas and communications sharing the Montrose ROW, trees, and the existing ROW. The following options were evaluated in detail.

Option 1 – Dual 10'x10's: Dual 10'x10' RCBs from Buffalo Bayou to Fairview Street transitioning to dual 10'x6' RCB from Fairview Street to Kipling Street, transitioning to dual 10'x4' RCB from Kipling Street to Richmond Avenue, and transitioning to 2-6'x2' RCB from Richmond Avenue to Woodrow Street.



Option 2 – Single 10'x10': This is the same as Option 1, except from Buffalo Bayou to Fairview there is a single 10'x10' RCB.



The primary difference between Options 1 and 2 is the addition of a second 10'x10' RCB downstream of Fairview Street. See **Exhibit A – Option 1 Layout and Exhibit B – Option 2 Layout**. Option 1 represents the maximum practical box sizes within the project corridor. The potential of future contributing lateral storm sewers at Richmond, W. Alabama, Westheimer, and Fairview warrant evaluating the additional second box. Option 1 evaluates the benefits of a second 10'x10' RCB downstream of Fairview, relative to Option 2.

Cost Estimate

Planning level cost estimates were prepared for each of the options evaluated. Utility relocation costs and utility adjustment costs were incorporated into the cost estimate. The addition of a second 10'x10' RCB downstream (north) of Fairview Street increases the total construction cost \$13 MM from \$55 MM to \$68 MM. This increase is primarily in accounted for in the storm sewer cost, which includes the additional 10'x10' RCBs and additional custom junction boxes necessary to tie in lateral systems. The total project cost for the two options, using current bid tabulation pricing and with a 25% contingency is as follows:

- Option 1 Dual 10'x10's: \$68 MM
- Option 2 Single 10'x10': \$55 MM

Benefit Assessment

Improvement Options 1 and 2 were analyzed for the 100-yrear event. Pre- and post-project inundation rasters were overlaid to evaluate the benefits of the proposed improvements. **Exhibits C and D** illustrate the 100-year depth benefits for Option 1 and Option 2, and **Exhibits E and F** illustrate the 100-year inundation benefits for Option 1 and Option 2. In the 100-year storm event, Option 1 shows a maximum depth reduction of 11-inches near the intersection of Westheimer and Montrose when compared to existing conditions. Option 2 shows a maximum depth reduction of 7-inches.

Conclusion

Of the two options evaluated, Option 1 represents the maximum box size that can be practically constructed within the ROW corridor. Option 2 represents a reduction in box size relative to Option 1 that is accompanied by a reduction in construction cost of \$13 Million dollars. Both options performed well hydraulically and demonstrated a significant

reduction in flood inundation and flood risk for the region. However, the additional flood reduction benefits achieved for Option 1 do not justify the \$13 million dollar increase in construction cost. Therefore, Option 2 is presented as the recommended option to advance to design.











